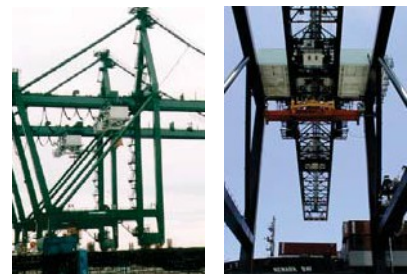


**PROJECT SPECIFICATIONS  
TASK 3 - LANDSIDE INFRASTRUCTURE UPGRADE  
BROWARD COUNTY FLORIDA  
PUBLIC WORKS DEPARTMENT  
SEAPORT ENGINEERING AND CONSTRUCTION DIVISION  
RLI# N1038712R1  
100% SUBMITTAL**

**PREPARED BY LIFTECH CONSULTANTS INC.**

**PROJECT NO. 2033  
FEBRUARY 16, 2015**



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**SCHEDULE OF BID PRICES**

Bidder has examined all of the Contract Documents and the following addenda:

Date	Number
_____	_____

Bidder has visited the project site and performed all tasks, research, investigation, reviews, examinations, analysis, and notices regarding the Project and the Site.

Bidder agrees to fully perform the work within the time stated and in strict accordance with the Contract Documents.

All bid items listed below, including lump sums, unit prices, must be filled in completely.

Item	Item Description	Estimate Quantity	Unit	Unit Price	Total
Phase 1 – Berths 31-33					
1	Permit allowance for agencies other than Broward County commissioners	Allowance			\$
2	Handling and/or isolation of unforeseen conditions allowance	Allowance			\$
3	Port security – background checks, identification badges, dockside permits, and security details	Allowance			\$
4	FPL connection to new Switchgear Building	Allowance			\$
5	Mobilization and demobilization	Lump Sum			\$
6	Standby rate for work stoppage requested by Owner to maintain terminal operations	240	Hour	\$	\$
		30	Day	\$	\$
7	Furnish and install Auger Cast Grout Test Piles	241	LF	\$	\$
8	Furnish and install 16” diameter Auger Cast Grout Piles (ACGPs) for Switchgear building foundation	1820	LF	\$	\$

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9	Furnish and install 18" diameter ACGPs	46,700	LF	\$	\$
10	Furnish and install 24" diameter ACGPs	13,100	LF	\$	\$
11	Demolition of existing concrete rail girders as required	Lump Sum			\$
12	Furnish and install waterside crane girder	1,937	LF	\$	\$
13	Furnish and install landside crane girder	1,937	LF	\$	\$
14	Furnish and install slotted drain pipe	1644	LF	\$	\$
15	Furnish and install Panzerbelt system	1,858	LF	\$	\$
16	Furnish and install electrical concrete vaults at Sta 54+68	1	EA	\$	\$
17	Furnish and install electrical concrete vaults at Sta 51+83	1	EA	\$	\$
17	Furnish and install crane stowage sockets	15	EA	\$	\$
18	Furnish and install crane tie-downs	16	EA	\$	\$
19	Furnish and install crane stops	4	EA	\$	\$
20	Furnish and install crane rails including rail, clips, sole plates, pads, and epoxy grout	3,835	LF	\$	\$
21	Removal and disposal of existing drainage pipes and structures	Lump Sum			\$
22	Abandon, grout, and cap existing sanitary and oily waste lateral pipe in bulkhead	Lump Sum			\$
23	Furnish and install drainage pipe-15" RCP	1005	LF	\$	\$
24	Furnish and install drainage pipe-18" RCP	410	LF	\$	\$
25	Furnish and install drainage pipe-24" RCP	26	LF	\$	\$
26	Furnish and install drainage pipe-12" PVC	1364	LF	\$	\$
27	Furnish and install drainage pipe-4" PVC	610	LF	\$	\$
28	Furnish and install Type M-4 drainage manhole structure	7	EA	\$	\$

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29	Furnish and install Type C-4 catch basin	19	EA	\$	\$
30	Furnish and install Type C-5 catch basin	1	EA	\$	\$
31	Adjust / Reset Existing Storm Drain Structure Frame & Grate / Ring & Cover	1	EA	\$	\$
32	Connect to existing storm drain structure	Lump Sum			\$
33	Restoration of asphalt following construction of crane rail girder and storm drain pipe, and structures	7028	SY	\$	\$
34	Removal and disposal of existing 4" -12" water main crossing landside and waterside rails	13	EA	\$	\$
35	Furnish and install 4"-12" PVC water main crossing landside and waterside rails	13	EA	\$	\$
36	Furnish and install 8" PVC (SDR 26) gravity sewer pipe	35	LF	\$	\$
37	Furnish and install sanitary sewer structure (6'-8' Depth)	2	EA	\$	\$
38	Removal and disposal of existing sanitary sewer and oil waste pipes, cap exiting pipes to remain	Lump Sum			\$
39	Furnish and install 1.5" asphalt Type SP-9.5 asphalt overlay	54,844	SY		\$
40	Furnish and install wharf pavement marking and signing	Lump Sum			\$
41	Furnish, install, and commission 13.2 kV switchgear in Switchgear building	Lump Sum			\$
42	Furnish and install 13.2 kV duct bank	769	LF	\$	\$
43	Furnish and install 13.2 kV cable, feeder tag #504	1,070	LF	\$	\$
44	Furnish and install 13.2 kV cable, feeder tag #505	1,080	LF	\$	\$



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45	Furnish and install 13.2 kV cable, feeder tag #506	1,417	LF	\$	\$
46	Furnish and install new 13.2 kV duct bank for FPL cables	145	LF	\$	\$
47	Remove 4160 V cables in existing duct banks and terminations	Lump Sum			\$
48	Furnish and install 4160 V cabling in the existing duct banks	4,724	LF	\$	\$
49	Furnish and install 120 V power equipment receptacles and local vault grounding, conduits and conductors	Lump Sum			\$
50	Furnish and install crane electrical connectors at vaults	Lump Sum			\$
51	Remove existing fiber optic cables from crane vaults	Lump Sum			\$
52	Install new fiber optic cables to crane vaults including connectors	8,502	LF	\$	\$
53	Furnish and install rail grounding	Lump Sum			\$
54	Furnish and install red warning light circuits	Lump Sum			\$
Phase 1 – Switchgear Building					
55	IT allowance for fiber and switching equipment not specifically designated	Allowance			\$
56	Switchgear Building site work	Lump Sum			\$
57	Switchgear Building shell construction	Lump Sum			\$
58	Switchgear Building interior construction	Lump Sum			\$
59	Switchgear room, station battery room, IT Room fire protection system	Lump Sum			\$

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Phase 2 – Berth 30 Extension					
60	Furnish and install 18” diameter ACGPs	34,320	LF	\$	\$
61	Furnish and install waterside crane girder	1,492	LF	\$	\$
62	Furnish and install landside crane girder	1,492	LF	\$	\$
63	Furnish and install Panzerbelt system	1,540	LF	\$	\$
64	Furnish and install electrical concrete vaults at STA 13+87 and STA 14+25	2	EA	\$	\$
65	Furnish and install crane stowage sockets	12	EA	\$	\$
66	Furnish and install crane tie-downs	24	EA	\$	\$
67	Furnish and install crane stops	2	EA	\$	\$
68	Furnish and install crane rails including rail, clips, sole plates, pads, and epoxy grout	3,000	LF	\$	\$
69	Furnish and install directional bore conduits	1,413	LF	\$	\$
70	Furnish and install new manholes	3	EA	\$	\$
71	Furnish and install 4160 V cable, feeder tag # 513	1,763	LF	\$	\$
72	Furnish and install 4160 V cable, feeder tag # 514	1,772	LF	\$	\$
73	Furnish and install 4160 V cable, feeder tag # 520	1,741	LF	\$	\$
74	Furnish and install 4160 V cable, feeder tag # 521	1,734	LF	\$	\$
75	Furnish and install 4160 V duct bank	1,040	LF	\$	\$
76	Furnish and install 120 V auxiliary power equipment receptacles, local vault grounding, conduits, and conductors	Lump Sum			\$

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77	Furnish and install crane electrical connectors at vaults	Lump Sum	/	/	\$
78	Remove existing fiber optic cables from crane vaults	Lump Sum	/	/	\$
79	Install new fiber optic cables to crane vaults and including connectors	6,896	LF	\$	\$
80	Furnish and install rail grounding	Lump Sum	/	/	\$
<b>Total Bid Price</b>					<b>\$</b>

The Total Bid Price shall include all cost for the completion of the work provided in the Contract Document. The cost of any item(s) of work not covered by a specific unit price or lump sum price listed above shall be included in the unit price or lump sum price to which the item(s) is most applicable.

SECTION 01 10 00 - SUMMARY

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Work description.
  2. Work by others.
  3. Contractor's use of Site.
  4. Work sequence.
  5. Permits.
  6. Security.
  7. Marine traffic.
  8. Lights.
  9. Specification conventions.

1.2 WORK DESCRIPTION

- A. The Work described below will be constructed in two phases:

Phase 1:

1. Construction of 120 ft gage waterside and landside crane girders at Berths 31-32.
2. Civil and electrical utility improvements at Berths 31-32.
3. Re-pave and re-stripe at Berths 31-33.
4. Construction of a new Switchgear Building.

Phase 2:

1. Construction of 100 ft gage waterside and landside crane girders at Berth 30 Extension.
2. Electrical utility improvements for cranes at Berth 30 Extension.
3. Re-pave and re-stripe at Berth 30.

- B. The Berths 31-32 construction in Items 1-3 of Phase 1 consists of, in general:

Furnishing and installing auger cast grout piles (ACGP)

Demolition of existing concrete crane girders

Demolition, abandoning, and re-routing existing utilities

Furnishing and installing 120 ft gage, waterside and landside concrete crane girders including excavation for girders

Furnishing and installing crane rail systems at landside and waterside girders

Furnishing and installing crane tie-downs, stowage sockets, and crane stops

Furnishing and installing cable trench with Panzerbelt system at waterside girder

Furnishing and installing duct banks and conduits for crane cables

Furnishing and installing crane cable vaults with Cavotec hinged covers and cable connectors

Furnishing and installing drainage system and relocating existing storm drain systems

Re-paving and re-striping approximately 200 ft wide pavement at Berths 30-33

Removing existing crane cables and installing new crane cables  
Disconnecting and connecting crane cables at crane cable vaults

- C. The Switchgear Building construction in Phase 1 consists of a 2,100 SF one-story FPL building and 9,400 SF two-story switchgear building, supported on 16" auger cast grout piles. The two-story building improvements, in general, include tenant improvements for office space at the second floor and warehouse space at ground floor; furnishing, installing, and commissioning a 13.2 kV switchgear including 13.2kV duct bank and cabling in the second floor switchgear room; and furnishing and installing an elevator, two exit stairways with one being an aluminum stair at the exterior, mechanical, electrical, and plumbing systems (MEP) at the first and second floors; large missile impact windows, fire protection system for switchgear room, battery storage room, and IT room; furnishing and installing site improvements including drainage, water, sewer, communication, parking, and security fence with double rolling entry gate.

The one-story FPL vault building shall have no interior improvements. Coordinate with FPL for Work interface such as duct bank and conduits through building foundation, floor slabs, and walls.

- D. The Berth 30 Extension construction in Phase 2 consist of, in general:

Furnishing and installing auger cast grout piles (ACGP)  
Furnishing and installing 100 ft gage, waterside and landside concrete crane girders  
Furnishing and installing crane rail systems at landside and waterside girders  
Furnishing and installing crane tie-downs, stowage sockets, and crane stops  
Furnishing and installing cable trench with Panzerbelt system at waterside girder  
Furnishing and installing electrical ductbanks and conduits for cranes, and cable vaults with Cavotec hinged covers  
Constructing directional bores between switchgear building and Berth 30 Extension for ductbanks through tenant yard  
Re-paving and re-striping approximately 200 ft wide pavement at Berth 30  
Removing existing crane cables and installing new crane cables  
Disconnecting and connecting crane cables at crane cable vaults

The wharf construction including bulkhead, tie-rods, and anchor walls at Berth 30 Extension will be performed by Other Contractor based on the contract documents prepared by DeRose Design Consultants for Turning Notch Project under a separate contract. The crane girder construction under this contract shall not begin until the Other Contractor has completed the construction pad, approximately four (4) feet below the finish grade, as shown on drawing sheet S1.04. After the crane girder construction is complete, the Other Contractor will complete the wharf construction. Close coordination of the construction planning, sequence, operation, and schedule with the Other Contractor is mandatory.

- E. Construction Phasing

1. The crane girder construction at Berths 31-32 will be phased to allow the port tenants to continue operating over the completed or partially completed Work with minimal interruption and to allow for the delivery and commissioning of two low profile cranes.

2. The construction activities at Berths 31-32 shall be limited to approximately 400 ft segment at any one time. Refer to construction sequence drawings.
  3. The construction activities at Berth 30 extension shall be performed in one phase and after the Berth 30 Extension bulkhead is completed by the Other Contractor.
  4. Coordinate construction planning, schedule and operations with the Owner.
  5. The contractor shall use a scheduling program such as Primavera showing detailed sequencing of the Work.
- F. The Work for this contract includes Work covered by unit prices and lump sum prices.
- G. The Work of this Contract comprises construction of all the Work shown on the Contract Documents.
- H. The Contractor's use of the site for Work and storage is limited to the area designated on the drawings or as approved by the Owner.
- I. Work shall be complete in accordance with contract documents. All Work, materials, and services not expressly indicated in the contract documents but necessary for the complete and proper construction of the Work shall be provided by the Contractor in good faith.
- J. The Contractor shall employ a full time coordinator to continually review the contract Documents, the Work of other Contractors, submittals, changes, and prepare overlay drawings as necessary to avoid conflicts, errors, omissions, and untimely construction.

### 1.3 WORK BY OTHERS

- A. The activities set forth below are anticipated to be in progress by others on or adjacent to the site before, during, and after the Work under this Contract. Contractor shall coordinate Work and shall coordinate shared access with the contractors performing these other activities and other Work.
1. Turning Notch project.
  2. Bulkhead construction at Berth 30 Extension.
  3. Delivery and commissioning of new low profile cranes.
  4. Upgrading and relocation of existing cranes.
- B. Should the conflicting Work with other contracts occur, timely coordination meetings are required to resolve the conflicts such that scheduling of Work can be accomplished.
- C. Coordinate Work with utilities of Owner and public agencies.

### 1.4 CONTRACTOR'S USE OF SITE

- A. Prior to commencement of Work or any excavation, the Contractor and the Engineer shall jointly survey the area adjacent to the Project area making record of such existing damage as cracks, sags, or other similar damage. This record shall serve as a basis for determination of subsequent damage to structures, conditions or other existing improvements due to the contractor's operation. The parties making the survey shall sign the official record of existing damage. Damage of any nature to the adjacent project area, not noted in the original survey but subsequently found, shall be reported to the Engineer.

- B. Utility outages and shutdown:
  - 1. Coordinate and schedule electrical and other utility outages with the Engineer.
  - 2. Outages: Allowed only at previously agreed upon times.
  - 3. At least one week before scheduled outage, submit Outage Request Plan to the Engineer itemizing the dates, times, and duration of each requested outage.

#### 1.5 WORK SEQUENCE

- A. Construct Work at Berths 31 and 32 in stages to accommodate terminal operation requirements during construction period. Refer to construction sequence drawings. Coordinate construction schedule and operations with the Engineer.
- B. Work at Berth 30 Extension can be performed in one stage.
- C. Sequencing of Construction Plan: Before start of construction, submit three copies of construction plan regarding phasing of Work for acceptance by the Engineer. After acceptance of plan, construction sequencing shall comply with accepted plan unless deviations are accepted by the Engineer.

#### 1.6 PERMITS

- A. Contractor is responsible for compliance with any and all applicable permits in performing the Work. Contractor shall obtain a construction permits from each of the municipalities having jurisdiction of the project area.
- B. Contractor shall obtain construction permits from the City of Hollywood Building Department and agencies having jurisdiction of the project area.
- C. Contractor shall prepare, submit, implement and maintain necessary documents to comply with the National Pollution Discharge Elimination System permit program, including all permit fees. These documents include but are not limited to, Notice of Intent, Storm Water Pollution Prevention Plans, Notice of Termination, etc., in accordance with the requirements of Florida Department of Environmental Protection.
- D. The specification of specific permits applying the Work shall not limit or restrict the obligation of the Contractor in the performance of the Work to comply with any and all other permits which are described in the Contract Documents or which apply to the performance of the Work.

#### 1.7 SECURITY

- A. The project site is a secured site governed by the TSA rules and regulations. Contractor, Subcontractors, and suppliers shall comply with TSA rules and regulations.
- B. Responsible for security of the Work and of its equipment and materials at the project site.
- C. Exercise control at all time over any persons or vehicles visiting the Work site of its activities.

1.8 MARINE TRAFFIC

- A. All floating operations shall be in accordance with the applicable laws and customs. Cargo ships and other marine vessels will be using adjacent waters during the entire period of the Contract. The Contractor shall not interfere with any ship traffic, the arrival or departure of ships, or cargo operations.
- B. Submit Notice to Mariners to US Coast Guard.

1.9 LIGHTS

- A. When Work at night is in progress, the Contractor shall maintain such lights as may be necessary for the proper observation of operation but not to endanger or obstruct navigation.

1.10 SPECIFICATION CONVENTIONS

- A. These specifications are written in imperative mood and streamlined form. This imperative language is directed to the Contractor unless specifically noted otherwise. The words "shall be" are included by inference where a colon (:) is used within sentences or phrases.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION



## SECTION 01 10 15 – BID ITEM DESCRIPTIONS

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Bid items and descriptions.

#### 1.2 BID ITEMS

- A. Any bid item may be deleted in total or in part prior to or after award of Contract without compensation in any form or adjustment of other bid items or prices therefore.
- B. Descriptions:

**ITEM 1: Permit allowance for agencies other than Broward County commissioners:** This Allowance Item allows for the Contractor to be reimbursed for the cost of any permits and impact fees charged by regulatory agencies applicable to the project other than Broward County Commissioners. The Contractor shall be responsible for complying with all the regulations and air and water pollution standards of the Department of Environmental Protection, the Corps of Engineers, the South Florida Water Management District, and the United States Coast Guard. Any pollution control measures necessary, such as turbidity curtains or oil spill booms shall be provided by the Contractor at no additional cost. The Port Everglades Construction Management and Planning Division will obtain necessary permits from the Broward County Department of Planning and Environmental Protection (BCDPEP), U.S. Army Corps of Engineers (USACOE), and the Florida Department of Environmental protection (FDEP) for water management and discharge. It is the responsibility of the Contractor to apply for, obtain, and pay for all construction permits and impact fees as may be required from governmental agencies to perform all contract work. After obtaining and paying for such permits and impact fees, the Contractor will be reimbursed the cost from the Permit Allowance Pay Item upon presentation of a paid receipt. No markup or charge by the Contractor will be reimbursed.

ITEM 2: **Handling and/or isolation of unforeseen conditions allowance:** This Allowance Item is established to readily deal with any unforeseen underground conditions including, but not limited to contaminated materials and abandoned utilities which may be encountered at the project site during the course of construction. In the event contaminated soils are detected during construction activities, the Contractor shall immediately notify the Port Everglades Department - Construction Management and Planning Division. After consultation with the Engineer, the Contractor's methods for handling and disposal of contaminated materials shall be as accordance with Section 3.02, Paragraph B of this specification. The cost for removal and disposal of contaminated soils is a pass through cost and shall be paid under the Handling and Isolation of Contaminated Materials Allowance Item. work to be considered for payment under this item requires written approval by the Engineer, prior to start of work by the Contractor. The Contractor shall provide the Engineer with sufficient documentation of the proposed work involved (including need and requirements, quantities and costs) to allow the Engineer to evaluate the Contractor's request for authorization and payment. The Contractor's invoice for reimbursement of cost shall be submitted with substantiating documentation to include paid receipts, chain of custody letter, and manifests.

ITEM 3: **Port security – background checks, identification badges, dockside permits, and security details:** This Allowance Item is established to reimburse the Contractor for paying for the requisite criminal background checks, identifications badges, dockside permits, and security details required in accordance with the Port Security Regulations. Contractor shall be responsible to insure that all his personnel possess identification badges and permits. Contractor shall be solely responsible to insure that all his personnel associated with this project display an identification badge or dockside permit at all times.

After obtaining and paying for the identification badges, and dockside permits, and security details, the Contractor will be reimbursed the cost, from Port Security – Background Checks, Identification Badges and Dockside Permits and Security Details Allowance Pay Item. Contractor shall include copies of paid receipts, identification badges and dockside permits in order to be reimbursed. The use of Security Details must be used judiciously and be pre-approved by the Engineer. No Security Detail will be approved for areas where the area can be accessed through a manned security gate or on days when the Contractor is not working. Contractor shall request reimbursement on a monthly basis, in conjunction with the Application for Payment. No markup or additional charge by the Contractor will be allowed. Contractor may use the allowance amount in any combination of background checks, dockside permits and security details.

Once the allowance amount is exhausted, Contractor shall request and be issued a change order for reimbursement of amounts spent for background checks, identification badges, and dockside permits. Contractor will not be allowed markup or additional charge for the reimbursement costs beyond the allowance amount.

ITEM 4: **FPL connection to new Switchgear Building** will not be measured. The allowance Item is established to reimburse the Contractor for coordinating and contracting FPL services to perform all work required to tie-in to primary switchgear. The Contractor's invoice for reimbursement of cost shall be submitted with substantiating documentation to include paid receipts. No markup or additional charge will be allowed.

**PHASE 1 – BERTHS 31-33**

ITEM 5: **Mobilization and demobilization** will not be measured. The lump sum price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in the mobilization and demobilization.

Except as otherwise specified, mobilization shall consist of preparatory work and operations, including but not limited to, those necessary for the movement of personnel, equipment, supplies, and incidentals to the project site; for the establishment of all field offices, and other facilities necessary for the work on the project; and for all other work and operations which must be performed or costs incurred prior to beginning work on the various bid items on the project site.

ITEM 6: **Standby rate for work stoppage requested by Owner to maintain terminal operations** will be measured by the hour. The unit price to be paid for under this item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in demobilizing the work area as necessary to allow crane and terminal operations over the work area and to re-mobilizing after the crane and vessel operation has completed. The crane geometry and clearance diagram are shown on drawing sheet CP1.07. Work stoppage notice will be requested by the Owner with a minimum of 4 hour notice.

ITEM 7: **Furnish and install Auger Cast Grout Test Piles** will be measured by the linear foot of test piles furnished and installed. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in testing procedure preparation, furnishing, installing and testing the auger cast grout test piles, as shown on the Geotechnical report and Contract Documents.

Except as otherwise specified, auger cast grout pile installation shall consists of preparatory work, including but not limited to, removing asphalt, locating the existing utilities, tie-rods, existing piles, and other obstruction, re-positioning auger pile as necessary to avoid conflicts, fill all excess auger holes with grout, dispose of excess soil, and finish the pavement surface suitable for terminal operation.

ITEM 8: **Furnish and install 16” diameter Auger Cast Grout Piles (ACGPs) for Switchgear Building foundation** will be measured by the linear foot of piles furnished and installed. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing 16” diameter auger cast grout piles for Switchgear Building foundation, as shown on the Contract Documents.

Except as otherwise specified, auger cast grout pile installation shall consist of preparatory work, including but not limited to, removing asphalt, locating the existing utilities, re-position auger pile as necessary to avoid conflicts, fill all excess auger holes with grout, dispose of excess soil

ITEM 9: **Furnish and install 18” diameter ACGPs** will be measured by linear foot of piles furnished and installed. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing 18” diameter auger cast piles, as shown on the Contract Documents.

Except as otherwise specified, auger cast grout pile installation shall consist of preparatory work, including but not limited to, removing asphalt, locating existing utilities, tie-rods, existing piles, and other obstructions, re-positioning auger pile as necessary to avoid conflicts, filling all excess auger holes with grout, disposing of excess soil, and finishing the pavement surface suitable for terminal operation.

ITEM 10: **Furnish and install 24” diameter ACGPs** will be measured by linear foot of piles furnished and installed. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, devices, transportation, services, and supervision for doing all work involved in furnishing and installing 24” diameter auger cast piles, as shown on the Contract Documents.

Except as otherwise specified, auger cast grout pile installation shall consist of preparatory work, including but not limited to, removing asphalt, locating the existing utilities, tie-rods, existing piles, and other obstructions, re-positioning auger piles as necessary to avoid conflicts, filling all excess auger holes with grout, disposing of excess soil, and finishing the pavement surface suitable for terminal operation.

ITEM 11: **Demolition of existing concrete rail girders and crane stops as required** will not be measured. The lump sum price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, devices, transportation, services, and supervision for removal of the existing concrete crane girders to allow for the construction of the new crane girders, and crane stops as shown on the Contract Documents.

ITEM 12: **Furnish and install waterside crane girder** will be measured by the linear foot. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in locating utilities in conflict with girder construction, providing excavation for girder installation, storing and off-hauling excess of excavated materials, removing and disposing of auger pile concrete to expose top reinforcing, furnishing and installing reinforcing bars, furnishing and installing structural concrete, backfilling of the excavated area, furnishing and installing 4” asphalt pavement over the excavated area, temporary in-fill rail pocket, and finish and clean pavement surface to be ready for terminal use, as shown on the contract Documents and as specified herein.

- ITEM 13: **Furnish and install landside crane girder** will be measured by the linear foot. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in locating utilities in conflict with girder construction, providing excavation for girder footing installation, storing and off-hauling excess of excavated materials, removing and disposing of auger pile concrete to expose top reinforcing, furnishing and installing reinforcing bars, furnishing and installing structural concrete, backfilling of the excavated area, furnishing and installing 4" asphalt pavement over the excavated area, temporary in-fill rail pocket, finishing and cleaning pavement surface to be ready for terminal use, as shown on the contract Documents and as specified herein.
- ITEM 14: **Furnish and install slotted drain pipe** will be measured by the linear foot. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, devices, transportation, services, and supervision for all work involved in furnishing and installing slotted drain embedded in the waterside crane girder, clean out with heavy duty cover capable of supporting 120 psi pressure, and precast clean-out box, as shown on the Contract Documents and as specified herein.
- ITEM 15: **Furnish and install Panzerbelt system** will be measured by the linear foot. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, devices, transportation, services, and supervision for doing all work involved in furnishing and installing stainless steel cable channels, Panzerbelt covers, PVC drain pipes, connections to the drainage system, insulated materials to electrically isolate dissimilar metals, and any forming supports required by the Panzerbelt supplier, as shown on the Contract Documents and as specified herein.
- ITEM 16: **Furnish and install electrical concrete vaults at Sta 54+68** will be measured by each completed vault. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, devices, transportation, services, and supervision for doing all work involved in forming, furnishing and installing reinforcing bars, pre-fabricated steel beam, structural concrete, Cavotec hinged covers and turnover anchors, aluminum ladder, submersible sump pump, and any additional framing as required by Cavotec covers installation, as shown on the Contract Documents and as specified herein.
- ITEM 17: **Furnish and install electrical concrete vaults at Sta 51+83** will be measured by each completed vault. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, devices, transportation, services, and supervision for doing all Work involved in forming, furnishing and installing reinforcing bars, pre-fabricated steel beam, structural concrete, stainless steel support frame with 1-1/2" metal deck, Cavotec hinged covers and turnover anchors, aluminum ladder, submersible sump pump, and any additional framing required by Cavotec cover installation, as shown on the Contract Documents and as specified herein.

- ITEM 18: **Furnish and install crane stowage sockets** will be measured by number of sockets furnished and installed. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing crane stowage socket hardware, cover, PVC drainage pipe, and connection to the drainage system, as shown on the Contract Documents and as specified herein.
- ITEM 19: **Furnish and install crane tie-downs** will be measured by number of tie-downs furnished and installed. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing crane tie-down hardware, bolts, cover, PVC drainage pipe, and connection to the drainage system, as shown on the Contract Documents and as specified herein.
- ITEM 20: **Furnish and install crane stops** will be measured by each installed crane stop. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing crane stops, as shown on the Contract Documents and as specified herein.
- ITEM 21: **Furnish and install crane rails including rail, clips, sole plates, pads, and epoxy grout** will be measured by the linear foot. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing crane rail, frogs, clips, sole plate, pad, epoxy grout, asphalt infill, as shown on the Contract Documents and as specified herein.
- ITEM 22: **Removal and disposal of existing drainage pipes and structures** will not be measured. The lump sum price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in demolition of drainage pipe, sanitary lateral through existing waterside girder and capped, structures, and disposal materials off-site, as shown on the Contract Documents and as specified herein.
- ITEM 23: **Abandon, grout, and cap existing sanitary and oily waste lateral pipe in bulkhead** will not be measured. The lump sum price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in abandoning, removing the lid, and grouting of the sanitary and oily waste lines within the bulkhead, and capping as shown on the Contract Documents and as specified herein.
- ITEM 24: **Furnish and install drainage pipe-15" RCP** will be measured by the linear foot. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing 15" RCP Class V pipe and fittings, as shown on the Contract Documents and as specified herein.

- ITEM 25: **Furnish and install drainage pipe-18” RCP** will be measured by the linear foot. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing 18” RCP Class V pipe and fittings, as shown on the Contract Documents and as specified herein.
- ITEM 26: **Furnish and install drainage pipe-24” RCP** will be measured by the linear foot. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing 24” RCP Class V pipe and fittings, as shown on the Contract Documents and as specified herein.
- ITEM 27: **Furnish and install drainage pipe-12” PVC** will be measured by the linear foot. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, including reinforcing steel, appliances, tools equipment, transportation, services, and supervision for doing all work involved in furnishing and installing 12” HDPE pipe and fittings, as shown on the Contract Documents and as specified herein.
- ITEM 28: **Furnish and install drainage pipe-4” PVC** will be measured by the linear foot. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, including reinforcing steel, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing 15" HDPE and fittings, as shown on the Contract Documents and as specified herein.
- ITEM 29: **Furnish and install Type M-4 drainage manhole structure** will be measured by each installed structure. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing manhole structures and fittings, as shown on the Contract Documents and as specified herein.
- ITEM 30: **Furnish and install Type C-4 catch basin** will be measured by each installed structure. The unit price to be paid under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing Type C-4 catch basin structures and fittings, as shown on the Contract Documents and as specified herein.
- ITEM 31: **Furnish and install Type C-5 catch basin** will be measured by each installed structure. The unit price to be paid under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing Type C-5 catch basin structures and fittings, as shown on the Contract Documents and as specified herein.
- ITEM 32: **Adjust / Reset Existing Storm Drain Structure Frame & Grate / Ring & Cover** will be measured by each adjusted structure. The unit price to be paid under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all Work involved in adjusting existing storm drain structure frame & grate / ring & cover, as shown on the Contract Documents and as specified herein.

- ITEM 33: **Connect to existing storm drain structure** will not be measured. The lump sum price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing storm drain connections including coring, as shown on the Contract Documents and as specified herein.
- ITEM 34: **Restoration of asphalt following construction of crane rail girder and storm drain pipe, and structures** will not be measured. The lump sum price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing 2" mill and overlay pavement, as shown on the Contract Documents and as specified herein.
- ITEM 35: **Removal and disposal of existing 4"-12" water main crossing landside and waterside rails** will be measured by the instance. The unit price to be paid for under this Item shall be full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in temporarily capping and demolition of water line and disposal of materials off-site, as shown on the Contract Documents and as specified herein.
- ITEM 36: **Furnish and install 4"-12" PVC water main crossing landside and waterside rails** will be measured by the instance. The unit price to be paid for each water line crossing the crane rail under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing 4" PVC water main crossing, sleeve, and fittings, as shown on the Contract Documents and as specified herein.
- ITEM 37: **Furnish and install 8" PVC (SDR 26) gravity sewer pipe** will be measured by the linear foot. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing 8" PVC (SDR 26) gravity sewer pipe and fittings, as shown on the Contract Documents and as specified herein.
- ITEM 38: **Furnish and install sanitary sewer structure (6'-8' Depth)** will be measured by each installed structure. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing sanitary structures and fittings, as shown on the Contract Documents and as specified herein.
- ITEM 39: **Removal and disposal of existing sanitary sewer and oil waste pipes, cap exiting pipes to remain** will not be measured. The lump sum price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in demolishing the oil waste line and manholes when in conflict with crane girder construction, grouting and filling oil waste lines and structures to abandon in place, and disposing of materials off-site, as shown on Contract Documents and as specified herein.



- ITEM 40: **Furnish and install 1.5” asphalt mill Type SP-9.5 asphalt overlay** will be measured by the square yard. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing 1.5” mill and overlay pavement, Type SP-9.5 asphalt overlay, as shown on the Contract Documents and as specified herein.
- ITEM 41: **Furnish and install wharf pavement marking and signing** will not be measured. The lump sum price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in surface preparation, furnishing and installing terminal striping, as shown on the Contract Documents and as specified herein.
- ITEM 42: **Furnish, install, and commission 13.2 kV switchgear in Switchgear Building** will not be measured. The lump sum price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing, installing, and commissioning the 13.2 kV switchgear including conduits, cables, and coordination with FPL, as shown on Contract Documents and as specified herein. The new 13.2 kV switchgear shall be complete and fully functional in all respects to meet the requirements of the specifications and drawings. It shall include but is not limited to, the switchgear circuit breakers, relays, arc flash duct installation, batteries and charger, and housekeeping pad. This item also includes the overcurrent protection study and settings, as well as all terminations and connections inside the switchgear, metering, and the HMI.
- ITEM 43: **Furnish and install 13.2 kV duct bank** will be measured by linear foot. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing duct banks from the Switchgear Building to electrical vaults, as shown on the Contract Documents and as specified herein. This shall include all modification of existing manholes, concrete reinforcement, markers, as well as conduit terminations.
- ITEM 44: **Furnish and install 13.2 kV cable, feeder tag #504** will be measured by linear foot from switchgear termination to vault termination. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services and supervision for doing all work involved in furnishing and installing cables and conductors as shown on the Contract Documents and as specified herein.
- ITEM 45: **Furnish and install 13.2 kV cable, feeder tag #505** will be measured by linear foot from switchgear termination to vault termination. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services and supervision for doing all work involved in furnishing and installing cables and conductors as shown on the Contract Documents and as specified herein.

- ITEM 46: **Furnish and install 13.2 kV cable, feeder tag #506** will be measured by linear foot from switchgear termination to vault termination. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services and supervision for doing all work involved in furnishing and installing cables and conductors as shown on the Contract Documents and as specified herein.
- ITEM 47: **Furnish and install new 13.2 kV duct bank for FPL cables** will be measured by linear foot. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in constructing the duct bank between the new FPL vault and the existing FPL manhole for FPL's conductors as well as the conduits between the new FPL vault and the new switchgear, as shown on the Plans and as specified herein.
- ITEM 48: **Remove 4160 V cables in existing duct banks and terminations** will not be measured. The lump sum price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in removing the 4160 V cables in the existing ducts and their terminations. This includes disconnecting the cables in their existing electrical vaults and in the existing switchgear. It includes all coordination with switchgear downtime and scheduling de-energizing the existing 4160 V switchgear. This item also includes cleaning and swabbing the conduits for preparing the 4160 V duct banks for the pulling of new 4160 V cables, as shown on the Plans and as specified herein. This item also includes removing the existing 120V conductors, ground conductors, ground check conductors, ground bars, etc., and cleaning the vaults to make them ready for the new installations.
- ITEM 49: **Furnish and install 4160 V cabling in the existing duct banks** will be measured by the linear foot. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in installing the 4160 V cable, the new ground conductor and ground check conductor in the existing duct bank system. This includes coordination, scheduling, pulling tension, calculations, and submittals as shown on the Plans and as specified herein.. ,
- ITEM 50: **Furnish and install 120 V power equipment receptacles and local vault grounding, conduits and conductors** will not be measured. The lump sum price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in installing all the 120 V system that will be brought to existing and new electrical vaults in the project for Phase 1. This includes conduits, conductors, unit transformers, receptacles, and grounding, as shown on the Plans and as specified herein.
- ITEM 51: **Furnish and install crane electrical connectors at vaults** will not be measured. The lump sum price to be paid for under this Item shall be full compensation for furnishing and installing all crane connector terminations inside electrical vaults for the landside cables, as shown on the Plans and as specified herein.

- ITEM 52: **Remove existing fiber optic cables from crane vaults** will not be measured. The lump sum price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in disconnecting and removing the existing landside fiber-optic cables, as shown on the Plans and as specified herein. This item also includes cleaning the fiber-optic conduits in preparation for the new fiber-optic cables.
- ITEM 53: **Install new fiber optic cables to crane vaults including connectors** will be measured by the linear foot. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing the landside fiber-optic cables including the terminations in both the existing Switchgear Building and new Switchgear Building, as shown on the Plans and as specified herein. This item includes termination boxes inside the vaults.
- ITEM 54: **Furnish and install rail grounding** will not be measured. The lump sum price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing rail grounding as shown on the drawings and specifications, and as specified herein.
- ITEM 55: **Furnish and install red warning light circuits** will not be measured. The lump sum price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in the installation of red warning lights at the new crane stops. This shall include all conduits, conductors, controls, power feeds, and terminations for the new warning lights.

#### **PHASE 1 – SWITCHGEAR BUILDING**

- ITEM 56: **IT allowance for fiber and switching equipment not specifically designated.** This Allowance Item allows for the reimbursement of the cost of any work and equipment to connect the New Switchgear Building to the Existing Switchgear Building and into the Broward County Network upon presentation of a paid receipt. The contractor shall be responsible for coordinating with an IT Contractor designated by the Broward County ETS Infrastructure Services Division. This allowance will not be used for the equipment designated to be installed within the building for building systems. . No markup or charge will be allowed.

- ITEM 57: **Switchgear Building site work** will not be measured. The lump sum price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in site preparation work, trenching, furnishing and installing potable water, backflow preventer, connection to existing sewer, sidewalk, pavement, bollards, parking, striping, security fence, double sliding gates, as shown on the contract Documents and as specified herein. This item includes the re-work of the fiber-optic cabling underneath the Switchgear Building. This also includes the re-routing of the existing power duct bank system that feeds the Customs office. This work will include demolition, conduits, conductors, coordination, and all terminations to make the systems fully complete and operational.
- ITEM 58: **Switchgear Building shell construction** will not be measured. The lump sum price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in constructing a two story building with a one story FPL vault, approximately 11,500 SF, including furnishing and installing all concrete work, concrete masonry walls, pre-cast joists, exterior aluminum stairs, elevator, roofing, roof and wall insulation system, impact resistant exterior windows and doors including hardware, cantilever canopy, slanted walls, miscellaneous steel such as protective bollards, exterior finishes, as shown on the Contract Documents and as specified herein. This item includes all electrical and mechanical systems for the completion of the shell building. This will include, but is not limited to, rooftop units, plumbing, electrical, and fire alarm system for a complete shell building. This includes the new pad-mount transformer and the electrical equipment infrastructure supporting the building. This includes the lightning protection system for the building and the 13.2 kV conduits and pullboxes routed through the storage room.
- ITEM 59: **Switchgear Building interior construction** will not be measured. The lump sum price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in tenant improvements at the office space, switchgear room, and warehouse space, including furnishing and installing lobby, offices, conference room, break room, men and women's restrooms, switchgear room including battery and IT rooms, lighting, HVAC, and plumbing, communication, and interior finishes including painting, acoustic ceiling, tiles, blinds, signage, and carpet, as shown on the Contract Documents and as specified herein. This item includes all mechanical and electrical not included in the building shell construction. This includes, but is not limited to, all light fixtures, branch circuits, panelboards, plumbing, low voltage conduits, and ductwork.

ITEM 60: **Switchgear room, Station Battery Room, IT Room fire protection system** will not be measured. The lump sum price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing a clean agent fire protection system for switchgear room, air tight gasket for doors and wall penetration, and testing as required by the clean agent fire protection system, as shown on the Contract Documents and as specified herein. This item includes all tanks, piping, systems, controls, and connections to the existing building fire alarm system for a complete and fully operational system. This shall include all submittals and calculations by the fire suppression vendor verifying and demonstrating compliance with the specifications.

## **PHASE 2 – BERTH 30 EXTENSION**

ITEM 61: **Furnish and install 18” diameter ACGPs** will be measured by the number of piles furnished and installed. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing 18” diameter auger cast piles, as shown on the Contract Documents.

Except as otherwise specified, auger cast grout pile installation shall consist of preparatory work, including but not limited to, removing asphalt, locating the existing utilities, tie-rods, existing bulkhead and sheet pile wall; re-positioning auger pile as necessary to avoid conflicts, filling all excess auger holes with grout, and disposing of excess soil.

ITEM 62: **Furnish and install waterside crane girder** will be measured by the linear foot. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing forming, reinforcing bars, and structural concrete, as shown on the contract Documents and as specified herein.

ITEM 63: **Furnish and install landside crane girder** will be measured by the linear foot. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing forming, reinforcing bars, and structural concrete, as shown on the contract Documents and as specified herein.

ITEM 64: **Furnish and install Panzerbelt system** will be measured by the linear foot. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, devices, transportation, services, and supervision for doing all work involved in furnishing and installing stainless steel cable channels, Panzerbelt covers, PVC drain pipes, connections to the drainage system, insulated materials to electrically isolate dissimilar metals, and any forming supports required by the Panzerbelt supplier, as shown on the Contract Documents and as specified herein.

- ITEM 65: **Furnish and install electrical concrete vaults at STA 13+87 and STA 14+25** will be measured by the number of electrical vault furnished and installed. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, devices, transportation, services, and supervision for doing all work involved in forming, furnishing and installing reinforcing bars, structural concrete, stainless steel support frame with 1-1/2" metal deck, Cavotec hinged covers and turnover anchors, submersible sump pump, and any additional framing required by Cavotec cover installation, as shown on the Contract Documents and as specified herein.
- ITEM 66: **Furnish and install crane stowage sockets** will be measured by the number of sockets furnished and installed. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing crane stowage socket hardware, cover, PVC drainage pipe, and connection to the drainage system, as shown on the Contract Documents and as specified herein.
- ITEM 67: **Furnish and install crane tie-downs** will be measured by the number of tie-downs furnished and installed. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing crane tie-down hardware, bolts, cover, PVC drainage pipe, and connection to the drainage system, as shown on the Contract Documents and as specified herein.
- ITEM 68: **Furnish and install crane stops** will be measured by the number of crane stops furnished and installed. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing crane stops, as shown on the Contract Documents and as specified herein.
- ITEM 69: **Furnish and install crane rails including rail, clips, sole plates, pads, and epoxy grout** will be measured by the linear foot. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved furnishing and installing crane rail, clips, sole plate, pad, epoxy grout, asphalt infill, as shown on the Contract Documents and as specified herein.
- ITEM 70: **Furnish and install directional bore conduits** will be measured by the linear foot. The unit price to be paid for under this Item includes full compensation for locating underground utilities to avoid interferences, furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing directional bore duct banks, as shown on the Contract Documents and as specified herein. This item includes directional boring from the new Switchgear Building, across the tenant yard to the Berth 30 Extension and conduits shown on the drawings. This shall include locating existing utilities, all conduits, directional boring, direction boring activities, laydown areas, as required and shown on the drawings for this activity.

- ITEM 71: **Furnish and install new manholes** will be measured by the number of manholes furnished and installed. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing manholes, as shown on the Contract Documents and as specified herein.
- ITEM 72: **Furnish and install 4160 V cable, feeder tag # 513** will be measured by linear foot from termination to termination. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services and supervision for doing all work involved in furnishing and installing 4160 V cable as shown on the Contract Documents and as specified herein.
- ITEM 73: **Furnish and install 4160 V cable, feeder tag # 514** will be measured by linear foot from termination to termination. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services and supervision for doing all work involved in furnishing and installing 4160 V cable as shown on the Contract Documents and as specified herein.
- ITEM 74: **Furnish and install 4160 V cable, feeder tag # 520** will be measured by linear foot from termination to termination. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services and supervision for doing all work involved in furnishing and installing 4160 V cable as shown on the Contract Documents and as specified herein.
- ITEM 75: **Furnish and install 4160 V cable, feeder tag # 521** will be measured by linear foot from termination to termination. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services and supervision for doing all work involved in furnishing and installing 4160 V cable as shown on the Contract Documents and as specified herein.
- ITEM 76: **Furnish and install 4160 V duct bank** will be measured by linear foot. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for furnishing and installing new 4160 V concrete encased duct banks and cabling as shown on the Plans and specifications. This shall include, but is not limited to, duct bank concrete and reinforcement, cables, markers, as well as terminations.
- ITEM 77: **Furnish and install 120 V auxiliary power equipment receptacles, local vault grounding, conduits, and conductors** will not be measured. The lump sum price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in installing all the 120 V system that will be brought to existing and new electrical vaults in the project for Phase 2. This includes conduits, conductors, unit transformers, receptacles, and grounding, as shown on the Plans and as specified herein.

- ITEM 78: **Furnish and install crane electrical connectors at vaults** will not be measured. The lump sum price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for furnishing and installing new 5 kV terminations at the vaults, as shown on the Plans specifications.
- ITEM 79: **Remove existing fiber optic cables from crane vaults** will not be measured. The lump sum price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for furnishing and installing all work involved in disconnecting and removing the existing landside fiber-optic cables, as shown on the Plans and as specified herein. This item also includes cleaning the fiber-optic conduits in preparation for the new fiber-optic cables, as shown on the Plans and as specified herein, and more particularly in Section 16302.
- ITEM 80: **Install new fiber optic cables to crane vaults including connectors** will be measured by the linear foot. The unit price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing the landside fiber-optic cables including the terminations in both the existing Switchgear Building and new Switchgear Building, as shown on the Plans and as specified herein. This item includes termination boxes inside the vaults.
- ITEM 81: **Furnish and install rail grounding** will not be measured. The lump sum price to be paid for under this Item includes full compensation for furnishing all labor, materials, appliances, tools, equipment, transportation, services, and supervision for doing all work involved in furnishing and installing rail grounding as shown on the drawings and specifications, and as specified herein.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION



## SECTION 01 20 00 - PRICE AND PAYMENT PROCEDURES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Schedule of Values.
- B. Application for Payment.
- C. Change procedures.
- D. Defect assessment.
- E. Unit prices.

#### 1.2 SCHEDULE OF VALUES

- A. Submit electronic file to Engineer on Contractor's standard form or electronic media printout will be considered for this use.
- B. Submit Schedule of Values as electronic file to the Engineer within 15 days after date established in Notice to Proceed. Schedule of values for Switchgear building item requires further breakdown.
- C. Format: Identify each line item with number and title to match bid items.
- D. Revise schedule to list approved Change Orders with each Application for Payment.

#### 1.3 APPLICATION FOR PAYMENT

- A. Submit electronic file to the Engineer of each Application for Payment on the approved Contractor's form Content and Format: Use Schedule of Values for listing items in Application for Payment.
- B. Submit updated construction schedule with each Application for Payment.
- C. Payment Period: Submit at intervals stipulated in the Agreement.
- D. Payment Retention: as stipulated in the Agreement.
- E. Submit submittals with transmittal letter as specified in Section 01 33 00 - Submittal Procedures.
- F. Substantiating Data: When Engineer requires substantiating information, submit data justifying dollar amounts in question. Include the following with Application for Payment:
  - 1. Current construction photographs specified in Section 01 33 00 - Submittal Procedures.
  - 2. Partial release of liens from major Subcontractors and vendors.

3. Record Documents as specified in Section 01 70 00 - Execution and Closeout Requirements, for review by the Engineer, which will be returned to Contractor.
4. Affidavits attesting to off-Site stored products.
5. Construction Progress Schedule, revised and current as specified in Section 01 33 00 - Submittal Procedures.

#### 1.4 CHANGE PROCEDURES

- A. Requests for Interpretation (RFI) and Clarifications: Allot time in construction scheduling for liaison with Engineer; establish procedures for handling queries and clarifications.
  1. Use CSI Form 13.2A - Request for Interpretation or approved Contractor's form for requesting interpretations.
  2. The Engineer may respond with a direct answer on the Request for Interpretation form.
- B. The Engineer will advise of minor changes in the Work not involving adjustment to Contract Sum/Price or Contract Time by issuing supplemental instructions.
- C. The Engineer may issue Proposal Request including a detailed description of proposed change with supplementary or revised Drawings and Specifications, a change in Contract Time for executing the change. Contractor will prepare and submit estimate within five days.
- D. Time and Material Change Order: Submit itemized account and supporting data after completion of change, within time limits indicated in Conditions of the Contract. The Engineer will determine change allowable in Contract Sum/Price and Contract Time as provided in Contract Documents.
- E. Refer to maximum Billing Rate Schedule for Broward County as stipulated in this Agreement.
- F. Maintain detailed records of Work done on time and material basis. Provide full information required for evaluation of proposed changes and to substantiate costs for changes in the Work.
- G. Document each quotation for change in Project Cost or Time with sufficient data to allow evaluation of quotation.
- H. Execution of Change Orders: The Engineer will issue Change Orders for signatures of parties as provided in Conditions of the Contract.
- I. Correlation of Contractor Submittals:
  1. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as separate line item and adjust Contract Sum/Price.
  2. Promptly revise Progress Schedules to reflect change in Contract Time, revise sub-schedules to adjust times for other items of Work affected by the change, and resubmit.
  3. Promptly enter changes in Record Documents.

#### 1.5 DEFECT ASSESSMENT

- A. Replace the Work, or portions of the Work, not conforming to specified requirements.

- B. If, in the opinion of Engineer, it is not practical to remove and replace the Work, Engineer will direct appropriate remedy or adjust payment.
- C. Individual Specification Sections may modify these options or may identify specific formula or percentage sum/price reduction.
- D. Authority of Engineer to assess defects and identify payment adjustments is final.
- E. Nonpayment for Rejected Products: Payment will not be made for rejected products for any of the following reasons:
  - 1. Products wasted or disposed of in a manner that is not acceptable.
  - 2. Products determined as unacceptable before or after placement.
  - 3. Products not completely unloaded from transporting vehicle.
  - 4. Products placed beyond lines and levels of the required Work.
  - 5. Products remaining on hand after completion of the Work.
  - 6. Loading, hauling, and disposing of rejected products.

#### 1.6 UNIT PRICES

- A. Engineer will take measurements and compute quantities accordingly. Provide assistance in taking of measurements.
- B. Unit Quantities: Quantities and measurements indicated on Bid Form are for Contract purposes only. Actual quantities provided shall determine payment.
  - 1. When actual Work requires more or fewer quantities than those quantities indicated, provide required quantities at contracted unit sum/prices.
  - 2. When actual Work requires 25 percent or greater change in quantity than those quantities indicated, Owner or Contractor may claim a Contract Price adjustment.
- C. Payment Includes: Full compensation for required labor, products, tools, equipment, plant and facilities, transportation, services and incidentals; erection, application, or installation of item of the Work; overhead and profit.
- D. Final payment for Work governed by unit prices will be made on basis of actual measurements and quantities accepted by Engineer multiplied by unit price for Work incorporated in or made necessary by the Work.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

## SECTION 01 25 00 - SUBSTITUTION PROCEDURES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Quality assurance.
- B. Product substitution procedures.

#### 1.2 QUALITY ASSURANCE

- A. Contract is based on products and standards established in Contract Documents without consideration of proposed substitutions.
- B. Products specified define standard of quality, type, function, dimension, appearance, and performance required.
- C. Substitution Proposals: Permitted for specified products except where specified otherwise. Do not substitute products unless substitution has been accepted and approved in writing by the Owner.

#### 1.3 PRODUCT SUBSTITUTION PROCEDURES

- A. Substitutions may be considered when a product becomes unavailable through no fault of Contractor.
- B. Document each request with complete data, substantiating compliance of proposed substitution with Contract Documents, including:
  - 1. Manufacturer's name and address, product, trade name, model, or catalog number, performance and test data, and reference standards.
  - 2. Itemized point-by-point comparison of proposed substitution with specified product, listing variations in quality, performance, and other pertinent characteristics.
  - 3. Reference to Article and Paragraph numbers in Specification Section.
  - 4. Cost data comparing proposed substitution with specified product and amount of net change to Contract Sum.
  - 5. Changes required in other Work.
  - 6. Availability of maintenance service and source of replacement parts as applicable.
  - 7. Certified test data to show compliance with performance characteristics specified.
  - 8. Samples when applicable or requested.
  - 9. Other information as necessary to assist Engineer's evaluation.
- C. A request constitutes a representation that Contractor:
  - 1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
  - 2. Will provide same warranty for substitution as for specified product.
  - 3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to the Owner.

4. Waives claims for additional costs or time extension that may subsequently become apparent.
  5. Will coordinate installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects.
- D. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals without separate written request or when acceptance will require revision to Contract Documents.
- E. Substitution Submittal Procedure:
1. Submit three copies or electronic files of Request for Substitution for consideration. Limit each request to one proposed substitution.
  2. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
  3. Engineer will notify Contractor in writing of decision to accept or reject request.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

## SECTION 01 30 00 - ADMINISTRATIVE REQUIREMENTS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Coordination and Project conditions.
- B. Preconstruction meeting.
- C. Site mobilization meeting.
- D. Progress meetings.
- E. Preinstallation meetings.
- F. Closeout meeting.

#### 1.2 COORDINATION AND PROJECT CONDITIONS

- A. Coordinate scheduling, submittals, and Work of various Sections of Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Verify that utility requirements and characteristics of operating equipment are compatible with site and building utilities. Coordinate Work of various Sections having interdependent responsibilities for installing, connecting to, and placing operating equipment in service.
- C. Coordinate space requirements, supports, and installation of mechanical and electrical Work indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit as closely as practical. Use spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
  - 1. Coordination Drawings: Prepare as required to coordinate all portions of Work. Show relationship and integration of different construction elements that require coordination during fabrication or installation to fit in space provided or to function as intended. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are important.
- D. Coordination Meetings: In addition to other meetings specified in this Section, hold coordination meetings with personnel and Subcontractors to ensure coordination of Work.
- E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within construction. Coordinate locations of fixtures and outlets with finish elements.
- F. Coordinate completion and clean-up of Work of separate Sections in preparation for Substantial Completion and for portions of Work designated for Owner's occupancy.

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

### 1.3 PRECONSTRUCTION MEETING

- A. Engineer will schedule and preside over meeting after Notice of Award.
- B. Attendance Required: Engineer, Owner, Resident Project Representative, major Subcontractors, and Contractor.
- C. Minimum Agenda:
  - 1. Execution of Owner-Contractor Agreement.
  - 2. Submission of executed bonds and insurance certificates.
  - 3. Distribution of Contract Documents.
  - 4. Submission of list of Subcontractors, list of products, schedule of values, and Progress Schedule.
  - 5. Designation of personnel representing parties in Contract and Engineer.
  - 6. Communication procedures.
  - 7. Procedures and processing of requests for interpretations, field decisions, submittals, substitutions, Applications for Payments, proposal request, Change Orders, and Contract closeout procedures.
  - 8. Scheduling.
  - 9. Critical Work sequencing.
  - 10. Scheduling activities of terminal operations.
- D. Contractor: Record minutes and distribute electronic file to participants within two days after meeting, to Engineer, and those affected by decisions made.

### 1.4 SITE MOBILIZATION MEETING

- A. Contractor shall schedule meeting at Project Site prior to Contractor occupancy. Contractor presides over meeting.
- B. Attendance Required: Engineer, Owner, Contractor, Contractor's superintendent, special consultants, major Subcontractors.
- C. Minimum Agenda:
  - 1. Use of premises by Owner and Contractor.
  - 2. Owner's requirements and partial occupancy.
  - 3. Construction facilities and controls provided by Owner.
  - 4. Temporary utilities.
  - 5. Survey layout.
  - 6. Security and housekeeping procedures.
  - 7. Schedules.
  - 8. Procedures for testing.
  - 9. Procedures for maintaining record documents.
  - 10. Requirements for startup of equipment.
  - 11. Inspection and acceptance of equipment put into service during construction period.

- D. Contractor: Record minutes and distribute electronic copies to participants within two days after meeting, to Engineer, Owner, and those affected by decisions made.

#### 1.5 PROGRESS MEETINGS

- A. Contractor shall schedule, prepare agenda, and administer meetings throughout progress of the Work at weekly intervals.
- B. Attendance Required: Job superintendent, major Subcontractors Contractors and suppliers, and Engineer, Owner, as appropriate to agenda topics for each meeting.
- C. Minimum Agenda:
  - 1. Safety review
  - 2. Coordination of vessel and terminal traffic
  - 3. Review minutes of previous meetings.
  - 4. Review of Work progress.
  - 5. Field observations, problems, and decisions.
  - 6. Identification of problems impeding planned progress.
  - 7. Review of submittal schedule and status of submittals.
  - 8. Review of off-Site fabrication and delivery schedules.
  - 9. Maintenance of Progress Schedule.
  - 10. Corrective measures to regain projected schedules.
  - 11. Planned progress during succeeding work period.
  - 12. Coordination of projected progress.
  - 13. Maintenance of quality and work standards.
  - 14. Effect of proposed changes on Progress Schedule and coordination.
  - 15. Other business relating to Work.
- D. Contractor: Record minutes and distribute electronic copies to participants within two days after meeting, to Engineer, Owner, and those affected by decisions made.

#### 1.6 PREINSTALLATION MEETINGS

- A. When required in individual Specification Sections, Contractor shall schedule and convene preinstallation meetings at Project Site before starting Work of specific Section.
- B. Prior to preinstallation meetings, all submittals for materials, installation plans, and procedures shall be approved by the Engineer.
- C. Preinstallation meetings are required, but not limited, for the following:
  - 1. Auger pile testing.
  - 2. Auger pile installation.
  - 3. Switchgear installation
  - 4. Directional boring.
  - 5. Medium voltage cabling.
  - 6. Electrical change over
- D. Require attendance of parties directly affecting, or affected by, Work of specific Section.



- E. Notify Engineer four days in advance of meeting date.
- F. Contractor: Record minutes and distribute electronic copies to participants within two days after meeting, to Engineer, Owner, and those affected by decisions made.

#### 1.7 CLOSEOUT MEETINGS

- A. Contractor shall schedule and administer Project closeout meetings with sufficient time to prepare for requesting Substantial Completion. Attendance Required: Contractor, Engineer, Owner, and others appropriate to agenda.
- B. Minimum Agenda:
  - 1. Start-up of facilities and systems.
  - 2. Operations and maintenance manuals.
  - 3. Testing, adjusting, and balancing.
  - 4. System demonstration and observation.
  - 5. Operation and maintenance instructions for Owner's personnel.
  - 6. Contractor's inspection of Work.
  - 7. Contractor's preparation of an initial "punch list."
  - 8. Procedure to request Engineer inspection to determine date of Substantial Completion.
  - 9. Completion time for correcting deficiencies.
  - 10. Inspections by authorities having jurisdiction.
  - 11. Certificate of Occupancy and transfer of insurance responsibilities.
  - 12. Partial release of retainage.
  - 13. Final cleaning.
  - 14. Preparation for final inspection.
  - 15. Closeout Submittals:
    - a. Project record documents.
    - b. Operating and maintenance documents.
    - c. Operating and maintenance materials.
    - d. Affidavits.
  - 16. Final Application for Payment.
  - 17. Contractor's demobilization of Site.
  - 18. Maintenance.
- C. Contractor: Record minutes and distribute electronic copies to participants within two days after meeting, to Engineer, Owner, and those affected by decisions made.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION – Not Used

END OF SECTION

## SECTION 01 32 16 - CONSTRUCTION PROGRESS SCHEDULE

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Submittals.
- B. Quality assurance.
- C. Construction schedules.
- D. Network analysis schedules.
- E. Review and evaluation.
- F. Updating schedules.
- G. Distribution.

#### 1.2 SUBMITTALS

- A. Within 10 days after date of Notice to Proceed, submit proposed preliminary construction schedule defining planned operations for the entire Work.
- B. Participate in review of preliminary and complete construction schedule jointly with the Engineer.
- C. Within 20 days after joint review of proposed preliminary construction schedule, submit proposed complete construction schedule for review. Include written certification that major Subcontractors have reviewed and accepted proposed schedule.
- D. Submit updated construction schedules every 30 days and with each Application for Payment. Submit as electronic file in PDF format and as .xer file for the Owner's use with Primavera or Asta software.
- E. Submit construction schedule under transmittal letter form specified in Section 01 33 00 – Submittal Procedures.

#### 1.3 QUALITY ASSURANCE

- A. Scheduler: Contractor's personnel specializing in Critical Path Method (CPM) scheduling with two years' minimum experience in scheduling construction work of complexity comparable to the Project.

#### 1.4 FORMAT FOR NETWORK ANALYSIS SCHEDULE

- A. Listings: Reading from left to right, in ascending order for each activity. Identify each activity with applicable Specification Section number.

#### 1.5 NETWORK ANALYSIS SCHEDULES

- A. Prepare network analysis diagrams and supporting mathematical analyses using critical path method.
- B. Illustrate order and interdependence of activities and sequence of Work; how start of given activity depends on completion of preceding activities, and how completion of activity may restrain start of subsequent activities.
- C. Illustrate complete sequence of construction by activity, identifying Work of separate stages. Indicate dates for submittals, and return of submittals; dates for procurement and delivery of critical products; and dates for installation and provision for testing. Include legend for symbols and abbreviations used.
- D. Mathematical Analysis: Tabulate each activity of detailed network diagrams using calendar dates, and identify for each activity:
  - 1. Preceding and following event numbers.
  - 2. Activity description.
  - 3. Estimated duration of activity, in maximum 7 day intervals. Status of critical activities.
  - 4. Earliest start date.
  - 5. Earliest finish date.
  - 6. Actual start date.
  - 7. Actual finish date.
  - 8. Latest start date.
  - 9. Latest finish date.
  - 10. Total and free float; accrue float time to Owner and to Owner's benefit.
  - 11. Monetary value of activity, keyed to Schedule of Values.
  - 12. Percentage of activity completed.
  - 13. Responsibility.
- E. Project Scheduling Program: Compatible with the Owner's scheduling software – Primavera or Asta Power Project. Contractor shall furnish the project scheduling program to the Engineer at no cost to the Owner.
- F. Required Sorts: List activities in sorts or groups:
  - 1. By preceding Work item or event number from lowest to highest.
  - 2. By longest float, then in order of early start.
  - 3. By responsibility in order of earliest possible start date.
  - 4. In order of latest allowable start dates.
  - 5. In order of latest allowable finish dates.
  - 6. Contractor's periodic payment request sorted by Schedule of Values list.
  - 7. List of basic input data-generating report.
  - 8. List of activities on critical path.

- G. Prepare subschedules for each stage of Work and Sequencing of Construction identified in Section 01 10 00 - Summary.
- H. Submittals and Schedule of Values shall be loaded into activities in the schedule.

#### 1.6 REVIEW AND EVALUATION

- A. Participate in joint review and evaluation of schedules with Engineer at each submittal.
- B. Evaluate Project status to determine Work behind schedule and Work ahead of schedule.
- C. After review, revise schedules incorporating results of review, and resubmit within 7 days.

#### 1.7 UPDATING SCHEDULES

- A. Maintain schedules to record actual start and finish dates of completed activities.
- B. Indicate progress of each activity to date of revision, with projected completion date of each activity. Update schedules to depict current status of Work.
- C. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.
- D. Upon approval of a Change Order, include the change in the next schedule submittal.
- E. Indicate changes required to maintain Date of Substantial Completion.
- F. Submit sorts as required to support recommended changes.
- G. Prepare narrative report to define problem areas, anticipated delays, and impact on schedule. Report corrective action taken or proposed and its effect.

#### 1.8 DISTRIBUTION

- A. Following joint review, distribute copies of updated schedules to Contractor's Project site file to Subcontractors, suppliers, Engineer, and Owner.
- B. Instruct recipients to promptly report, in writing, problems anticipated by projections shown in schedules.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

## SECTION 01 33 00 - SUBMITTAL PROCEDURES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Definitions.
- B. Submittal procedures.
- C. Product data.
- D. Use of electronic CAD files of Project Drawings.
- E. Shop Drawings.
- F. Samples.
- G. Test reports.
- H. Certificates.
- I. Construction Photographs.
- J. Contractor review.
- K. Engineer review.

#### 1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action.
- B. Informational Submittals: Written and graphic information and physical Samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements.

#### 1.3 SUBMITTAL PROCEDURES

- A. Transmit each submittal with contractor's submittal transmittal form.
- B. Prepare submittal register of all submittals required in these specifications and the following:
  - 1. Certificate of Insurance.
  - 2. Surety bond.
  - 3. List of proposed subcontractors.
  - 4. List of proposed products.
  - 5. Schedule of values.
  - 6. Health and safety plan.

7. Work plan.

- C. Sequentially number transmittal forms. Mark revised submittals with original number and sequential alphabetic suffix.
- D. Identify: Project, Contractor, Subcontractor and supplier, pertinent Drawing and detail number, and Specification Section number appropriate to submittal.
- E. Apply Contractor's stamp, signed or initialed, certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is according to requirements of the Work and Contract Documents.
- F. Schedule submittals to expedite Project, and submit electronic submittals via email as PDF electronic files. Coordinate submission of related items.
- G. For each submittal for review, allow 21 calendar days excluding delivery time to and from Contractor.
- H. Identify variations in Contract Documents and product or system limitations that may be detrimental to successful performance of completed Work.
- I. Allow space on submittals for Contractor and Engineer review stamp.
- J. When revised for resubmission, identify changes made since previous submission.
- K. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.
- L. Submittals not requested will not be recognized nor processed.
- M. Incomplete Submittals: Engineer will not review. Complete submittals for each item are required. Delays resulting from incomplete submittals are not the responsibility of Engineer.

1.4 PRODUCT DATA

- A. Product Data: Action Submittal: Submit to Engineer for review for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Submit electronic submittals via email as PDF electronic files. If hard copies are submitted, submit number of copies Contractor requires, plus two copies Engineer will retain.
- C. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- D. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances
- E. After review, produce copies and distribute according to "Submittal Procedures" Article and for record documents described in Section 01 70 00 - Execution and Closeout Requirements.

## 1.5 ELECTRONIC CAD FILES OF PROJECT DRAWINGS

- A. Electronic CAD Files of Project Drawings: May only be used to expedite production of Shop Drawings for the Project. Use for other Projects or purposes is not allowed.
- B. Electronic CAD Files of Project Drawings: Distributed only under the following conditions:
  - 1. Use of files is solely at Contractor's risk. Engineer does not warrant accuracy of files. Receiving files in electronic form does not relieve receiver of responsibilities for measurements, dimensions, and quantities set forth in Contract Documents. In the event of ambiguity, discrepancy, or conflict between information on electronic media and that in Contract Documents, notify Engineer of discrepancy and use information in hard-copy Drawings and Specifications.
  - 2. CAD files do not necessarily represent the latest Contract Documents, existing conditions, and as-built conditions. Contractor is responsible for determining and complying with these conditions and for incorporating addenda and modifications.
  - 3. Contractor shall not hold Engineer responsible for their use of CAD files including viruses and shall hold Engineer harmless against costs, losses, or damage caused by presence of computer virus in files or media.

## 1.6 SHOP DRAWINGS

- A. Shop Drawings: Action Submittal: Submit to Engineer for assessing conformance with information given and design concept expressed in Contract Documents.
- B. When required by individual Specification Sections, provide Shop Drawings signed and sealed by a professional Engineer responsible for designing components shown on Shop Drawings.
  - 1. Include signed and sealed calculations to support design.
  - 2. Submit Shop Drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.
  - 3. Make revisions and provide additional information when required by authorities having jurisdiction.
- C. Designation of work "by others", if shown on submittals, shall mean that work will be the responsibility of the contractor rather than subcontractor or supplier who has prepared submittals.
- D. Submit electronic submittals via email as PDF electronic files. If hard copies are submitted, submit number of copies Contractor requires, plus two copies Engineer will retain.
- E. Favorable review will not constitute acceptance by the Engineer or Owner of any responsibility for the accuracy, coordination and completeness of the submittals. Accuracy, coordination, and completeness of submittals shall be sole responsibility of the Contractor, including responsibility to backcheck comments, corrections, and modifications from Engineer's review before fabrication.
- F. After review, produce copies and distribute according to "Submittal Procedures" Article and for record documents described in Section 01 70 00 - Execution and Closeout Requirements.

## 1.7 SAMPLES

- A. Samples: Action Submittal: Submit to Engineer for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Samples for Selection as Specified in Product Sections:
  - 1. Submit to Engineer for aesthetic, color, and finish selection.
  - 2. Submit Samples of finishes, textures, and patterns for Engineer selection.
- C. Submit Samples to illustrate functional and aesthetic characteristics of products, with integral parts and attachment devices. Coordinate Sample submittals for interfacing work.
- D. Include identification on each Sample, with full Project information.
- E. Submit number of Samples specified in individual Specification Sections; Engineer will retain one Sample.
- F. After review, produce copies and distribute according to "Submittal Procedures" Article and for record documents described in Section 01 70 00 - Execution and Closeout Requirements.

## 1.8 TEST REPORTS

- A. Informational Submittal: Submit reports for Engineer's knowledge as Contract administrator or for Owner.
- B. Submit test reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

## 1.9 CERTIFICATES

- A. Informational Submittal: Submit certification by manufacturer, installation/application Subcontractor, or Contractor to Engineer, in quantities specified for Product Data.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or product but must be acceptable to Engineer.

## 1.10 CONSTRUCTION PHOTOGRAPHS

- A. Employ professional photographer to take construction record photographs and videos as required to document existing conditions and construction progress.
- B. Submit photographs monthly with application for payment. Photographs shall include aerial photograph showing the entire construction area.
- C. Submit videos with narrative to document the conditions of the storm drain pipes crossing the crane girders before and after the auger pile installation.



### 1.11 CONTRACTOR REVIEW

- A. Review for compliance with Contract Documents and approve submittals before transmitting to Engineer.
- B. Contractor: Responsible for:
  - 1. Determination and verification of materials including manufacturer's catalog numbers.
  - 2. Determination and verification of field measurements and field construction criteria.
  - 3. Checking and coordinating information in submittal with requirements of Work and of Contract Documents.
  - 4. Determination of accuracy and completeness of dimensions and quantities.
  - 5. Confirmation and coordination of dimensions and field conditions at Site.
  - 6. Construction means, techniques, sequences, and procedures.
  - 7. Safety precautions.
  - 8. Coordination and performance of Work of all trades.
- C. Contractor's QC representative shall review and approve each submittal.
- D. Stamp, sign or initial, and date each submittal to certify compliance with requirements of Contract Documents.
- E. Do not fabricate products or begin Work for which submittals are required until approved submittals have been received from Engineer.

### 1.12 ENGINEER REVIEW

- A. Do not make "mass submittals" to Engineer. "Mass submittals" are defined as six or more submittals or items in one day or 15 or more submittals or items in one week. If "mass submittals" are received, Engineer's review time stated above will be extended as necessary to perform proper review. Engineer will review "mass submittals" based on priority determined by Engineer after consultation with Contractor.
- B. Informational submittals and other similar data are for Engineer's information, do not require Engineer's responsive action, and will not be reviewed or returned with comment.
- C. Submittals made by Contractor that are not required by Contract Documents may be returned without action.
- D. After review by the Engineer, submittals will be returned to the Contractor with actions defined as follows:
  - 1. No Correction Noted – Accepted subject to its compatibility with with future submittals for portion of the work not covered in this submittal. Does not constitute approval or deletion of specified or required items not shown on the submittal
  - 2. Make Correction Noted (No resubmission required) – Same as 1. Above, except that minor corrections as noted shall be made by the Contractor.
  - 3. Revise and /Or Resubmit – Rejected because of major inconsistencies or errors which shall be resolved or corrected by the Contractor prior to subsequent review by the Engineer.
  - 4. Rejected (Resubmit) – Submitted material does not conform to Contract Documents in major respect.

- E. Submittal approval does not authorize changes to Contract requirements unless accompanied by Change Order.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

## SECTION 01 40 00 - QUALITY REQUIREMENTS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Quality control.
- B. Quality Control Manager.
- C. Tolerances.
- D. References.
- E. Labeling.
- F. Testing and inspection services.

#### 1.2 QUALITY CONTROL

- A. Monitor quality control over suppliers, manufacturers, products, services, Site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with specified standards as the minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- C. Perform Work using persons qualified to produce required and specified quality.
- D. Products, materials, and equipment may be subject to inspection by Engineer at place of manufacture or fabrication. Such inspections shall not relieve Contractor of complying with requirements of Contract Documents.
- E. Supervise performance of Work in such manner and by such means to ensure that Work, whether completed or in progress, will not be subjected to harmful, dangerous, damaging, or otherwise deleterious exposure during construction period.

#### 1.3 QUALITY CONTROL MANAGER

- A. Contractor shall employ and designate a full time competent Quality Control Manager(s) who shall report directly to the Contractor's Company President and/or his/her designated corporate representative, and shall spend 100% of their time present during all work on site in overseeing safety operations. The Quality Control Manager shall be required to have a minimum of five years experience in administrating safety on construction with similar scope of work.
- B. Submit written documentation of the safety experience of Quality Control Manager(s) and must be favorable reviewed by the Owner prior to the Contractor starting work at the site.

- C. Submit a written letter signed by the Contractor's Company President stating that the Quality Control Manager(s) has the authority to enforce safety plan, plans and specifications, stop work, and corrective measures without reprisal from the Contractor's Company.

#### 1.4 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' recommended tolerances and tolerance requirements in reference standards. When such tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

#### 1.5 REFERENCES

- A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current as of date of contract documents except where specific date is established by code.
- C. Obtain copies of standards and maintain on Site when required by product Specification Sections.
- D. When requirements of indicated reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.
- E. Neither contractual relationships, duties, or responsibilities of parties in Contract nor those of Engineer shall be altered from Contract Documents by mention or inference in reference documents.

#### 1.6 LABELING

- A. Attach label from agency approved by authorities having jurisdiction for products, assemblies, and systems required to be labeled by applicable code.
- B. Label Information: Include manufacturer's or fabricator's identification, approved agency identification, and the following information, as applicable, on each label:
  - 1. Model number.
  - 2. Serial number.
  - 3. Performance characteristics.
- C. Manufacturer's Nameplates, Trademarks, Logos, and Other Identifying Marks on Products: Not allowed on surfaces exposed to view in public areas, interior or exterior.

## 1.7 TESTING AND INSPECTION SERVICES

- A. Owner will employ a firm to perform Construction Engineering and Inspection Services to perform inspection and testing.
- B. All testing and inspection required by the Contractor shall be included in the Contractor's bid price and at no additional cost to the Owner.
- C. Independent firm will perform tests, inspections, and other services specified in individual Specification Sections and as required by Engineer.
  - 1. Laboratory: Authorized to operate in the State of Florida.
  - 2. Laboratory Staff: Maintain full-time Professional Engineer on staff to review services.
  - 3. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to National Bureau of Standards or accepted values of natural physical constants.
- D. Testing, inspections, and source quality control may occur on or off Project Site. Perform off-Site testing as required by Engineer.
- E. Reports shall be submitted by independent firm to Engineer, Contractor, and authorities having jurisdiction, indicating observations and results of tests and compliance or noncompliance with Contract Documents.
  - 1. Submit final report indicating correction of Work previously reported as noncompliant.
- F. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
  - 1. Notify Engineer and independent firm two days before expected time for operations requiring services.
  - 2. Make arrangements with independent firm and pay for additional Samples and tests required for Contractor's use.
- G. Employment of testing agency or laboratory shall not relieve Contractor of obligation to perform Work according to requirements of Contract Documents.
- H. Retesting or re-inspection required because of nonconformance with specified or indicated requirements shall be performed by same independent firm on instructions from Engineer. Payment for retesting or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum/Price.
- I. Testing Agency Responsibilities:
  - 1. Test Samples of mixes submitted by Contractor.
  - 2. Provide qualified personnel at Site. Cooperate with Engineer and Contractor in performance of services.
  - 3. Perform indicated sampling and testing of products according to specified standards.
  - 4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
  - 5. Promptly notify Engineer and Contractor of observed irregularities or nonconformance of Work or products.
  - 6. Perform additional tests required by Engineer.
  - 7. Attend preconstruction meetings and progress meetings.

- J. Testing Agency Reports: After each test, promptly submit one copy of report to Engineer, Contractor, and authorities having jurisdiction. When requested by Engineer, provide interpretation of test results. Include the following:
1. Date issued.
  2. Project title and number.
  3. Name of inspector.
  4. Date and time of sampling or inspection.
  5. Identification of product and Specification Section.
  6. Location in Project.
  7. Type of inspection or test.
  8. Date of test.
  9. Results of tests.
  10. Conformance with Contract Documents.
- K. Limits on Testing Authority:
1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
  2. Agency or laboratory may not approve or accept any portion of the Work.
  3. Agency or laboratory may not assume duties of Contractor.
  4. Agency or laboratory has no authority to stop the Work.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

## SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Temporary Utilities:
  - 1. Temporary electricity.
  - 2. Temporary lighting for construction purposes.
  - 3. Communication services.
  - 4. Temporary water service.
  - 5. Temporary sanitary facilities.
  
- B. Construction Facilities:
  - 1. Field offices and sheds.
  - 2. Vehicular access.
  - 3. Parking.
  - 4. Progress cleaning and waste removal.
  - 5. Project identification.
  - 6. Traffic regulation.
  - 7. Fire-prevention facilities.
  
- C. Temporary Controls:
  - 1. Barriers.
  - 2. Enclosures and fencing.
  - 3. Security.
  - 4. Water control.
  - 5. Dust control.
  - 6. Erosion and sediment control.
  - 7. Noise control.
  - 8. Pollution control.
  
- D. Removal of utilities, facilities, and controls.

#### 1.2 REFERENCES

- A. ASTM International:
  - 1. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 2. ASTM E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
  - 3. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

### 1.3 TEMPORARY ELECTRICITY

- A. Provide and pay for power service as needed for construction operation. Contractor shall maintain all temporary power lines required to perform the Work in a safe and satisfactory manner.

### 1.4 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

- A. Provide and maintain lighting for construction operations. Coordinate with the Owner the required illumination so as not to affect the vessel navigation and terminal equipment operation. Provide and maintain temporary lighting whenever new permanent lighting fixtures are switched over from the existing lighting.

### 1.5 COMMUNICATION SERVICES

- A. Telephone Service: Provide, maintain, and pay for telephone service to field office at time of Project mobilization and until completion of Work.
- B. Facsimile Service: Provide, maintain, and pay for facsimile service including dedicated telephone line to field office at time of Project mobilization and until completion of Work.
- C. Internet Service: Provide, maintain, and pay for broadband Internet service to field at time of Project mobilization.
- D. Contractor shall permit the Engineer, the Owner, and their authorized representatives or employees free and unlimited use of said telephone, facsimile, and internet services. Calls originated by the Engineer, the Owner, and their representatives or employees which involve toll charges shall be billed to Owner at the rates charged by the telephone company.

### 1.6 TEMPORARY WATER SERVICE

- A. Provide and pay for suitable quality water service as needed to maintain specified conditions for construction operations. Provide separate metering and reimburse Owner for cost of water used including permit.
- B. Provide temporary water connection from Owner's designated source to the points of use in accordance with the requirements of the Contract Document. Contractor shall not make connection to, or draw water from, any hydrant or pipeline without first obtaining permission of the authority having jurisdiction over the use of said hydrant or pipeline and from the agency owning the affected water system.
- C. Provide drinking water on site during construction. Notices shall be posted conspicuously throughout the site warning the contractor's personnel that piped water may be contaminated.

### 1.7 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Existing facility use is not permitted. Provide facilities at time of Project mobilization.



- B. Toilet at construction site shall conform to the requirements of Subpart D, Section 1926.51 of the OSHA Standards for Construction
- C. All wastes and refuse from sanitary facilities related to Contractor's operations shall be disposed of away from the site in a manner satisfactory to the Engineer and in accordance with all laws and regulations pertaining thereto.

#### 1.8 FIELD OFFICES AND SHEDS

- A. Field Office: Weather tight, with lighting, electrical outlets, heating, cooling and ventilating equipment, and equipped with sturdy furniture including conference table, drawing rack, filing cabinets, and drawing display table.
- B. Provide space for Project meetings, with table and chairs to accommodate twelve persons.
- C. Provide separate private office, workstation, similarly equipped and furnished, for use of the Engineer.
- D. Locate field offices and sheds at a designated construction staging area shown on the Contract Document. Coordinate with the Engineer for final location.
- E. Environmental Control:
  - 1. Heating, Cooling, and Ventilating for Offices: Automatic equipment to maintain comfort conditions.
- F. Engineer Field Office:
  - 1. Separate space for use by Engineer only, with separate entrance door with new lock and two keys. Same requirements as Field Office.
  - 2. Area: Minimum 500 square feet for a two person staff and one conference room.
  - 3. Communication Services: As specified in this Section.
  - 4. Sanitary Facilities: Convenient access to private lavatory facilities.
  - 5. Drinking Fountain: Convenient access by workers.
  - 6. Engineer Field Office Furnishings:
    - a. Two (2) desks 72x32 inches.
    - b. Two (2) swivel armchairs.
    - c. Two (2) book shelves, 72"x36"x12"
    - d. Two (2) six-foot partitions to accommodate two 12'x12' cubicles.
    - e. Two (2) 8'-0 folding tables.
    - f. Eight (8) folding chairs.
    - g. Four (4) four-drawer file cabinets – legal size.
    - h. Two (2) utilities cabinets, 31"x27"x20"
    - i. Two (2) mobile plan racks
    - j. Two (2) 30" steel cabinet fixed shelves
    - k. One tackboard 36 x 30 inches.
    - l. One wastebasket for each desk and table.
- G. Installation:
  - 1. Install field office spaces ready for occupancy 15 days after date established by Notice to Proceed.

2. Employee Residential Occupancy: Not allowed on Owner's property.

H. Maintenance and Cleaning:

1. Weekly janitorial services for field offices; periodic cleaning and maintenance for sheds and storage areas.
2. Maintain walks free of mud, water, and the like.

I. Removal: At completion of Work remove buildings, foundations, utility services, and debris. Restore areas to same or better condition as original condition.

1.9 VEHICULAR ACCESS

- A. Extend and relocate vehicular access as Work progress requires and provide detours as necessary for unimpeded traffic flow.
- B. Provide and maintain access to fire hydrants and control valves free of obstructions.
- C. Provide means of removing mud from vehicle wheels before entering streets.
- D. Coordinate construction traffic with Owner so as not to impede the terminal traffic.

1.10 PARKING

- A. Arrange for temporary surface parking areas to accommodate construction personnel.
- B. Designate three parking spaces for Engineer and Owner. One space designated for handicapped or as required by regulatory agencies.
- C. Direct personnel to park in designated areas secured by the Contractor.
- D. Maintenance:
  1. Maintain traffic and parking areas in sound condition free of excavated material, construction equipment, products, mud, and the like.
  2. Maintain existing and permanent paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original condition.
- E. Mud from Site vehicles: Provide means of removing mud from vehicle wheels before entering streets.

1.11 PROGRESS CLEANING AND WASTE REMOVAL

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain Site in clean and orderly condition.
- B. Collect and remove waste materials, debris, and rubbish from Site periodically and dispose of off-Site. Comply with Section 01 74 19 - Construction Waste Management and Disposal.

## 1.12 PROJECT IDENTIFICATION

- A. Project Identification Sign:
  - 1. One painted sign, 32-sq ft area, bottom 6 feet above ground.
  - 2. Content:
    - a. Project title, logo, and name of Owner.
    - b. Names and titles of authorities.
    - c. Names and titles of Engineer and Consultants.
    - d. Name of Prime Contractor.
  - 3. Graphic Design, Colors, and Style of Lettering: Designated by the Engineer.
- B. Design sign and structure to withstand 60-mph wind velocity. Submit drawings and calculations to Engineer for approval.
- C. Installation:
  - 1. Install Project identification sign within 15 days after date established by Notice to Proceed.
  - 2. Erect at designated location.
  - 3. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.
  - 4. Install sign surface plumb and level, with butt joints. Anchor securely.
  - 5. Paint exposed surfaces of sign, supports, and framing.
- D. Maintenance: Maintain clean signs and supports; repair deterioration and damage.
- E. Removal: Remove signs, framing, supports, and foundations at completion of Project and restore area.

## 1.13 TRAFFIC REGULATION

- A. Signs, Signals, and Devices:
  - 1. Post-Mounted and Wall-Mounted Traffic Control and Informational Signs, Traffic Cones, Drums, Flares, Barriers, Lights, and Flag Person and Equipment shall be in accordance with the requirements of Broward County and the “Manual of Uniform Traffic Control Devices , Part VI – Traffic Controls for Street and Highway Construction and Maintenance Operations,” published by U.S., Department of Transportation, Federal Highway Administration (ANSI D6.1).
  - 2. Submit Traffic control plan to the Engineer a minimum of two (2) weeks prior to construction. The Owner reserves the right to observe these traffic control plans in use and to make any changes as site conditions warrant. Any changes shall supersede these plans and be done solely at the Contractor’s expense.
- B. Flag Persons: Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes or when operational paths are reduced to one-way traffic.
- C. Flares and Lights: Use flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.
- D. Haul Routes:

1. Coordinate with Owner for a designated haul route to enter and exit the project site.
2. Confine construction traffic to designated haul routes.
3. Provide traffic control at critical areas of haul routes to regulate traffic and to minimize interference with public traffic.

E. Traffic Signs and Signals:

1. Provide signs at approaches to Site and on Site, at crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.
2. Provide, operate, and maintain traffic control signals to direct and maintain orderly flow of traffic in areas under Contractor's control and areas affected by Contractor's operations.
3. Relocate signs and signals as Work progresses, to maintain effective traffic control.

F. Removal:

1. Remove equipment and devices when no longer required.
2. Repair damage caused by installation.
3. Remove post settings to depth of 2 feet.

#### 1.14 FIRE-PREVENTION FACILITIES

- A. Prohibit smoking within buildings under construction and demolition. Designate area on Site where smoking is permitted. Provide approved ashtrays in designated smoking areas.
- B. Establish fire watch for cutting, welding, and other hazardous operations capable of starting fires. Maintain fire watch before, during, and after hazardous operations until threat of fire does not exist.
- C. Portable Fire Extinguishers: NFPA 10; 10-pound capacity, 4A-60B: C UL rating.
  1. Provide minimum of one fire extinguisher in every construction trailer and storage shed.

#### 1.15 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas, to allow for Owner's use of Site, and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Protect non-owned vehicular traffic, stored materials, Site, and structures from damage.

#### 1.16 ENCLOSURES AND FENCING

- A. Construction: Commercial-grade chain-link fence.
- B. Provide 8-foot-high fence around construction Site; equip with vehicular and pedestrian gates with locks.

#### 1.17 SECURITY

- A. Security Program:
  1. Protect work and equipment on existing premises from theft, vandalism, and unauthorized entry.

2. Initiate program in coordination with Owner's existing security system at Project mobilization.
3. Maintain program throughout construction period until Owner occupancy.

B. Entry Control:

1. Restrict entrance of persons and vehicles to Project Site.
2. Allow entrance only to authorized persons with proper identification. The Owner will provide information on ID program and TWIC.
3. Maintain log of workers and visitors and make available to Owner on request.
4. Coordinate access of Owner's personnel to Site in coordination with Owner's security forces.

C. Personnel Identification:

1. Provide identification badge for each person authorized to enter premises.
2. Badge to Include: Personal photograph, name, assigned number, expiration date, and employer.
3. Maintain list of accredited persons and submit copy to Owner on request.
4. Require return of badges at expiration of employment on the Work.

#### 1.18 WATER CONTROL

- A. Grade Site to drain. Maintain excavations free of water. Provide, operate, and maintain necessary pumping equipment to direct drainage to proper run-off.
- B. Protect Site from puddles or running water. Provide water barriers as required to protect Site from soil erosion.
- C. Dispose of drainage water in a manner to prevent flooding, erosion, or other damage to any portion of the site or to adjoining areas.

#### 1.19 DUST CONTROL

- A. Execute Work by methods that minimize raising dust from construction operations.
- B. Provide positive means to prevent airborne dust from dispersing into atmosphere.
- C. Submit Dust Management Plan to the Engineer for approval prior to construction. Dust Management Plan shall comply with all air pollution and environmental control rules, regulations, ordinances and statues which apply to any phase of the project.

#### 1.20 EROSION AND SEDIMENT CONTROL

- A. Plan and execute construction by methods to control surface drainage from cuts and fills from borrow and waste disposal areas. Prevent erosion and sedimentation in accordance with Contractor's approved SWPPP Plan.
- B. Minimize surface area of bare soil exposed at one time.

- C. Provide temporary measures including berms, dikes, drains, and other devices to prevent water flow as shown on Contract Document
- D. Construct fill and waste areas by selective placement to avoid erosive surface silts and clays.
- E. Periodically inspect earthwork to detect evidence of erosion and sedimentation. Promptly apply corrective measures.

#### 1.21 NOISE CONTROL

- A. Provide methods, means, and facilities to minimize noise produced by construction operations.
- B. Where noise level exceeds 80 dBA, provide personnel with personal protective equipment for hearing protection (i.e., ear plugs and/or muffs). Areas where noise levels are routinely expected to exceed 80 dBA, provide a sign "Hearing Protection Required in this Area".
- C. Comply with the applicable OSHA requirements and local ordinance having jurisdiction of the Work.

#### 1.22 POLLUTION CONTROL

- A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances and pollutants produced by construction operations.
- B. Provide equipment and personnel. Perform emergency measures required to contain any spillage, and to remove contaminated soils or liquids
- C. Excavate and dispose of any contaminated earth off-site in accordance with regulatory requirements and replace with suitable compacted fill and topsoil.
- D. Prevent harmful substance from entering public waters. Prevent disposal of wastes, effluents, chemicals, or other such substances adjacent to bays, or in sanitary or storm sewers.
- E. Provide systems for control of atmospheric pollutants
  - 1. Prevent toxic concentrations of chemicals
  - 2. Prevent harmful dispersal of pollutants into the atmosphere

#### 1.23 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, and materials before Substantial Completion inspection.
- B. Remove underground installations to minimum depth of 2 feet. Grade Site as indicated on Drawings.
- C. Clean and repair damage caused by installation or use of temporary Work.
- D. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

## SECTION 01 60 00 - PRODUCT REQUIREMENTS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Products.
- B. Product delivery requirements.
- C. Product storage and handling requirements.
- D. Product options.

#### 1.2 PRODUCTS

- A. At minimum, comply with specified requirements and reference standards.
- B. Specified products define standard of quality, type, function, dimension, appearance, and performance required.
- C. Furnish products of qualified manufacturers that are suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise. Confirm that manufacturer's production capacity can provide sufficient product, on time, to meet Project requirements.

#### 1.3 PRODUCT DELIVERY REQUIREMENTS

- A. Comply with delivery requirements in Section 01 74 19 - Construction Waste Management and Disposal.
- B. Transport and handle products according to manufacturer's instructions.
- C. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
- D. Provide equipment and personnel to handle products; use methods to prevent soiling, disfigurement, or damage.

#### 1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS

- A. Store and protect products according to manufacturer's instructions.
- B. Store products with seals and labels intact and legible.
- C. Store sensitive products in weathertight, climate-controlled enclosures in an environment suitable to product.
- D. For exterior storage of fabricated products, place products on sloped supports aboveground.



- E. Provide off-Site storage and protection when Site does not permit on-Site storage or protection.
- F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- G. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.
- H. Provide equipment and personnel to store products; use methods to prevent soiling, disfigurement, or damage.
- I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

#### 1.5 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Products complying with specified reference standards or description.
- B. Products Specified by Naming One or More Manufacturers: Products of one of manufacturers named and complying with Specifications; no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit Request for Substitution for any manufacturer not named, according to Section 01 25 00 - Substitution Procedures.

#### 1.6 REPAIRS AND REPLACEMENTS

- A. Promptly replace lost or damaged materials and equipment with replacements of like kind and quality or repair them at no additional cost to the Owner.
- B. Repair any damage to any work and premises prior to acceptance by the Owner.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

## SECTION 01 70 00 - EXECUTION AND CLOSEOUT REQUIREMENTS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Field engineering.
- B. Closeout procedures.
- C. Starting of systems.
- D. Demonstration and instructions.
- E. Project record documents.
- F. Operation and maintenance data.
- G. Manual for equipment and systems.
- H. Product warranties and product bonds.
- I. Maintenance service.
- J. Examination.
- K. Cutting and patching.
- L. Protecting installed construction.
- M. Final cleaning.

#### 1.2 FIELD ENGINEERING

- A. Employ land surveyor registered at Project location in State of Florida and acceptable to the Engineer. Submit name and address of Professional Surveyor and Mapper to the Engineer.
- B. Contractor shall locate and protect survey control and reference points. Promptly notify Engineer of discrepancies discovered.
- C. Control datum for survey is established by Owner-provided survey.
- D. Prior to beginning Work, verify and establish elevations of existing site facilities or structures to ensure that new Work will meet existing elevations in smooth and level alignment except where specifically detailed or indicated otherwise.
- E. Verify setbacks and easements; confirm Drawing dimensions and elevations.

- F. Establish elevations, lines and levels, locate and layout, prepare horizontal and vertical control plan for the purpose of construction staking by instrumentation or similar appropriate means
- G. Maintain complete and accurate log of control and survey Work as Work progresses.
- H. On completion of crane girder foundation, crane tie-down, stow socket hardware, and crane rail prepare certified survey illustrating dimensions, locations, angles, and elevations of construction
- I. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to the Engineer.

### 1.3 CLOSEOUT PROCEDURES

- A. Prerequisites to Substantial Completion: Complete following items before requesting Certification of Substantial Completion, either for entire Work or for portions of Work:
  - 1. Submit maintenance manuals, Project record documents, digital images of construction photographs, and other similar final record data in compliance with this Section.
  - 2. Complete facility startup, testing, adjusting, balancing of systems and equipment, demonstrations, and instructions to Owner's operating and maintenance personnel as specified in compliance with this Section.
  - 3. Conduct inspection to establish basis for request that Work is substantially complete. Create comprehensive list (initial punch list) indicating items to be completed or corrected, value of incomplete or nonconforming Work, reason for being incomplete, and date of anticipated completion for each item. Include copy of list with request for Certificate of Substantial Completion.
  - 4. Obtain and submit releases enabling Owner's full, unrestricted use of Project and access to services and utilities. Include certificate of occupancy, operating certificates, and similar releases from authorities having jurisdiction and utility companies.
  - 5. Deliver tools, spare parts, extra stocks of material, and similar physical items to Owner.
  - 6. Make final change-over of locks and transmit keys directly to Owner. Advise Owner's personnel of change-over in security provisions.
  - 7. Discontinue or change over and remove temporary facilities and services from Project Site, along with construction tools, mockups, and similar elements.
  - 8. Perform final cleaning according to this Section.
- B. Substantial Completion Inspection:
  - 1. When Contractor considers Work to be substantially complete, submit to Engineer:
    - a. Written certificate that Work, or designated portion, is substantially complete.
    - b. List of items to be completed or corrected (initial punch list).
  - 2. Within seven days after receipt of request for Substantial Completion, Engineer will make inspection to determine whether Work or designated portion is substantially complete.
  - 3. Should Engineer determine that Work is not substantially complete:
    - a. Engineer will promptly notify Contractor in writing, stating reasons for its opinion.
    - b. Contractor shall remedy deficiencies in Work and send second written request for Substantial Completion to Engineer.
    - c. Engineer will reinspect Work.
    - d. Redo and Inspection of Deficient Work: Repeated until Work passes Engineer's inspection.
  - 4. When Engineer finds that Work is substantially complete, Engineer will:

- a. Prepare Certificate of Substantial Completion on Owner's Closeout Form 007600-1: Certificate of Substantial Completion, accompanied by Contractor's list of items to be completed or corrected as verified and amended by Engineer and Owner (final punch list).
  - b. Submit Certificate to Owner and Contractor for their written acceptance of responsibilities assigned to them in Certificate.
  5. After Work is substantially complete, Contractor shall:
    - a. Allow Owner occupancy of Project under provisions stated in Certificate of Substantial Completion.
    - b. Complete Work listed for completion or correction within time period stipulated.
  - C. Prerequisites for Final Completion: Complete following items before requesting final acceptance and final payment.
    1. When Contractor considers Work to be complete, submit written certification that:
      - a. Contract Documents have been reviewed.
      - b. Work has been examined for compliance with Contract Documents.
      - c. Work has been completed according to Contract Documents.
      - d. Work is completed and ready for final inspection.
    2. Submittals: Submit following:
      - a. Final punch list indicating all items have been completed or corrected.
      - b. Final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
      - c. Specified warranties, workmanship/maintenance bonds, maintenance agreements, and other similar documents.
      - d. Accounting statement for final changes to Contract Sum.
      - e. Contractor payments to subcontractors on Owner's Project Form 007500-9: Certification of Payment to Subcontractors.
      - f. Final payment on Owner's Closeout Form 007600-2: Final Certificate of Payment; Closeout Form 007600-3: Form of Final Receipt; Closeout Form 007600-4: Final List of Non-Certified Subcontractors and Suppliers; and other forms as required by Contract.
    3. Perform final cleaning for Contractor-soiled areas according to this Section.
  - D. Final Completion Inspection:
    1. Within seven days after receipt of request for final inspection, Engineer will make inspection to determine whether Work or designated portion is complete.
    2. Should Engineer consider Work to be incomplete or defective:
      - a. Engineer will promptly notify Contractor in writing, listing incomplete or defective Work.
      - b. Contractor shall remedy stated deficiencies and send second written request to Engineer that Work is complete.
      - c. Engineer will reinspect Work.
      - d. Redo and Inspection of Deficient Work: Repeated until Work passes Engineer's inspection.
- 1.4 STARTING OF SYSTEMS
- A. Coordinate schedule for startup of various equipment and systems.

- B. Notify Engineer seven days prior to startup of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.
- D. Verify that tests, meter readings, and electrical characteristics agree with those required by equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute startup under supervision of manufacturer's representative or Contractors' personnel according to manufacturer's instructions.
- G. When specified in individual Specification Sections, require manufacturer to provide authorized representative who will be present at Site to inspect, check, and approve equipment or system installation prior to startup and will supervise placing equipment or system in operation.
- H. Submit a written report according to Section 01 33 00 - Submittal Procedures that equipment or system has been properly installed and is functioning correctly.

#### 1.5 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of final inspection.
- B. Demonstrate Project equipment and instruct in classroom environment located at project office and instructed by qualified manufacturer's representative who is knowledgeable about the Project.
- C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
- D. Demonstrate startup, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at designated location.
- E. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.
  - 1. Drawings.
  - 2. Specifications.
  - 3. Addenda.
  - 4. Change Orders and other modifications to the Contract.
  - 5. Reviewed Shop Drawings, product data, and Samples.
  - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- F. Ensure entries are complete and accurate, enabling future reference by Owner.
- G. Store record documents separate from documents used for construction.
- H. Record information concurrent with construction progress, not less than weekly.

- I. Specifications: Legibly mark and record, at each product Section, description of actual products installed, including the following:
  - 1. Manufacturer's name and product model and number.
  - 2. Product substitutions or alternates used.
  - 3. Changes made by Addenda and modifications.
  
- J. Record Drawings: Legibly mark each item to record actual construction as follows:
  - 1. Include Contract modifications such as Addenda, supplementary instructions, change directives, field orders, minor changes in the Work, and change orders.
  - 2. Include locations of concealed elements of the Work.
  - 3. Identify depth of buried utility lines and provide dimensions showing distances from permanent facility components that are parallel to utilities.
  - 4. Dimension ends, corners, and junctions of buried utilities to permanent facility components using triangulation.
  - 5. Identify and locate existing buried or concealed items encountered during Project.
  - 6. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
  - 7. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
  - 8. Field changes of dimension and detail.
  - 9. Details not on original Drawings.
  
- K. Submit PDF electronic files of marked-up documents to Engineer before Substantial Completion.

#### 1.6 OPERATION AND MAINTENANCE DATA

- A. Submit in PDF composite electronic indexed file.
- B. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS," title of Project.
- C. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

#### 1.7 MANUAL FOR EQUIPMENT AND SYSTEMS

- A. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Engineer will review draft and return one copy with comments.
- B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.
- C. Submit two sets of revised final volumes within ten days after final inspection.
- D. Submit in PDF composite electronic indexed file of final manual within ten days after final inspection.

- E. Each Item of Equipment and Each System: Include description of unit or system and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.
- F. Operating Procedures: Include startup, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shutdown, and emergency instructions. Include summer, winter, and special operating instructions.
- G. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

## 1.8 PRODUCT WARRANTIES AND PRODUCT BONDS

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

## PART 2 PRODUCTS - Not Used

## PART 3 EXECUTION

### 3.1 CUTTING AND PATCHING

- A. Employ skilled and experienced installers to perform cutting and patching.
- B. Submit written request in advance of cutting or altering elements affecting:
  - 1. Structural integrity of element.
  - 2. Integrity of weather-exposed or moisture-resistant elements.
  - 3. Efficiency, maintenance, or safety of element.
  - 4. Visual qualities of sight-exposed elements.
  - 5. Work of Owner or separate contractor.
- C. Execute cutting, fitting, and patching including excavation and fill to complete Work and to:
  - 1. Fit the several parts together, to integrate with other Work.
  - 2. Uncover Work to install or correct ill-timed Work.

3. Remove and replace defective and nonconforming Work.
  4. Remove samples of installed Work for testing.
  5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.
- D. Execute Work by methods to avoid damage to other Work and to provide proper surfaces to receive patching and finishing.
  - E. Cut masonry and concrete materials using masonry saw or core drill.
  - F. Restore Work with new products according to requirements of Contract Documents.
  - G. Fit Work tight to pipes, sleeves, ducts, conduits, and other penetrations through surfaces.
  - H. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.
  - I. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for assembly, refinish entire unit.
  - J. Identify hazardous substances or conditions exposed during the Work to Engineer for decision or remedy.

### 3.2 PROTECTING INSTALLED CONSTRUCTION

- A. Protect installed Work and provide special protection where specified in individual Specification Sections.
- B. Provide temporary and removable protection for installed products. Control activity in immediate Work area to prevent damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Use durable sheet materials to protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic from landscaped areas.

### 3.3 FINAL CLEANING

- A. Execute final cleaning prior to final Project assessment.
  1. Employ experienced personnel or professional cleaning firm.
- B. Clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains, and foreign substances; polish transparent and glossy surfaces; and vacuum carpeted and soft surfaces.



- C. Clean equipment and fixtures to sanitary condition with appropriate cleaning materials.
- D. Clean filters of operating equipment.
- E. Clean debris from roofs, gutters, downspouts, and drainage systems.
- F. Clean Site; sweep paved areas, rake clean landscaped surfaces.
- G. Remove waste and surplus materials, rubbish, and construction facilities from Site.

END OF SECTION

## SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Construction waste management plan.
  - 2. Construction waste recycling.

#### 1.2 PLAN REQUIREMENTS

- A. Develop and implement construction waste management plan as approved by the Engineer.
- B. Intent:
  - 1. Divert construction, demolition, and land-clearing debris from landfill disposal.
  - 2. Redirect recyclable material back to manufacturing process.
  - 3. Generate cost savings or increase minimal additional cost to Project for waste disposal.

#### 1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures contains requirements for submittals.
- B. Construction Waste Management Plan: Submit construction waste management plan describing methods and procedures for implementation and monitoring compliance including the following:
  - 1. Transportation Company hauling construction waste to waste processing facilities.
  - 2. Recycling and adaptive reuse processing facilities and waste type each facility will accept.
  - 3. Construction waste materials anticipated for recycling and adaptive reuse.
  - 4. On-Site sorting and Site storage methods.
- C. Submit documentation with each application for payment substantiating construction waste management plan was maintained and goals are being achieved.
  - 1. Trash: Quantity by weight deposited in landfills. Include associated fees, transportation costs, container rentals, and taxes for total cost of disposal.
  - 2. Salvaged Material: Quantity by weight with destination for each type of material salvaged for resale, recycling, or adaptive reuse. Include associated fees, transportation costs, container rentals, taxes for total cost of disposal, and reimbursements due to salvage resale.
  - 3. Total Cost: Indicate total cost or savings for implementation of construction waste management plan.

#### 1.4 CONSTRUCTION WASTE MANAGEMENT PLAN

- A. Construction Waste Landfill Diversion: Minimum 50 percent by weight of construction waste materials for duration of Project through resale, recycling, or adaptive reuse.
- B. Implement construction waste management plan at start of construction.

- C. Review construction waste management plan at preconstruction meeting and progress meetings specified in Section 01 30 00 - Administrative Requirements.
- D. Distribute approved construction waste management plan to Subcontractors and others affected by plan requirements.
- E. Oversee plan implementation, instruct construction personnel for plan compliance, and document plan results.

#### 1.5 CONSTRUCTION WASTE RECYCLING

- A. Use source separation method or comingling method suitable to sorting and processing method of selected recycling center. Dispose nonrecyclable trash separately into landfill.
- B. Source Separation Method: Recyclable materials separated from trash and sorted into separate bins or containers, identified by waste type, prior to transportation to recycling center.
- C. Comingling Method: Recyclable materials separated from trash and placed in unsorted bins or container for sorting at recycling center.
- D. Materials suggested for recycling include:
  - 1. Packing materials including paper, cardboard, foam plastic, and sheeting.
  - 2. Recyclable plastics.
  - 3. Earth materials.
  - 4. Native stone and granular fill.
  - 5. Asphalt and concrete paving.
  - 6. Metals.

#### 1.6 CONSTRUCTION WASTE ADAPTIVE REUSE

- A. Arrange with processing facility for salvage of construction material and processing for reuse. Do not reuse construction materials on-Site except as allowed by Engineer.
- B. Materials suggested for adaptive reuse include:
  - 1. Concrete and crushed concrete.

### PART 2 PRODUCTS - Not Used

### PART 3 EXECUTION

#### 3.1 CONSTRUCTION WASTE COLLECTION

- A. Collect construction waste materials in marked bins or containers and arrange for transportation to recycling centers or adaptive salvage and reuse processing facilities.

- B. Maintain recycling and adaptive reuse storage and collection area in orderly arrangement with materials separated to eliminate co-mingling of materials required to be delivered separately to waste processing facility.
- C. Store construction waste materials to prevent environmental pollution, fire hazards, hazards to persons and property, and contamination of stored materials.
- D. Cover construction waste materials subject to disintegration, evaporation, settling, or runoff to prevent polluting air, water, and soil.

### 3.2 CONSTRUCTION WASTE DISPOSAL

- A. Deliver construction waste to waste processing facilities. Obtain receipt for deliveries.
- B. Dispose of construction waste not capable of being recycled or adaptively reused by delivery to landfill, incinerator, or other legal disposal facility. Obtain receipt for deliveries.

END OF SECTION

## SECTION 02 41 19 - SELECTIVE DEMOLITION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. All applicable provisions of the Bidding and Contract Requirements, and Division 1 - General Requirements shall govern the work under this section.

#### 1.2 SUMMARY

- A. This Section includes demolition and removal of the following:
  - 1. Selected site elements.
  - 2. Crane girder footing and crane stops.

#### 1.3 WORK INCLUDED

- A. Provide all labor, materials, necessary equipment and services to complete the site demolition work, as indicated on the drawings, as specified herein or both.

#### 1.4 RELATED WORK

- A. Earthwork.
- B. Site Clearing

#### 1.05 QUALITY ASSURANCE

- A. Contractor Qualifications: Minimum of five years experience in demolition of comparable nature.
- B. Requirements of All Applicable Regulatory Agencies:
  - 1. All applicable Building Codes and other Public Agencies having jurisdiction upon the work.

#### 1.6 SUBMITTALS

- A. Permits and notices authorizing demolition.
- B. Certificates of severance of utility services.
- C. Permit for transport and disposal of debris.
- D. Demolition procedures and operational sequence for review and acceptance by Engineer.

#### 1.7 JOB CONDITIONS

- A. Existing Conditions:

1. The demolition work shall be done as indicated on the construction plans.
2. Remove all demolition debris from the site the same day the work is performed. Leave no deposits of demolished material on site overnight unless approved by the Engineer.
3. Demolition of utility structure, crane girder footing, and crane stop, excavation, backfill and compaction as indicated in drawings.

B. Protection:

1. Erect barriers, fences, guardrails, enclosures, and shoring to protect personnel, structures, and utilities remaining intact.

C. Maintaining Traffic:

1. Ensure minimum interference with terminal lanes, roads, streets, driveways, sidewalks, and adjacent facilities.
2. Do not close or obstruct terminal lanes, streets and sidewalks without written approval from the Engineer.
3. If required by governing authorities, provide alternate routes around closed or obstructed traffic ways.
4. The Contractor shall submit an approved traffic control plan.

D. Dust Control:

1. Use all means necessary for preventing dust from demolition operations from being a nuisance to terminal operations and adjacent property Owners. Methods used for dust control are subject to approval by the Engineer prior to use.

E. Burning:

1. On-site burning will not be permitted.

1.8 GENERAL ITEMS

- A. Scope of work shall comprise the following: Provide all labor, materials, necessary equipment and services to complete the demolition and clearing work, as indicated on the contract plans, and as specified herein.
- B. The Contractor shall provide references to the Owner to demonstrate a minimum of five years experience in demolition of a comparable nature. Current occupational licenses held by Contractor shall be submitted to the Owner.
- C. The Contractor shall be responsible for adherence to all applicable codes of all regulatory agencies having jurisdiction upon the works.

## 1.9 REFERENCE STANDARDS

- A. Code of Federal Regulations
  - 1. 40 CRF 82
- B. National Fire Protection Association
  - 1. NFPA 241 - Standard for Safeguarding.

## 1.10 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or recycled.
- B. Remove and Salvage: Detach items from existing construction and deliver them to the Owner.
- C. Abandon in place: Existing items of construction that are not required to be removed but are required to be cut, grout as filled as indicated on the drawings and capped.
- C. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or recycled.

## 1.11 MATERIALS OWNERSHIP

- A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to the Owner that may be encountered during demolition shall remain on Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to the Owner.

## 1.12 SUBMITTALS (When required by Owner or authorities having jurisdiction)

- A. Qualification Data for the following:
  - 1. Demolition Firm.
  - 2. Test Control Firm.
  - 3. Refrigerant Recovery Technician.
  - 4. Licensed Professional Providing Demolition Oversight.
- B. Pollution Control Measures

1. The Contractor shall prepare and deliver approved pollution and dust control drawings to the Owner prior to the commencement of demolition work. The drawing shall outline proposed methods for dust control, noise control and maintaining the surrounding streets and buildings in a clean condition for both demolition operations and during debris removal. The drawing shall be subject to the review and approval by the Owner and the Owner's Engineer.

C. Demolition Schedule/Plan

1. The Contractor shall submit for review and approval a detailed schedule for all proposed work to the Owner prior to the commencement of demolition work. This submission shall include a calendarized schedule of the proposed work and a step-by-step description of all aspects pertaining to demolition and protection of existing structures and adjacent community, labor forces, demolition rubble management and disposal and other items of work required under this contract.

D. Utility Schedule

1. The Contractor shall submit to the Owner and all affected utility/service companies, a proposed schedule of coordination for all necessary utility/service shut-offs, capping and continuation of utility services as required with the bid package. The Contractor shall provide the Owner with written confirmation for all utility or service companies serving the site that service has been terminated prior to capping, abandoning or removal of any such utility and prior to commencement of building demolition.
2. The Contractor shall, during his work, accurately locate and mark on the contract drawing the location of all underground utility and services that have been capped and those that are to remain within the contract limit area.

E. Permits

1. Prior to submission of bid package, the Contractor shall investigate all permit requirements and include any cost for these requirements in the bid. Prior to the commencement of work, the Contractor shall obtain all necessary permits and certificates associated with utility disconnections, storage tank removals and building demolition work from any and all Federal, State or regulatory authorities having jurisdiction over this project. The Contractor shall incur all fees and other requirements associated with obtaining the required permits and certificates. Copies of all permits executed and certificates obtained shall be sent to the Owner. Costs associated with permit and certificate procurements, including drawing and permit preparation, revisions, filing fees, etc., shall be borne by the Contractor.
2. Including but not limited to, the following permits and certificates may be applicable and shall be obtained by the Contractor prior to applying for and obtaining general demolition permits.



- a. Plumbing permit for water shut-off.
- b. Plumbing permit for sewer seal.
- c. Water shut-off certificate (original).
- d. Building and/or Fire Department permit for underground storage tank removal.
- e. Letters from Electric and Gas Utility companies and gas meter shut-offs.
- f. Letters from Cable TV companies for cable disconnections and removals.
- g. Certificate from Tax Office (taxes paid).
- h. Letter to adjacent Owners of proposed demolition with proof of receipt.
- i. Exterminator Certificate.
- j. Board of Health approval.
- k. Soil Erosion and Sediment Control Permit.
- l. Asbestos Abatement Permit.
- m. Asbestos Abatement Completion.
- n. Demolition Contractor's License.

### 1.13 QUALITY ASSURANCE

#### A. Pre-Demolition Conference

- 1. The Contractor along with all designated subcontractors shall schedule a pre-demolition meeting to be attended by the Owner and other necessary attendees prior to commencement of work.

#### B. Pre-Demolition Video

- 1. The Contractor shall conduct and provide to the Owner a video of site conditions prior to initiation of demolition activities. The video shall provide documentation of the condition of on-site and adjacent building structures and on-site surface features including, but not limited to curbs, sidewalks, landscapes, pavements, utility structures at grade, light poles, telephone poles, fences, bollards, etc.

#### C. Progress Conference

- 1. Once the demolition work has begun, the Contractor shall schedule, administer and attend meetings with the Engineer as deemed necessary by the Engineer to maintain optimum degree of communications between interested parties. The Contractor shall include selected subcontractors at such times as their interests may be involved.

#### 1.14 PROJECT CONDITIONS

- A. The Contractor shall maintain access to terminal lanes, existing walkways, exits, and other adjacent occupied or used facilities. The Contractor shall not close or obstruct terminal lanes, walkways, exits, or other occupied or used facilities without written permission from authorities having jurisdiction.
- B. Owner assumes no responsibility for site elements to be demolished.
  - 1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work, unless otherwise identified in the Contract Documents.
  - 1. If materials suspected of containing hazardous materials are encountered, other than those identified in the Contract Documents, do not disturb; immediately notify the Owner.

#### 1.15 COORDINATION

- A. Arrange demolition schedule so as not to interfere with the Owner's operations.

### PART 2 - PRODUCTS

- 2.01 The Contractor shall supply all materials as required.

### PART 3 - EXECUTION

#### 3.01 CLARIFICATION

- A. The drawings do not purport to show all objects existing on the site; at the pre-demolition or preconstruction meeting before commencement of the work, verify with the Owner all objects to be removed and all objects to be preserved.
- B. Before commencing the work of this Section, verify with the Owner all objects to be removed and all objects to be preserved. Notify the Engineer two weeks in advance of items to be removed the terminal that impact the Owner's operations.

#### 3.02 SCHEDULING

- A. Schedule all work in a careful manner with all necessary consideration for the public and the Owner.
- B. Avoid interference with the use of, and passage to and from, adjacent facilities.

#### 3.03 EXAMINATION

- A. Survey existing conditions and correlate with requirements indicated to determine extent of demolition required.

- B. Review project record documents of existing construction. Owner does not guarantee that existing conditions are same as those indicated in project record documents.
- C. Inventory and record the condition of items to be removed and salvaged.
- D. Do not commence work until all conditions and requirements of all applicable public agencies are complied with.

#### 3.04 PROTECTION

- A. Existing Facilities: Protect adjacent walkways, building entries, and other building facilities during demolition operations.
- B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during demolition. When permitted by the Owner items may be removed to a suitable, protected storage location during demolition and reinstalled in their original locations after demolition operations are complete.
- C. Existing Utilities: Maintain utility services indicated to remain and protect them against damage during demolition operations.
  - 1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by the Owner and authorities having jurisdiction.
  - 2. Provide temporary services during interruptions to existing utilities, as acceptable to the Owner and to authorities having jurisdiction.
    - a. Provide at least 72 hours notice to Owner if shutdown of service is required during changeover.
- D. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Temporary Controls.
  - 1. Protect existing site improvements, appurtenances, and landscaping to remain;
  - 2. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain; and
  - 3. Provide protection to ensure safe passage of people around demolition area and to and from occupied portions of adjacent buildings and structures.

#### 3.05 DISCONNECTION OF UTILITIES

- A. Before starting site operations, disconnect or arrange for the disconnection of all effected utility service:

1. Arrange and pay for disconnecting, removing, capping, and plugging utility services and meters. Disconnect and stub off. Notify affected utility company in advance and obtain approval before starting this work.
2. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction.
3. Place markers to indicate location of disconnected services.
4. Coordinate with the Engineer, Owner, and Owner's tenants for disconnection of crane power.

### 3.06 PROTECTION OF EXISTING STRUCTURES AND UTILITIES

- A. Utility Services: Maintain existing utilities including crane power, keep in service, and protect against damage during demolition operations.
- B. Prevent movement or settlement of adjacent structures. Provide and place bracing or shoring and be responsible for safety and support of structures. Assume liability for such movement, settlement, damage, or injury.
- C. Cease operations and notify Owner immediately if safety of adjacent structures appears to be endangered. Take precautions to properly support structures. Do not resume operations until safety is restored.
- D. Prevent movement, settlement, damage, or collapse of adjacent services. Assume liability for such movement, settlement, or collapse. Promptly repair damage at no cost to the Owner.
- E. Prevent damage of existing crane girder, crane wharf hardware, and duct bank. Assume liability for such damage. Promptly repair damage at no cost to the Owner.
- E. Ensure safe passage of persons around areas of demolition.

### 3.07 POLLUTION CONTROLS

- A. Clean structures and improvements of dust, dirt, and debris caused by demolition operations as directed by the Owner or his representative or governing authorities. Return adjacent areas to condition existing prior to start of work.

### 3.08 DEMOLITION

- A. General: Demolish as indicated on drawings as specifically identified on construction drawings including existing crane girders, existing crane stops, existing utility structures, and site improvements completely.
- B. Site Access and Temporary Controls: Conduct demolition and debris-removal operations to ensure minimum interference with terminal lanes, roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Do not close or obstruct terminal lanes streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
  2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
- C. Pull out any existing utility lines designated for abandonment, irrigation, electrical lines, pull boxes and splice boxes, maintenance access structures and catch basins to be removed and all other objects designated to be removed or interfering with the work in advance of mobilization. Contact the utility company or agency involved for their requirements for performing this work in advance of construction. All removed equipment and materials shall be removed from the work area the same day as removed.

### 3.09 SITE RESTORATION

- A. Below-Grade Areas: Rough grade below-grade areas ready for further excavation or new construction.
- B. Below-Grade Areas: Completely fill below-grade areas and voids resulting from demolition operations with satisfactory soil materials according to backfill requirements in Division 2 Section 31 20 00 - Earthwork.
- C. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

### 3.10 REPAIRS

- A. General: Promptly repair damage to adjacent construction caused by demolition operations.
- B. Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
- C. Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

### 3.11 DISPOSAL OF DEMOLISHED MATERIALS

- A. General

1. The Contractor shall remove from the site all debris, rubbish and other materials resulting from demolition and shall safely and legally dispose of all these items in accordance with applicable Federal, State and regulatory authority having jurisdiction codes and regulations. All recycling must be done in accordance with all currently applicable State waste flow regulations, and regulatory authority having jurisdiction requirements. Burning of any demolished materials on-site shall not be permitted. Any recycling of demolition debris shall be approved by the Owner.
2. Material resulting from demolition and not scheduled for salvaging shall become the property of the Contractor and shall be removed from site and legally disposed of off-site. Disposal shall be timely, performed as promptly as possible and not left until the final cleanup. Material shall not be left on the job site for more than 60 days.

B. Submittals

1. Written permission shall be obtained from the property Owner on whose property the demolition material is to be disposed. Copies of the agreements shall be furnished to the Owner prior to removing any materials from the demolition site.

3.12 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing before building demolition operations began.

3.13 COMPLETION OF WORK

- A. Leave the site in a neat, orderly condition to the full acceptance of the Owner.
- B. Dirt remaining after demolition shall be graded level and compacted, in preparation for filling operations to follow demolition. Trenches shall be filled in layers of 12" maximum thickness and compacted in accordance with the technical specifications applicable to backfilling of trenches.

END OF SECTION

## SECTION 03 10 00 - CONCRETE FORMING AND ACCESSORIES

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Formwork for cast-in-place concrete.
  - 2. Form accessories.
  - 3. Form stripping.
- B. Related Requirements:
  - 1. Section 03 20 00 - Concrete Reinforcing.
  - 2. Section 03 30 00 - Cast-in-Place Concrete.

#### 1.2 REFERENCE STANDARDS

- A. American Concrete Institute:
  - 1. ACI 117 - Specification for Tolerances for Concrete Construction and Materials.
  - 2. ACI 301 - Specifications for Structural Concrete.
  - 3. ACI 318 - Building Code Requirements for Structural Concrete.
  - 4. ACI 347 - Guide to Formwork for Concrete.
- B. American Forest & Paper Association:
  - 1. AF&PA - National Design Specification (NDS) for Wood Construction.
- C. ASTM International:
  - 1. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

#### 1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate Work of this Section with other Sections of Work in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.

#### 1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures.
- B. Shop Drawings:
  - 1. Indicate:
    - a. Formwork, shoring, and reshoring.
    - b. Pertinent dimensions, openings, methods of construction, types of connections, materials, joint arrangement and details, ties and shores, location of framing, studding and bracing, and temporary supports.

- c. Sequence and timing of erection and stripping, assumed compressive strength at time of stripping, height of lift, and height of drop during placement.
- d. Notes to formwork erector showing size and location of conduits and piping embedded in concrete according to ACI 318.

## 1.5 QUALITY ASSURANCE

- A. Perform Work according to ACI 347
- B. For wood products furnished for Work of this Section, comply with AF&PA.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements.
- B. Store materials off ground in ventilated and protected manner to prevent deterioration from moisture.

## PART 2 PRODUCTS

### 2.1 PREFABRICATED FORMS

- A. Preformed Steel Forms:
  - 1. Description: Matched, tightly fitted, and stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- B. FRP Forms: Matched, tightly fitted, and stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.
- C. Steel Forms:
  - 1. Description: Sheet steel, suitably reinforced.
  - 2. Design: For particular use as indicated on Drawings.
- D. Form Liners: Smooth, durable, grainless, and non-staining hardboard unless otherwise indicated on Drawings.

### 2.2 FORMWORK ACCESSORIES

- A. Form Ties:
  - 1. Type: Removable.
  - 2. Material: Galvanized.
  - 3. Length: Adjustable.
- B. Spreaders:
  - 1. Description: Standard, non-corrosive metal-form clamp assembly, of type acting as spreaders and leaving no metal within 1 inch of concrete face.
  - 2. Wire ties, wood spreaders, or through bolts are not permitted.



- C. Form Release Agent:
  - 1. Description: Colorless mineral oil that will not stain concrete or absorb moisture or impair natural bonding or color characteristics of coating intended for use on concrete.
  
- D. Corners:
  - 1. Type: Fillet Chamfer, rigid plastic wood strip.
  - 2. Size:  $\frac{3}{4}$ " by  $\frac{3}{4}$ " inches, unless otherwise noted.
  - 3. Lengths: Maximum possible.
  
- E. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Size, strength, and character to maintain formwork in place while placing concrete.

### PART 3 EXECUTION

#### 3.1 FORMWORK

- A. The Contractor shall be responsible for the design, construction, installation, and removal of formwork.
  
- B. Formwork shall meet the applicable requirements of ACI 347, including those for loads, stresses and deflection limits.
  
- C. Formwork shall be designed so that concrete surfaces conform to the tolerances of ACI 347, unless indicated otherwise. In particular, the following tolerances shall apply to the crane rail girders:
  - 1. Surface of concrete (top):  $+1/2$ " and not more than  $+1/4$ " in 10 feet,  $-0$ "  
Straightness:  $1/4$ " deviation from crane rail centerline in 10 feet.  
Distance from crane rail centerline:  $\pm 1/4$ "
  - 2. Provision shall be made for securing expansion joint material firmly and without damage during concrete placement
  - 3. Exposed concrete corners shall have a 3/4-inch chamfer unless otherwise specifically shown on the Plans
  
- D. Construction of formwork shall be in accordance with the following:
  - 1. Forms shall result in a final structure that is free from cavities and honeycombing and conforms to shapes, lines, and dimensions of the members as required by the Plans and Specifications. Exposed concrete surfaces shall be free from protrusions, fins, roughness and other imperfections. Forms shall be strong, flat and rigid and be set true to line and level. They shall be fixed firmly in place and shall resist, without movement, the weight and pressures of wet concrete, and all loads incidental to its placement.
  - 2. Form accessories to be partially or wholly embedded in the concrete, such as ties and anchors, shall be "Superior", "Burke," or approved equal, plastic-coated or plastic. Wire is not acceptable, nor are ties that remain exposed, or could cause rusting or spalling of concrete. The anchors shall not be left in place, but shall be carefully removed and the holes neatly filled with the specified dry-pack mortar.

3. All concrete embedments and penetrating items requiring attachment to forms shall be accurately located and rigidly secured so that they will not become displaced during concrete placement.
4. Form joints shall be sufficiently tight to prevent leakage of grout or cement paste.
5. Forms shall be properly braced or tied together to maintain position and shape.
6. Plywood and other wood surfaces subject to shrinkage shall be sealed against absorption of moisture from the concrete by either (1) a form oil such as "Formfilm," manufactured by A. C. Horn or approved equal; or (2) a factory applied non-absorbent liner.
7. When forms are coated to prevent bond with concrete, coating shall be applied prior to placing of the reinforcing steel. Coating material shall not be allowed on concrete against which fresh concrete will be placed.
8. Before placing concrete, the forms shall be thoroughly cleaned of all foreign material. Before placing concrete, all reinforcement shall be checked by the Contractor to insure that each bar is accurately set and anchored against movement such that specified clearances will exist in the finished concrete.
9. The Contractor shall notify the Engineer in writing at least 24 hours in advance for each successive placement of concrete that the forms are ready to be inspected by the Engineer. No concrete shall be placed until the Engineer has given written approval to begin placing.

### 3.2 FORM REMOVAL

- A. All forms shall be removed when possible. Removal shall be in accordance with the following:
  1. Formwork for sides of slabs, beams and other parts not supporting the weight of the concrete may be removed as soon as the concrete has hardened sufficiently to resist damage from removal operations, particularly when form ties will be bent by the removal operations.
  2. Soffit forms shall remain in place until the concrete has attained a minimum age of two weeks and strength of at least 2,500 psi. This strength shall be determined by the Contractor from cylinder tests, which shall be submitted to the Engineer for review.
  3. Whenever the formwork is removed during the curing period, the exposed concrete shall be cured by one of the methods specified under "Curing and Protection" in this Section. No concrete shall remain exposed and unprotected for more than two hours during the curing period.
  4. All form surfaces shall be cleaned before reuse

### 3.3 FIELD QUALITY CONTROL

- A. Inspection:
  1. Inspect erected formwork and bracing to ensure that Work complies with formwork design and that supports, fastenings, wedges, ties, and items are secure.
  2. Notify Engineer after placement of reinforcing steel in forms but prior to placing concrete.
  3. Schedule concrete placement to permit formwork inspection before placing concrete.

END OF SECTION

## SECTION 03 20 00 - CONCRETE REINFORCING

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Reinforcing bars.
  - 2. Welded wire fabric.
  - 3. Reinforcement accessories.
  
- B. Related Requirements:
  - 1. Section 03 10 00 - Concrete Forming and Accessories.
  - 2. Section 03 30 00 - Cast-in-Place Concrete.
  - 3. Section 03 35 00 - Concrete Finishing.
  - 4. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

#### 1.2 REFERENCE STANDARDS

- A. American Concrete Institute:
  - 1. ACI 301 - Specifications for Structural Concrete.
  - 2. ACI 318 - Building Code Requirements for Structural Concrete.
  - 3. ACI 530/530.1 - Building Code Requirements and Specification for Masonry Structures.
  - 4. ACI SP-66 - ACI Detailing Manual.
  
- B. American Welding Society:
  - 1. AWS D1.4 - Structural Welding Code - Reinforcing Steel.
  
- C. ASTM International:
  - 1. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
  - 2. ASTM A706 - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
  - 3. ASTM A767 - Standard Specification for Zinc-Coated Galvanized Steel Bars for Concrete Reinforcement.
  - 4. ASTM A775 - Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
  - 5. ASTM A970 Standard Specification for Headed Steel Bars for Concrete Reinforcement
  - 6. ASTM A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
  
- D. Concrete Reinforcing Steel Institute:
  - 1. CRSI 10-MSP - Manual of Standard Practice.
  - 2. CRSI 10PLACE - Placing Reinforcing Bars.

1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements.
- B. Coordinate Work of this Section with placement of formwork, formed openings, and other Work.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures.
- B. Shop Drawings:
  - 1. Indicate bar sizes, spacings, locations, splice locations, and quantities of reinforcing steel.
  - 2. Indicate bending and cutting schedules.
  - 3. Indicate supporting and spacing devices.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Submit certified copies of mill test report of reinforcement materials analysis.
- E. Welder Certificates: Certify welders and welding procedures employed on Work, verifying AWS qualification within previous 12 months.

1.5 QUALITY ASSURANCE

- A. Perform Work according to ACI 318.
- B. Prepare Shop Drawings according to ACI SP-66.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements.
- B. Inspection: Accept materials on Site in fabricator's original delivery and inspect for damage.
- C. Protection:
  - 1. Protect materials from moisture by storing in clean, dry location remote from construction operations areas.
  - 2. Provide additional protection according to manufacturer instructions.

1.7 EXISTING CONDITIONS

- A. Field Measurements:
  - 1. Verify field measurements prior to fabrication.
  - 2. Indicate field measurements on Shop Drawings.

## PART 2 PRODUCTS

### 2.1 REINFORCEMENT

- A. Reinforcing Steel:
  - 1. Comply with ASTM A615.
  - 2. Yield Strength: 60 ksi.
  - 3. Billet Bars: Deformed.
  - 4. Finish: Uncoated unless otherwise noted on drawings.
  
- B. Reinforcing Steel to be welded:
  - 1. Comply with ASTM A706.
  - 2. Yield Strength: 60 ksi.
  - 3. Billet Bars: Deformed.
  - 4. Finish: Uncoated unless otherwise noted on drawings.
  
- C. Welded Plain Wire Fabric:
  - 1. Comply with ASTM A1064.
  - 2. Configuration: Flat sheets.
  - 3. Finish: Galvanized.

### 2.2 FABRICATION

- A. Fabricate concrete reinforcement according to CRSI 10 – MSP and ACI 318.
  
- B. Form standard hooks for 180-degree bends, 90-degree bends, stirrups and tie hooks, and seismic hooks as indicated on Drawings.
  
- C. Fabricate column reinforcement with offset bends at reinforcement splices.
  
- D. Reinforcing bars to be welded shall conform to ASTM A706, Gr. 60.
  
- E. Welding electrodes for reinforcing bars shall be in accordance with ANSI/AWS D1.4.
  
- F. The fabrication, material, testing, physical characteristics, inspection and marking of Headed Bar Reinforcement shall conform to ASTM A970.
  
- G. Splicing:
  - 1. If not indicated on Drawings, locate reinforcement splices at point of minimum stress.

### 2.3 SHOP FINISHING

- A. Epoxy-Coated Finish for Steel Bars: Comply with ASTM A775.
  
- B. Epoxy-Coated Finish for Steel Wire: Comply with ASTM A884, Class A.

## 2.4 ACCESSORY MATERIALS

- A. Tie Wire:
  - 1. Minimum 16 gage, annealed type. Tie wire that will be in contact with epoxy-coated bars shall be plastic-covered.
- B. Chairs, Bolsters, Bar Supports, and Spacers:
  - 1. Size and Shape: To strengthen and support reinforcement during concrete placement conditions.
- C. Special Chairs, Bolsters, Bar Supports, and Spacers Adjacent to Weather-Exposed Concrete Surfaces:
  - 1. Material: Plastic-coated, plastic, dobies. Plastic coating shall not be less than 3/32" thick.
  - 2. Size and Shape: To meet Project conditions.
  - 3. If dobies are used, contractor shall demonstrate they are of the same quality (strength, density and durability) as pour concrete. Dobies shall have no embedded wire.
- D. Reinforcing Splicing Devices:
  - 1. Type: Mechanical set screw or threaded; full tension and compression.
  - 2. Size: To fit joined reinforcing.
  - 3. Bar Splice Products, Inc., Erico/Lenton, Bar-Lock or approved Equal. Couple shall be capable of developing 125 percent of the yield strength of the bar.
- E. Epoxy Coating Patching Material: Type as recommended by coating manufacturer.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. All reinforcing shall be free from rust, scale or any coating that may reduce the bond strength.
- B. Place, support, and secure reinforcement against displacement.
- C. Do not deviate from required position beyond specified tolerance.
- D. Accommodate placement of formed openings.
- E. Spacing:
  - 1. Space reinforcement bars with minimum clear spacing according to ACI 318 equal to one bar diameter but not less than 1 inch.
  - 2. If bars are indicated in multiple layers, place upper bars directly above lower bars as shown on drawings.

- F. Reinforcing steel located above earth may rest upon precast concrete block (“dobies”) which are of a thickness that will provide the required cover, and of concrete strength and density equal to that of the concrete being cast. Ends of wire shall be pointed toward center of pour. End of tie wire shall not be located in the clear area between the reinforcing steel and the outside of the concrete. All loose pieces of the tie wire shall be removed from form work.
- G. Whatever conduits, piping, sleeves, bolts, hangers, boxes or other embedded items interfere with the proper placement of reinforcing steel, as detailed, the contractor shall submit to the Engineer his proposed reinforcement adjustment and obtain the Engineer’s approval at least 48 hours prior to concrete placement. Bars shall not be bent around openings or sleeves, except where shown on drawings.
- H. No welding of reinforcing steel to embedded items shall be performed without the Engineer's prior approval.
- I. Bond and ground reinforcement as specified in Section 26 05 26 - Grounding and Bonding for Electrical Systems.

### 3.2 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements.
- B. Field inspection and testing will be performed by Owner's testing laboratory according to ACI 318.
- C. Provide unrestricted access to Work and cooperate with appointed inspection and testing firm.
- D. Reinforcement Inspection:
  - 1. Placement Acceptance: Inspect specified material requirements and specified placement tolerances.
  - 2. Welding: Inspect welds according to AWS D1.1.
  - 3. Periodic Placement Inspection: Inspect for correct materials, fabrication, sizes, locations, spacing, concrete cover, and splicing.
  - 4. Weldability Inspection: Inspect for reinforcement weldability if formed from steel other than ASTM A706.

END OF SECTION



## SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes Cast-in-Place Concrete for Following Items:
  - 1. Rail Girder Foundation.
  - 2. Switchgear Building.
  - 3. Control, expansion, and contraction joint devices.
- B. Related Requirements:
  - 1. Section 03 10 00 - Concrete Forming and Accessories.
  - 2. Section 03 20 00 - Concrete Reinforcing.

#### 1.2 REFERENCE STANDARDS

- A. American Concrete Institute:
  - 1. ACI 301 - Specifications for Structural Concrete.
  - 2. ACI 308.1 - Specification for Curing Concrete.
  - 3. ACI 318 - Building Code Requirements for Structural Concrete.
- B. U.S. Army Corps of Engineers' Specifications
- C. ASTM International:
  - 1. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
  - 2. ASTM C33 - Standard Specification for Concrete Aggregates.
  - 3. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
  - 4. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
  - 5. ASTM C150 - Standard Specification for Portland Cement.
  - 6. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
  - 7. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
  - 8. ASTM D994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).

#### 1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures.
- B. Cement: certificate for each delivery.
- C. Design Data:
  - 1. Submit concrete mix design for each concrete strength.
  - 2. Identify mix ingredients and proportions, including admixtures.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of embedded utilities and components concealed from view in finished construction. This shall provide for the checking of formwork, reinforcement, and embedded items, concrete quantity, date and time of placement, weather, signature of contractor's and Engineer's representative, and any other items necessary to provide a complete record.

#### 1.5 QUALITY ASSURANCE

- A. Perform Work according to ACI 301.
- B. Comply with ACI 305R when pouring concrete during hot weather.
- C. Acquire cement and aggregate from one source for Work.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

- A. Concrete:
  - 1. Cement shall be Portland cement comply with ASTM C150, Type II – Modified.
  - 2. Normal Weight Aggregates shall comply with ASTM C33. Coarse Aggregate Maximum Size is 1-1/2 inches.
  - 3. Fine aggregates shall comply with ASTM C33. It shall be clean, washed natural sand or crushed rock. It shall be uniformly graded between the No. 4 and No. 200 sizes, with at least 95 percent passing the No. 4 sieve, and not more than 5 percent passing the No. 200.
  - 4. Portable water shall comply with ACI 318 without deleterious amounts of chloride ions.
  - 5. Air Entrainment shall comply with ASTM C260.
  - 6. Water Reducing admixture shall comply with ASTM C494 Type A or D.
  - 7. No calcium choride or admixtures containing chlorides shall be used.
  - 8. Fly Ash or Calcined Pozzolan: Comply with ASTM C618, Class F or N. Fly ash shall have a maximum loss of ignition of 1 percent , a maximum SO<sub>2</sub> content of 3 percent by weight, and a maximum water requirement of 100 percent.
- B. Joint Devices and Filler:
  - 1. Joint Filler, Premolded sponge rubber comply with ASTM D1752, or as designated on drawings.

#### 2.2 CONCRETE MIX

- A. Select proportions for normal weight concrete according to ACI 301, Method 1.

B. Concrete shall be designed, proportioned and mixed in accordance with ASTM C94, and as follows:

1. Prior to starting work, a design of each proposed concrete mix shall be submitted, accompanied by three 7-day and three 28-day test reports made by an approved testing laboratory. The design shall indicate the brand of cement, type and source of aggregate, pozzolan, admixtures if used, the water-cement ratio, and the weights of all ingredients per cubic yard. The minimum cement/pozzolan content shall be 564 pounds per cubic yard, and the maximum water-cement ratio shall vary with respect to maximum aggregate size as follows:

<u>Maximum Coarse Aggregate Size</u>	<u>W/C Ratio</u>
1-1/2 inch	0.400
1 inch	0.385
¾ inch	0.375

2. The Contractor shall obtain the Engineer's prior approval for the use of the admixtures. These shall conform to ASTM C 260 or ASTM C 494, for air entraining agent and water reducing agent respectively.
3. Concrete materials shall be accurately measured and proportioned by approved weighing and measuring equipment. Pozzolan shall be batched separately from cement, and positive means, such as interlocks, shall be instituted to prevent the confusion of cement and pozzolan. The water/cement ratio shall be accurately controlled.
4. Concrete shall be mixed in a power batch mixer equipped with automatic devices for timing the mixing operations. The materials for each batch of concrete shall be accurately and separately weighed and placed in the mixer. The water shall be measured and combined with the batch and the whole mixture shall be mixed not less than one and one-half minutes for mixers of one cubic yard capacity or less. The mixing time shall be increased 15 seconds for each additional cubic yard or fraction thereof. The mixer shall rotate at a peripheral speed of about 200 feet per minute. Over-loading of mixers, or excessive over-mixing of batches, will not be permitted.
5. Concrete Slump: The maximum slump shall be four (4) inches. If a high range water reducer is used to increase slump, the Contractor shall demonstrate that the maximum water-cement ratio is not exceeded.

C. Concrete weight at the time of strength tests shall not be less than 145 pcf. Unless otherwise shown, all concrete shall have a minimum compressive strength of 5,000 psi at 28 days, as defined by ASTM C 39. Pozzolan or fly ash shall be used to replace 15 percent of the total cement that would otherwise be used. For example, for a combined cement/pozzolan content of 564 pounds per cubic yard of concrete (see Paragraph A.3.) the weight of each shall be: Cement 480 pounds; Pozzolan or fly ash 84 pounds. Batch cement and fly ash separately.

D. The concrete supply source and materials shall receive the prior approval of the Engineer, and shall not be changed without the prior agreement of the Engineer.

## 2.3 ACCESSORIES

- A. Epoxy bonding Agent shall be a two-component formulation conforming to ASTM C881, type II, such as Concrese Liquid LPL or approved equal.
- B. Non-shrink Grout shall be cement-based, suitable for use in a salt water attack area and conforming to the Corps of Engineers specification CRD-C621. It shall have an initial setting time of not less than 60 minutes.
- C. Dry-pack mortar shall comprise one part cement and two and one-half (2-1/2) parts fine aggregate by volume, with just sufficient water to produce a stiff consistency that can be placed without sagging.
- D. Hardboard shall conform to Federal Specification LLL-B-810, Type II, smooth one side, plain. Hardboard shall be 1/8-inch minimum thickness, unless shown or specified otherwise. All boards shall be held in place by nails, waterproof adhesive, or other means approved by the Engineer.
- E. Expanded polystyrene shall be a commercially available polystyrene board. Expanded polystyrene shall have a flexural strength of 35 pounds per square inch, minimum, determined in accordance with ASTM C 203, and a compressive yield strength of between 16 and 40 pounds per square inch, at five percent compression. All boards shall be held in place by nails, waterproof adhesive, or other means approved by the Engineer.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements.
- B. Verify requirements for concrete cover over reinforcement.
- C. Verify that anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

### 3.2 EMBEDDED ITEMS

- A. Miscellaneous and other embedded items are specified in Division 5, Section 05 50 00, Metal Fabrications.
- B. Items to be embedded in concrete shall be installed prior to concrete placement. The Contractor shall notify the Engineer at least 24 hours in advance of concrete placement when all items are in place, ready for his inspection.

- C. Embedded items shall be positioned accurately and rigidly secured against movement during concrete placement. Tolerances shall be + 1/2 inch in location and + 1/4 inch in depth from face of concrete, unless a more stringent tolerance is established elsewhere in these Specifications or Plans. Voids in sleeves, inserts and anchor slots, and ends of pipes and conduits shall be filled temporarily with readily removable material to prevent the entry of concrete.
- D. Anchor bolts shall be assembled in templates accurately formed to the steel fabricator's or equipment supplier's dimensions. Bolt assemblies shall be set true to line and elevation, encased in sleeves where shown on the Plans, and secured rigidly to prevent their movement during concrete placement.

### 3.3 PLACING CONCRETE

- A. Placing shall conform to ACI 304.
- B. The Contractor shall schedule concrete placement to be continuous between construction joints. Sandblast all construction joints, while concrete is fresh, to clean and roughen the surface of the joint, exposing clean coarse aggregate solidly embedded in mortar matrix. High-pressure water wash is not acceptable. Clean forms and reinforcing by means of compressed air.
- C. Bonding to new concrete at horizontal construction joints: after preparing the surface, thoroughly clean and saturate with water, remove all standing and ponded water and immediately place concrete. New concrete is defined as less than 60 days old.
- D. Prior to girder concrete placement, the tops of piles, shall be roughened and then cleaned as described in Paragraph B, above.
- E. Once concrete placement has started, every effort shall be made to carry it on as an uninterrupted operation until the scheduled placement has been completed.
- F. Do not over vibrate the concrete.
- G. Where concrete is placed on grade, it shall be placed only on firm, undisturbed ground or engineered fill. Concrete shall not be placed in standing water.

### 3.4 HOT AND COLD WEATHER CONCRETING

- A. During hot weather, the Contractor shall implement the requirements of ACI 305R. During cold weather, the requirements of ACI 306R shall be implemented.
- B. Hot weather is when a combination of high ambient temperature, high concrete temperature, low relative humidity, high wind velocity, and high solar radiation impair the quality of freshly mixed or hardened concrete by accelerating the rate of moisture loss and rate of cement hydration or other means.

- C. Cold weather is defined as a period, when for more than 3 days the average air temperature is 40 F or less and the temperature is not greater than 50 F for more than one half of any 24 hour period.

### 3.5 STRENGTH TEST

- A. Concrete will be sampled and tested by the Engineer in accordance with ASTM C39 to determine compressive strength. Samples will be taken as frequently as specified in ACI 318, and more frequently if required by the Engineer. The age of strength tests for acceptance shall be 28 days. Minimum strength for acceptance of the concrete will be as set forth in ACI 318.
- B. The Contractor may choose to pay for additional tests at earlier ages to obtain advance information on the adequacy of strength development and to determine when forms may be removed.
- C. If strength tests fail to meet the minimum requirements, the concrete represented by such tests will be considered questionable, and will be subjected to additional testing as follows:
  - 1. Core samples of the questionable concrete will be taken and tested for compressive strength in accordance with ASTM C 42.
  - 2. If either of the following conditions apply, load tests will be conducted and their results evaluated in accordance with Chapter 20 of ACI 318:
    - a. Core tests fail to demonstrate strengths adequate for the intended purpose of the member or members in question, as determined by the Engineer,
    - b. If the failure to meet specified strength requirements occurred in members from which it is impracticable to secure test specimens by the method of ASTM C 42,
  - 3. If the results of the load tests fail to meet the requirements of Chapter 20 of ACI 318, additional curing shall be conducted for 2 weeks. Core tests shall be conducted again. If the results of the load test still fail to meet the requirements of Chapter 20 of ACI 318, low-strength portions of the structure shall be evaluated by the Engineer. The low-strength portions of the structure may be required to be demolished and rebuilt, or adequately reinforced as directed by the Engineer, all at the Contractor's expense.
- D. The Owner will pay for the tests stated in Paragraph A. The Contractor shall pay for all additional testing requested by the Contractor or that which is required under Paragraph B and C above.

### 3.6 CONCRETE FINISH

- A. The crane girder shall be finished to a vertical tolerance of  $\pm 1/4$  inch in 10 feet from the dimensions shown on the Plans and shall have a broomed finish. The sequence of finishing operations shall be:
  - 1. Immediately after initial placement and leveling, the screeding operation shall commence. This shall be performed carefully and thoroughly so as to strike off all excess concrete and fill any low areas.

2. Machine steel troweling shall follow screeding. This shall not commence until water sheen has disappeared, and until concrete is hard enough to receive a foot impression no deeper than 1/8 inch. Troweling shall produce a dense uniform surface free from blemishes, ripples and trowel marks, but shall not be continued long enough to induce surface crazing.
  3. When the surface has almost hardened, the broomed finish shall be applied. Horsehair bristle brooms shall be employed, with broom strokes perpendicular to the length of the wharf.
  4. Curing shall immediately follow as specified herein.
- B. Channels, curbs, recesses, trenches, drain holes, utility boxes, and other exposed surfaces (except wearing courses) shall receive a steel troweled finish:
1. This shall be obtained by first performing operations 1 and 2 described above.
  2. Then, when the surface has almost hardened, as described in 3 above, steel troweling shall be repeated using a firm pressure until the surface is hard. Suitable hand tools shall be employed in confined areas.
  3. Curing shall immediately follow as specified herein.

### 3.7 CURING AND PROTECTION

- A. Freshly deposited concrete shall be protected from premature drying and excessively hot or cold temperatures, and shall be maintained with minimal moisture loss at a relatively constant temperature for the time necessary for hydration of the cement and hardening of the concrete.
- B. Curing shall immediately follow the finish operation. Concrete shall be kept continuously moist for a minimum of seven (7) days by absorbent mat or fabric kept continuously wet. If side forms are removed prior to the seven day curing period, a curing compound shall be applied to the concrete.
- C. Steel forms heated by the sun and all wood forms in contact with the concrete during the curing period, shall be kept wet. If forms are to be removed during the curing period, one of the above curing materials or methods shall be employed immediately. Such curing shall be continued for the remainder of the seven (7) day curing period.
- D. During the curing period, the concrete shall be protected from damaging mechanical disturbances, particularly load stresses, shock and excessive vibration. All finished concrete surfaces shall be protected from damage caused by construction equipment, materials, methods, and by frost, rain or running water. Self-supporting structures shall not be loaded in such a way as to overstress the concrete.
- E. The Contractor shall be entirely responsible for protecting the concrete from damage, from whatever cause, until its acceptance by the Owner.

### 3.8 REPAIR OF CONCRETE

- A. Immediately after forms are removed and curing is completed, surface defects shall be repaired. During repair work, the curing of adjoining surfaces shall not be delayed or interrupted. Repair procedures shall be as follows:
1. Fins and other projections not acceptable to the Engineer shall be removed, and the concrete ground to an even surface. Individual small surface defects such as air bubbles, voids, and fissures will be accepted without repair, if the voids or air bubbles are less than 1/2-inch in diameter and 3/8 inch in depth and if fissures do not penetrate more than 3/8-inch in depth.
  2. All honeycombed and other defective concrete shall be removed down to sound concrete. The sides of all cuts shall be square and the minimum depth of the defective concrete removal shall be one inch. The area to be patched shall be coated with the approved epoxy bonding agent, applied in accordance with the manufacturer's instructions. Small, shallow holes caused by air entrapment at surface of forms shall not be considered to be defective unless amount is so great as to be considered not the standard of the industry.
    - a. The void shall then be filled with dry-pack mortar. This shall be rammed firmly into place and finished flush with the surrounding concrete.
    - b. Form-tie cavities shall be repaired in the same manner, except that the epoxy bonding agent need not be employed.
  3. For cavities exceeding three (3) inches in depth or 1/4-cubic foot in volume, concrete shall be employed instead of dry-pack mortar. A coating of the approved epoxy bonding agent shall first be applied to the surface after removal of all loose material. Concrete of the same strength and composition as that in the defective member shall then be well rammed into the cavity and finished flush. It shall be just plastic enough to permit effective placement. If necessary, a form shall be fixed to prevent concrete sagging.
  4. All repaired surfaces shall be cured in the same manner as the surrounding concrete.
- B. Areas of structures which are outside the tolerance limits listed in ACI 347 shall be removed to the specified limits if the Engineer so requires. The finished surface shall be ground smooth to a finish comparable to the surrounding area.

### 3.9 GROUT

- A. Grout is required for crane stop base plates and elsewhere where shown on the Plans. The grout shall be the specified non-shrink grout.
- B. Metal surfaces, which will be in contact with grout, shall first have all loose mill scale and foreign matter removed. Concrete surfaces shall be roughened and all laitance and foreign matter removed.
- C. The grout shall be stored, mixed, handled, placed and cured in accordance with the manufacturer's instructions. Forms shall be provided, if necessary, to confine the grout to its required location. During placement of bollards, care shall be taken that anchor bolt sleeves are completely filled before the grout is placed under base plates.



3.10 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements.
- B. Perform inspection and testing according to ACI 318.
- C. Provide unrestricted access to Work and cooperate with appointed testing and inspection firm.
- D. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work.
- E. Concrete Inspections:
  - 1. Continuous Placement Inspection: Inspect for proper installation procedures.
  - 2. Periodic Curing Inspection: Inspect for specified curing temperature and procedures.
  - 3. Sampling Procedures: Comply with ASTM C172.
  - 4. Sample concrete and make one set of three cylinders for every 75 cu. yd. or less of each class of concrete placed each day, and for every 5,000 sq. ft. of surface area for slabs and walls.
  - 5. If volume of concrete for a class of concrete would provide less than five sets of cylinders, take samples from five randomly selected batches, or from every batch if less than five batches are used.
  - 6. Make one additional cylinder during cold weather concreting and field cure.

END OF SECTION

SECTION 03 41 00 - PRECAST PRESTRESSED CONCRETE JOISTS AND BEAMS

PART 1 GENERAL

1.1 SUMMARY

- A. Precast prestressed concrete Sections.
- B. Forming of prestressed concrete Sections.

1.2 RELATED SECTIONS

- A. Section 03300-Cast-In-Place Concrete.

1.3 REFERENCES (EDITIONS SPECIFIED IN CURRENT APPLICABLE PROVISIONS OF FBC)

- A. ASTM International (ASTM).
  - 1. ASTM A370-96 Test Methods and Definitions for Mechanical Testing of Steel Products.
  - 2. ASTM A416/A-96 Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.
  - 3. ASTM A615/A-96a Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
  - 4. ASTM A36 Specification for Structural Steel.
  - 5. ASTM C33 Specification for Concrete Aggregates.
  - 6. ASTM C150 Specification for Portland cement.
  - 7. ASTM C.494 Standard Specifications for Chemical Admixtures for Concrete.
- B. Codes and Standards
  - 1. Prestressed Concrete Institute MNL 116: Manual for Quality Control for Plants and Production of Precast Concrete Products.
  - 2. ACI 318 Building Code Requirements for Reinforced Concrete and Commentary.
  - 3. ACI 301 (latest Edition) Specification for Structural Concrete for Buildings.
  - 4. AWS D1.4 Structural Welding Code-Reinforcing Steel.
  - 5. AWS D1.1 Structural Welding Code-Steel.
- C. Prestressed Concrete Institute (PCI).
  - 1. PCI MNL-116, Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products.
  - 2. PCI MNL-120, Design Handbook-Precast and Prestressed Concrete
- D. Fire-resistance Rated Precast Units: Where precast concrete units are shown or scheduled as requiring a fire-resistance classification, provide units:
  - 1. Tested and listed by UL according to UL specifications, with each unit bearing UL label and marking.
  - 2. Complying with the requirements of the applicable building codes.
  - 3. E, ASCE 37-12 Design loads on structures during erection.

1.4 DESIGN REQUIREMENTS

- A. Prestressed Concrete Sections: Conform to the requirements of ACI 318 except as noted herein. Design units for the live loads and dead loads as noted on the structural drawings. Superimposed dead loads listed are in addition to weight of units and slab or topping. Connections, openings, erection and details under provisions of manufacturer's specifications and details as noted on the Drawings.

1.5 SUBMITTALS

- A. Shop Drawings: Submit shop and erection drawings for approval, showing:
1. Concrete design strength.
  2. Unit dimensions and unit weights.
  3. Size, number, location, and stress in prestressing strands.
  4. Size, number, and location of reinforcing bars including reinforcing for erection and handling stresses.
  5. Concrete cover over reinforcing and strands.
  6. Bearing and anchorage details.
  7. Size and locations of holes for slab form support pins.
  8. Concrete finish.
  9. Curing method.
  10. Erection marks.
  11. Joist pick-up points and shoring points.
- B. Shoring and reshoring shop drawings shall be prepared under the supervision of and signed and sealed by a Professional Engineer licensed in the State of Florida.
- C. Design Calculations:
1. Submit for approval, neat, legible, and complete design calculations before fabrication.
  2. Calculations shall be by a Florida licensed Professional engineer whose seal and signature shall appear on calculation sheets and shop drawings.
  3. Revise calculations if required by A/E or Owner.
  4. Calculations shall include predicted in-place cambers without superimposed loads, with superimposed dead loads, and with superimposed dead loads and live loads.
  5. Span length in calculations shall be from center of bearing to center to center of bearing.
- D. Shop drawings and calculations shall be prepared under the supervision of and signed and sealed by a Professional Engineer licensed in the State of Florida.
- E. Test Reports: Furnish reports of tests on concrete.
- F. Certificates: Submit manufacturer's test certificates on prestressing strands and reinforcing.

- G. Concrete Cylinder Tests: Submit copies of cylinder break reports by an approved commercial test laboratory, made from each casting for this project to verify that concrete has attained minimum ultimate prestressed transfer strength specified.

#### 1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: A recognized prestressed concrete manufacturer whose design, fabrication, and erection operations are supervised by a Florida Licensed Professional Engineer, with a minimum of 5 years experience.
- B. Erector Qualifications: Regularly engaged for at least 5 (five) years in the erection of precast structural concrete similar to the requirements of this project. Upon request, provide written evidence that equipment and personnel are adequate and qualified for the performance of contract requirements.
- C. Testing Agency: Capable of performing testing under provisions ASTM E329.7

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle projects to site under provisions of Section 01663, "Product Delivery, Storage and Handling Requirements."
- B. Handle precast members in position consistent with their shape and design. Lift and support only from support points.
- C. Protect from dirt and damage. Do not place units in position, which will cause overstress, warp or twist. Handle by means of lifting inserts.
- D. Store units off ground. Place stored units so that identification marks are discernible. Separate stacked units by battens across full width of each bearing point. Do not use upper member of stacked tier as storage area for shorter members or heavy equipment.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

- A. Concrete:
  - 1. Minimum seven (7) day ultimate compressive strength of 5000 PSI.
  - 2. Higher strength will be allowed to suit manufacturer's design. Use Type III Portland cement.
  - 3. Ensure concrete complies with Section 03300 - Cast-in-Place Concrete.
- B. Prestressing Strands:
  - 1. High strength 7-wire strand conforming with ASTM A416- grade 250 or 270.
  - 2. Elongation test conforming with ASTM A370- with minimum elongation at rupture of 3.5 percent in 24 inches.
  - 3. Tests need not be made if certification of conformance with specifications is provided by manufacturer.

- C. Reinforcing Steel: ASTM A615-, Grade 60, deformed.
- D. Forms:
  - 1. Unit:
    - (a) Forms: Provide smooth units true to size, shape, and detail with flat planes, sharp lines, and arises free from warp, twist, bow, or similar distortions and spalling, broken edges, or similar defects.
    - (b) Dimensional Tolerances: Under provisions of ACI 525 standard minimum requirements for thin section precast concrete construction.
- E. Slab forms between joists and beam side forms at end of joists:
  - 1. Provide use of manufacturer's standard forms complete with slab form support pins.
  - 2. Provide coordination of forming.

## 2.2 FABRICATION

- A. Fabricate units under provisions of approved shop drawings and approved design calculations.
- B. Unit Design and Fabrication:
  - 1. Conform with ACI Standard 318 Building Code requirements for reinforced concrete, Prestressed Concrete Association Standards, and the Florida Building Code.
  - 2. Fabricator shall design joists and beams according to loads indicated on drawings.
  - 3. Camber under dead load or deflection under total load does shall not exceed 1/360 of span.
- C. Maintain plant records and quality control program during production of precast members. Make records available upon request.
- D. Tension reinforcement tendons as required to achieve design load criteria.
- E. Inserts: Install hanger inserts and sleeves in unit forms for mechanical and electrical items as provided under other sections.
- F. Top Finish of Units Receiving Cast-In-Place Slab: Rough screeded. Provide projecting stirrups and slab reinforcing support bar per manufacturer's composite action design.
- G. Cure members under identical conditions to develop required concrete quality, and minimize appearance blemishes such as non-uniformity, staining or surface cracking.
- H. Plant Finish: Normal plant finish; surface may contain small surface holes caused by air bubbles, minor chips or spalling at edges or ends, without major discoloration.
- I. Exposed-to-View Finish: Normal plant finish with fins and protrusions removed, ground edges and ends, flat face surfaces.

- J. Curing:
  - 1. Top Surface: receives water curing only.
  - 2. Sides and Bottoms: Water cured or membrane cured using approved wax free type compound.
  - 3. Water cure units at least 5 days or cure until concrete reaches minimum specified 7 day strength.
- K. Marking: Distinctively mark each unit with manufacturer's name and mark indicated on erection drawings.
- L. Age: Ensure units are a minimum 10 days old before shipping or erecting.

### PART 3 EXECUTION

#### 3.1 ERECTION

- A. Erection: by manufacturer or another firm with experience in this Work, and supervised by manufacturer's Florida licensed Professional Engineer, or his authorized representative. Handle and install joists with precision, in conformance with drawings, details, and erection drawings. Prior to concrete placement, manufacturer shall provide a written certification stating that all units, forming, bracing and shoring have been installed in accordance with approved shop drawings
- B. Erect members level and plumb within allowable tolerances.
- C. Adjust differential camber between units to within tolerance.
- D. No drilling, chipping, PAF or any other intrusions into precast concrete without written specific approval and detailed instructions of Specialty Engineer and fabricator.
- E. Secure units in place.
- F. Install and secure forms between joist for cast-in-place concrete.
- G. Ensure conformance to provisions of ASCE 37-12.
- H. Design and erect to tolerances listed in ACI 301.
- I. When members cannot be adjusted to conform to design or tolerance criteria, advise Project Consultant. Execute modifications as directed.
- J. Shoring: Before pouring slabs over units, supervise shoring of unit bottoms for composite action. Shoring to remain in place until cylinder tests indicate the specified concrete strength for slabs and secondary pours over beams have been attained.
- K. Forming: Furnish slab form support pins for joist units, slab forms between joists, and beam side forms between joists as required.

- L. Repairs: Repair nicks or chips in exposed areas that occur after inspection and approved by the Project Consultant.
- M. Fasteners:
  - 1. Drilled holes for expansion anchors, self-tapping concrete screw fasteners or power activated mechanical fasteners (shots), shall not be allowed on any surface of precast joists and beams.

3.2 CLEANING

- A. After slab pouring is complete, clean exposed surfaces of units of stains to a uniform appearance. Do not use caustic or acid cleaners.

END OF SECTION

SECTION 00 42 00 - UNIT MASONRY

PART 1 GENERAL

1.1 SUMMARY

A. Related Sections:

1. 03300-Cast-In-Place Concrete.
2. 08100-Steel Doors and Frames.
3. 09200-Metal Studs, Lath, Suspension Ceiling, Plaster, and Stucco.
4. Furnishing of other items to be built-in under respective sections.

1.2 REFERENCES: Editions, Required by appropriate section of Florida Building Code (FBC).

A. ASTM International (ASTM):

1. A82 Specification for Steel Wire, Plain, for Concrete Reinforcement.
2. A153 Specifications for zinc coating (hot-dip) on iron and steel hardware
3. C55 Specification for Concrete Brick.
4. C90 Specification for Load bearing Concrete Masonry Units.
5. C91 Specification for Masonry Cement.
6. C129 Specification for Non-Load bearing Concrete Masonry Units.
7. C144 Specification for Aggregate for Masonry Mortar.
8. C150 Specification for Portland Cement.
9. C270 Specification for Mortar for Unit Masonry.
10. C331 Specification for Lightweight Aggregates for Concrete Masonry Units.

B. Florida Building Code.

C. American Concrete Institute (ACI):

1. ACI 530/530.1-Building Code Requirements and Specifications for Masonry Structures.
2. D. ASCE-37-02-Design loads on structures during construction.

1.3 SUBMITTALS

A. Submit properly identified product data on masonry units and each type of metal anchor and accessory, before starting work, which shall certify conformance to these specifications.

1. Submittal is for information only. Neither receipt of list nor acceptance of mockup constitutes approval of deviations from Contract Documents unless such deviations are specifically brought to the attention of the Architect and approved in writing.

1.4 QUALITY ASSURANCE

1. Refer to ACI 530/530.1 and FBC for inspection requirements. Note that for all masonry bearing walls, a 'special inspector' is required.
2. Certifications: Provide certification from concrete unit masonry manufacturer stating the materials supplied meet specifications.



- (a) Provide a certification for fire rating for each masonry unit type submittal.
  - (b) Submit compressive strength and absorption tests demonstrating compliance with specifications.
  - (c) Test reports shall be no older than one year and be representative of the batch characteristics of the proposed masonry unit(s).
3. Mason Certification:
- (a) Perform under the direct supervision of a "Certified Structural Masonry Contractor".
  - (b) The supervisor of the masonry portion of the project: "Certified Structural Masonry Contractor and a Certified Structural Mason" as recognized by the Florida Concrete & Products Association (FC&PA).
  - (c) The Masonry Supervisor: Responsible to assure that the work is accomplished under provisions of the contract documents.
  - (d) The Masonry Contractor: Submit credentials from the FC&PA to the Architect for review and approval prior to bidding.
  - (e) All Masonry Work: Under the direct, onsite supervision of a certified structural mason.
4. Testing Agency Qualifications: Conform to ASTM C10 83
5. Pre-construction testing: Perform the following pre-construction testing to establish compliance of proposed materials and construction with specified requirements:
- (a) Prism Test: For each type of wall construction indicated, test masonry prisms per ASTM E447, Method B.
  - (b) Evaluate Mortar composition and properties per ASTM C780.
  - (c) Test grout compressive strength per ASTM C109.
  - (d) Provide additional testing as required in section 3.6.
6. Fire-Resistant Ratings: Provide materials and construction identical to those of assemblies with fire resistance ratings determined per ASTM E119.
7. Single-source Responsibility 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 1 source and by a single manufacturer for each different product required.
8. Single-Source Responsibility for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from 1 manufacture for each cementitious component and from 1 source or producer for each aggregate.
9. Preinstallation Conference: Conduct conference at project site to comply with requirements of Section 01310, "Project Management and Coordination".
10. Delivery, Storage, And Handling
- (a) Store masonry units on elevated platforms, under cover, and in a dry location to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, and other causes.
  - (b) Store cementitious materials on elevated platforms, under cover, and in a dry location.

- (c) Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- (d) Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

11. Project Conditions:

- (a) Protection of Masonry: During erection, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
  - (1) Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
  - (2) Where 1 wythe of multi-wythe masonry walls is completed in advance of the wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.
- (b) Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 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.
  - (1) Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on ground and over wall surface.
  - (2) Protect sills, ledges, and projections from mortar droppings.
  - (3) Protect surfaces of window and doorframes, as well as similar products with painted and integral finishes, from mortar droppings.
  - (4) Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt on completed masonry.

1.5 PROJECT CONDITIONS

- 1. Environmental Conditions
  - (a) Temperature: 40 degrees F. minimum and rising.
  - (b) Weather: No application during precipitation.
- 2. Special Requirements
  - (a) Comply with the following requirements:
    - (1) Cover masonry with a weather-resistant membrane for 48 hours after construction.
    - (2) Hot-Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 degrees Fahrenheit and above.

PART 2 PRODUCTS

2.1 LOAD BEARING UNIT MASONRY

- A. Weight: Normal.
- B. Nominal Size: 8 inches x 16 inches x 12 inches thick and 8 inches x 16 inches x 8 inches thick
  - 1. Two cell flush end type.
  - 2. Two cell stretcher type one end (to be used adjacent to concrete construction)
- C. Texture: Medium.
- D. Grade: ASTM C90, Type II.
- E. Shapes: Appropriate to suit conditions.
  - (a) Provide special shapes for lintels, corners, jambs, sash, control joints, headers, bonding, and other special conditions including partition top closures.
  - (b) Provide bullnose units for outside corners, unless otherwise indicated.

2.2 NON-LOAD BEARING CONCRETE UNIT MASONRY

- A. Weight: Normal.
- B. Size: 8 inches x 16 inches x thickness indicated
  - 1. 2 cell flush end type.
  - 2. 2 cell stretcher type one end (to be used adjacent to concrete construction)
- C. Texture: Medium.
- D. Grade: ASTM C129, Type II.
- E. Shapes: Appropriate to suit conditions.
  - (a) Provide special shapes for lintels, corners, jambs, sash, control joints, headers, bonding, and other special conditions including partition top closures.
  - (b) Provide bullnose units for outside corners, unless otherwise indicated.

2.3 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C150, Type I, domestic.
- B. Masonry Cement: ASTM C91.
  - 1. For pigmented mortars, use premixed, colored mortar cements of formulation required to produce color indicated, or if not indicated, as selected from manufacturer's standard formulations.
  - 2. Pigments: Do not exceed 5 percent of mortar cement by weight for mineral oxides nor 1 percent for carbon black.

- C. Hydrated Lime: ASTM C207, Type S.
- D. Portland Cement-Lime Mix: Packaged blend of Portland cement complying with ASTM C150, Type I or Type III, and hydrated lime complying with ASTM C207.
  - 1. For pigmented mortars, use premixed, colored mortar cements of formulation required to produce color indicated, or if not indicated, as selected from manufacturer's standard formulations. Pigments: do not exceed 10 percent of mortar cement by weight for mineral oxides nor 5 percent for carbon black.
- E. Aggregate for Grout: ASTM C404.
- F. Sand: ASTM C144.
- G. Water: Potable.

#### 2.4 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.
- B. Mortar for Unit Masonry: ASTM C270, Type S, 1800 psi use, and Type M-2500 psi. Mix accurately proportioned by volume.
- C. Grout for Unit Masonry: Comply with ASTM C476.
  - 1. Use grout of consistency indicated or, if not otherwise indicate, of consistency (fine or coarse) at time of placement that will completely fill spaces intended to receive grout.
  - 2. Use fine grout in grout spaces less than 2 inches in horizontal dimension, unless otherwise indicated.
  - 3. Use coarse grout in grout spaces 2 inches or more in least horizontal dimension, unless otherwise indicated.
  - 4. Slump for grout shall be between 8 inch and 11 inch.
  - 5. See also requirements in Section 03300.

#### 2.5 REINFORCEMENT, ANCHORS, TIES, AND ACCESSORIES

- A. Horizontal Joint Reinforcement: Continuous 9 gage truss (see below) design, deformed, galvanized steel.
  - 1. Acceptable manufacturers:
    - (a) A.A. Wire Products.
    - (b) Dur-O-Wal.
    - (c) Hohmann and Barnard, Inc.
  - 2. Galvanized to meet ASTM A-153, Class B-2.
  - 3. Provide ladder type for reinforced walls, truss type for non-reinforced walls.
  - 4. Provide prefabricated corners and tees for use at wall intersections.
  - 5. Widths to suit thickness of block to within 1 inch of each face.

- B. Buck Anchors: 16 gage corrugated galvanized steel, 1-1/4 inch wide, 8 inch long leg, with 2 inch upturned end, punched for fastenings, complete with No.10 galvanized machine screws and metal expansion anchors for securement to concrete.
- C. Dovetail Slots: 22 gage galvanized with filler, 1 inch wide x 1 inch deep.
- D. Dovetail Anchors: 16 gage corrugated galvanized steel, 1 inch wide x 5-1/2 inch long, sized to fit dovetail slots.
- E. Embedded Flashing Materials:
  - 1. Concealed Through-Wall Flashing: Manufacturer's full sheet of copper, 7 ounces per square foot, laminated between and bonded to two 2 layers of asphalt impregnated fiberglass fabric.
  - 2. Adhesive Backed Membrane Flashing: Manufacturer's standard composite flashing product consisting of pliable and highly adhesive rubberized asphalt compound, 32 mils thick, bonded completely and integral to a high-density, cross laminated polyethylene film, 8 mils thick to produce an overall thickness of 40 mils.
    - (a) Primer: Flashing manufacturer's standard product or product recommended by flashing manufacturer for bonding flashing sheets to masonry and concrete.
  - 3. Solder and Sealants for Sheet-Metal Flashings: As specified in Division 7 Section "Flashing and Sheet Metal".
  - 4. Products: Subject to compliance with requirements, provide one of the following:
    - (a) Concealed Through-Wall Flashing:
      - (1) FCO Copper-Fabric Flashing: As manufactured by AFCO Products, Inc., Somerville, Mass. 617-623-7700.
      - (2) H & B C-Fab Flashing: As manufactured by Hohmann & Barnard, Inc., Hauppauge, N.Y. 516-234-0600.
      - (3) Approved equivalent alternative.
- F. Miscellaneous Masonry Accessories:
  - 1. Compressible Filler: Premolded filler strips complying with ASTM D1056, Type Class A, Grade 1; compressible up to 35 percent; of width and thickness indicated; formulated from the following material:
    - (a) Neoprene.
    - (b) Urethane.
    - (c) Polyvinyl chloride.
  - 2. Preformed Control-Joint Gaskets: Material as indicated below, designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
    - (a) Styrene-Butadiene Rubber Compound: ASTM D2000, Designation M2AA-805.
  - 3. Cavity Drainage Material: Two inch thick, reticulated, nonabsorbent mesh, made from polyethylene strands and shaped to maintain drainage at weep holes without being clogged by mortar droppings.
    - (a) Product: Subject to compliance with requirements, provide "Mortar Net" by Mortar Net USA, Ltd.
  - 4. Approved equivalent alternative.

## PART 3 EXECUTION

### 3.1 PREPARATION

#### A. Examination:

1. Verify that the surfaces, substrates and conditions are satisfactory to receive unit masonry, and are free from deviations affecting quality of the work.
2. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of unit masonry. Do not proceed with installation until unsatisfactory conditions have been corrected.
  - (a) For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of unit masonry.
  - (b) Examine rough-in and built-in construction to verify actual locations of piping connections prior to Installation.

### 3.2 LOCATION OF MASONRY SYSTEMS (UON on drawings)

- A. Load Bearing Units: For partitions and walls 8 inches or greater.
- B. Load Bearing Lightweight Units: For partitions and walls as indicated.

### 3.3 LOCATION OF REINFORCEMENT, ANCHORS, TIES, AND ACCESSORIES

- A. Horizontal Joint Reinforcement: Every second block course and at first joint above and below openings, for all masonry, interior or exterior.
- B. Buck Anchors: Every second block course for masonry walls and partitions abutting precast concrete and wherever dovetail anchors cannot be incorporated. Secure upturned ends to concrete with specified screws and anchors.
- C. Dovetail Anchors: Every second block course for masonry walls and partitions abutting cast-in-place concrete with continuous dovetail anchor slots.

### 3.4 ERECTION

#### A. General:

1. Ensure scaffolds and loadings conform to requirements of ASCE 37-02.
2. Thickness: Build cavity and composite walls and other masonry construction to the full thickness shown. Build single-wythe walls to the actual thickness of the masonry units, using units of thickness indicated.
3. Build chases and recesses to accommodate items specified in this and other Sections of the Specifications.
4. Leave openings for equipment to be installed before completion of masonry. After installing equipment, complete masonry to match construction immediately adjacent to the opening.

5. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining construction. Use full-size units without cutting, where possible. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
  6. Mix units for exposed unit masonry from several pallets or cubes as they are placed to produce uniform blend of colors and textures.
- B. Laying Units:
1. Lay masonry plumb, true to line, with level and accurately spaced courses.
  2. Keep bond plumb throughout.
  3. Lay corners and reveals plumb and true.
  4. Avoid over plumbing of corners and jambs to fit stretcher units after they are set in position.
  5. Where adjustment must be made after mortar has started to harden, remove mortar and replace with fresh mortar.
  6. Use concrete brick to course out walls concealed in the finished work.
  7. Vertical cells to be grouted shall be aligned to provide unobstructed openings for grout.
  8. Stopping and Resuming Work: In each course, rack back one-half (1/2) unit length for one-half (1/2) running bond or one-third (1/3) unit length for one-third (1/3) running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly if required, and remove loose masonry units and mortar prior to laying fresh masonry.
- C. Tolerances:
1. Conform to tolerances listed in ACI530.1, Part 3.
- D. Bond:
1. Provide common bond, with vertical joints centered over masonry unit below, except where other bonds are indicated.
  2. Lap alternate masonry courses at corners and intersections.
- E. Joint Treatment:
1. Concealed Block: Joints struck flush.
  2. Joint Thickness: 3/8 inch.
- F. Jointing Methods:
1. Where block cores are indicated to be filled with grout, lay in full mortar beds and full mortar end joints.
  2. Lay all other concrete block with full beds of mortar on vertical and horizontal face shells.
  3. Furrowing of mortar not allowed.
  4. Shove vertical joints tight.
  5. Finish tooled joints to uniformly straight and true lines and surfaces, smooth and free of tool marks.
  6. Uniformly rake joints between masonry and doorframes to 3/8 inch depth to receive caulking or sealant.

7. Rake joints around flush electrical outlets in wet locations to receive caulking or sealant.
  8. Remove masonry protrusions extending 1/2 inch or more into cells or cavities to be filled.
- G. Mortar Filled Units:
1. First cell of blocks abutting doorjamb and window frames.
  2. Cells of blocks at free ends of partitions and walls.
  3. Where necessary for embedment of anchors, and where otherwise shown.
  4. Voids around ducts, pipes, and other items passing through masonry work.
  5. Hollow metal door frames and elevator hoistway door frames in masonry walls and partitions:
    - (a) Grout solid with mortar as masonry is laid.
    - (b) Include tops of door frames.
    - (c) Load Bearing Masonry Walls:
      - (1) Erect masonry before reinforced concrete building frame.
      - (2) Close masonry top course cores under poured concrete beams with paper stuffing or metal caps.
      - (3) Do not use flush end type units against columns or poured concrete walls.
- H. Non-Load Bearing Masonry Wall and Partition Anchorage:
1. Erect masonry after steel and concrete frames are in place, and after concrete floors and roof decks are in place.
  2. After forms are stripped, remove slot fillers.
  3. At edges of non-bearing interior masonry walls and partitions abutting concrete columns and poured concrete walls, provide corrugated dovetail type anchors.
  4. Grout dovetail slots and space between end of masonry units and concrete solid.
  5. Point up all joints solid and flush on both sides of partitions.
- I. Partition Heights:
1. Partitions to be continuous from floor to underside of floor or roof construction above. UON drawings.
  2. Full height partitions and walls to be wedged tight with tile or brick set in mortar.
  3. Use brick or solid units for top masonry course. UON drawings.
  4. Point up all joints solid and flush on both sides of walls and partitions.
  5. Where suspended ceilings on both sides of partitions are indicated, the partitions other than those shown to be continuous may be terminated approximately four inches above the ceiling level, where noted on drawings.
- J. Concrete Grout Fill for Masonry Cores:
1. Coordinate masonry work to allow placing of grout as indicated and as specified in this section.
  2. Fill top courses of masonry walls with grout before placing or use concrete brick for top courses to assure solid masonry.
- K. Pipe Chase Walls and Partitions: Erect after pipes are in place, tested, and accepted.



- L. Slots, Chases, Recesses and Openings: Provide as required for work of other trades.
- M. Setting of Items Furnished Under Other Sections: Set anchors, bolts, sleeves, access panels, doorframes, and other items occurring in masonry as the work proceeds.
- N. Securing Hollow Metal Door Frames: Set in hollow metal frames on floor, floor clips secured and frames braced in proper position. Grout anchors into masonry joints as walls are erected.
- O. Lintels: Set reinforced precast concrete or coordinate installation of cast-in-place concrete lintels as indicated.
1. Precast concrete lintels to be set in full mortar beds with 8 inches minimum bearing each end.
  2. Cast-in-place lintels shall be used at openings, which have cast-in-place columns at either or both ends.
  3. Lintels shall be appropriately sized for the opening and shall have openings cast into the unit each end to allow for the passage of vertical reinforcing.
- P. Flashing And Vents:
1. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to the downward flow of water in the wall, and where indicated.
  2. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Place through-wall flashing on sloping bed of mortar and cover with mortar. Seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer before covering with mortar.
  3. Install flashing as follows:
    - (a) Interlock end joints of sheet-metal flashing by overlapping ribs not less than 4 inches, and seal lap with elastomeric sealant complying with requirements of Section 07920-Joint Sealants for application indicated.
    - (b) Extend sheet-metal flashing 1/2 inch beyond face of masonry at exterior and turn down to form a drip.
- Q. Installation of Horizontal Wall Reinforcement:
1. In masonry areas indicated to have concrete filled cores, provide reinforcement in every horizontal joint.
  2. At other areas, provide reinforcing in every second block course joint and at first joint above and below openings for exterior and interior masonry.
  3. Provide prefabricated corners and tees at all wall intersections.
  4. Extend reinforcement 6 inches into concrete tie columns and concrete encasement of steel columns poured after block is in place.
  5. Unless walls have cast-in-place concrete corner tie columns, make wall and partition joint reinforcing continuous around corners and at intersections according to manufacturer's published directions.
  6. Lap splices in joint reinforcement no less than 6 inches. Reinforcement shall not be continuous through expansion or control joints.

- R. Covers: At work stoppage, provide waterproof covers secured over exposed wall tops for weather protection.
- S. Pointing: Point holes in masonry. Cut out and point up defective joints.

3.5 MASONRY WASTE DISPOSAL:

1. Recycling: Undamaged, excess masonry materials are Contractor's property and removed from the Project site for his use.
2. Disposal as Fill Material: Dispose of clean masonry waste, including broken masonry units, waste mortar, and excess or soil-contaminated sand, by crushing and mixing with fill material as fill is placed.
  - (a) Crush masonry waste to less than 4 inches in greatest dimension.
  - (b) Mix masonry waste with at least 2 parts specified fill material for each part masonry waste. Fill material is specified in Section 02300-Earthwork.
  - (c) Do not dispose of masonry waste as fill within 18 inches of finished grade.
3. Excess Masonry Waste: Remove excess, clean masonry waste that cannot be used as fill, as described above, and other masonry waste and legally dispose of off Owner's property.

3.6 FIELD QUALITY CONTROL

- A. The Owner will employ and pay a qualified independent testing agency to perform the following testing for field quality control. Retesting of materials failing to meet specified requirements shall be done at Contractor's expense.
- B. Testing Frequency: Tests and Evaluations listed in this Article will be performed during construction for each 5000 square feet of wall area or portion thereof.
- C. Mortar composition and properties will be evaluated per ASTM C780.
- D. Prism-Test Method: For each type of wall construction indicated, masonry prisms will be tested per ASTM E447, Method B. and as follows:
  1. Test prior to construction.
  2. Test for every 5,000 sq/ft of wall area or portion thereof.
- E. Evaluation of Quality-Control Tests: In the absence of other indications of non-compliance with requirements, masonry will be considered satisfactory if results from construction quality-control tests comply with minimum requirements indicated.

END OF SECTION

SECTION 04 20 16 - REINFORCED UNIT MASONRY

PART 1 GENERAL

1.1 SUMMARY

- A. Reinforced Unit Masonry Construction
- B. Related Sections:
  - 1. 03 10 00 - Concrete Formwork.
  - 2. 03 20 00 - Concrete Reinforcement.
  - 3. 03 30 00 - Cast-in-Place Concrete.
  - 4. 04 20 00 - Unit Masonry.

1.2 REFERENCES

- A. Comply with Reference requirements of Sections 03 30 00 and 04 20 00.

1.3 QUALITY ASSURANCE

- A. Comply with provisions of applicable codes, specifications, and standards, except where more stringent requirements are shown or specified, as referred to in Sections 03300 and 04200.
- B. Certifications: Comply with applicable certification requirements of Sections 03300 and 04200.
- C. Mock-Ups: Comply with applicable mockup requirements of Sections 03300 and 04200.

1.4 SUBMITTALS

- A. Comply with applicable submittal requirements of Sections 03300 and 04200.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Formwork: Comply with applicable requirements of Section 03100 Concrete Formwork.
- B. Reinforcement: Comply with applicable requirements of Section 03200 Concrete Reinforcement.
- C. Grout: Comply with applicable portions of Sections 03300 and 04200.
- D. Masonry Materials and Accessories: Comply with applicable requirements of Section 04200 Concrete Unit Masonry.

PART 3 EXECUTION

3.1 FORMWORK

- A. General: Refer to Section 04200 for general installation requirements of unit masonry.
- B. Temporary Formwork: Provide formwork and shores as required for temporary support of reinforced masonry elements. Design, erect, support, brace and maintain formwork.
- C. Construct formwork to conform to shape, line, and dimensions shown. Make sufficiently tight to prevent leakage of mortar grout, or concrete. Brace, tie, and support as required to maintain portion and shape during construction and curing of reinforced masonry.
- D. Do not remove forms and shores until reinforced masonry member has hardened sufficiently to carry its own weight and all other reasonable temporary loads that may be placed on it during construction.

3.2 PLACING REINFORCEMENT

- A. General: Clean reinforcement of loose rust, mill scale, dirt, or other materials capable of reducing bond to mortar or grout. Do not use reinforcement bars with kinks or bends not shown on drawings or final shop drawings, or bars with reduced cross section due to excessive rusting or other causes.
- B. Position reinforcement accurately at the spacing shown. Support vertical bars are shown in close proximity. Provide a clear distance between bars of not less than the nominal bar diameter or 1 inch whichever is greater.
  - 1. For columns, piers, and pilasters, provide a clear distance between vertical bars as shown, but not less than 1-1/2 times the nominal bar diameter or 1-1/2 inch, whichever is greater. Provide lateral ties as shown.
- C. Splice reinforcement bars where shown and according to applicable provisions of Section 03200, Concrete Reinforcement. Do not splice at other points unless acceptable to the A/E. Provide lapped splices, unless otherwise shown. In splicing vertical bars or attaching to dowels, lap ends, place in contact and wire tie.
- D. Embed metal ties in mortar joints as work progresses, with a minimum mortar cover of 5/8 inch on exterior face of walls and 1/2 inch at other locations.
- E. Embed prefabricated horizontal joint reinforcing as the work progresses, with a minimum cover of 5/8 inch on exterior face of walls and 1/2 inch at other locations. Lap units not less than 6 inches at ends. Use prefabricated "L" and "T" units to provide continuity at corners and intersections. Cut and bend units as recommended by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

- F. Anchoring:
1. Anchor reinforced masonry work to supporting structure as indicated.
  2. At intersections of reinforced masonry walls with non-reinforced masonry, provide anchorage as shown.

### 3.3 INSTALLATION OF REINFORCED CONCRETE UNIT MASONRY

- A. General:
1. Do not wet concrete masonry units (CMU).
  2. Lay CMU units with full-face shell mortar beds.
  3. Fill vertical head joints (end joints between units) solidly with mortar from face of unit to a distance behind face equal to not less than the thickness of longitudinal face shells.
  4. Solidly bed cross-webs of starting courses in mortar.
  5. Maintain head and bed joint widths shown, or if not shown, provide 3/8 inch joints.
  6. Where solid CMU units are shown, lay with full mortar head and bed joints.
- B. Walls:
1. Pattern Bond: Lay CMU wall units in 1/2 running bond with vertical joints in each course centered on units in courses above and below, unless otherwise indicated.
  2. Bond and interlock each course at corners and intersections. Use special-shaped units where shown, and as required for corners, jambs, sash, control joints, lintels, bond beams, and other special conditions.
  3. Maintain vertical continuity of core or cell cavities, to be reinforced and grouted, to provide minimum clear dimensions indicated and to provide minimum clearance and grout coverage for vertical reinforcement bars. Keep cavities free of mortar. Solidly bed webs in mortar where adjacent to reinforced cores or cells.
  4. Where horizontal reinforced beams (bond beams) are shown, use special units or modify regular units to allow for placement of continuous horizontal reinforcement bars. Place small mesh expanded metal lath or wire screening in mortar joints under bond beam courses over cores or cells of non-reinforced vertical cells, or provide units with solid bottoms.
- C. Columns, Piers, and Pilasters:
1. Use CMU units of the size, shape, and number of vertical core spaces shown. If not shown, use units providing minimum clearances and grout coverage for number and size of vertical reinforcement bars shown.
  2. Provide pattern bond shown, or if not shown, alternate head joints in vertical alignment.
  3. Where bonded pilaster construction is shown, lay wall and pilaster units together to maximum pour height specified.
  4. Grouting, General:
    - (a) Use "Fine Grout" only where allowed by Section 04200.
    - (b) Use "Coarse Grout" for typical reinforced masonry construction. Use high-slump where height of any lift exceeds 4 feet.

- (c) Grouting Technique: At the Contractor's option, use either low lift or high-lift grouting techniques subject to the requirements as specified.
5. Low-Lift Grouting:
- (a) Provide minimum clear dimension of 2 inches and clear area of 8 square inches in vertical cores to be grouted.
  - (b) Place vertical reinforcement before laying of CMU. Extend above elevation of maximum pour height as required to allow for splicing. Support in position at vertical intervals not exceeding 160 bar diameters.
  - (c) Lay CMU to maximum pour height. Do not exceed 4 feet height, or if bond beam occurs below 4 feet height stop pour at course below bond beam.
  - (d) Pour grout using container with spout or by chute or by pumping. Vibrate grout during placing. Place grout continuously. Do not interrupt pouring of grout for more than one hour. Terminate grout pours 1-1/2 inch below top course of pour.
  - (e) Bond Beams: Stop grout in vertical cells 1-1/2 inch below bond beam course. Place horizontal reinforcing in bond beams. Lap at corners and intersections as shown. Place grout in bond beam course before filling vertical cores above bond beam.
  - (f) High-Lift Grouting:
    - (1) Do not use high-lift grouting technique for grouting of CMU unless minimum cavity dimension is 3 inches and 10 square inches, respectively.
    - (2) Provide clean-out holes in first course at all vertical cells to be filled with grout.
      - (a) Use units with one face shell removed and provide temporary supports for units above, or use header units with concrete brick supports, or cut openings in one face shell.
    - (3) Construct masonry to full height of maximum grout pour specified, before placing grout.
    - (4) Limit grout lifts to a maximum height of 4 feet and grout pour to a maximum height of 12 feet, for single wythe hollow concrete masonry walls, unless otherwise indicated.
    - (5) Place vertical reinforcement before grouting. Place before or after laying masonry units, as required by job conditions. Tie vertical reinforcement to dowels at base of masonry where shown and if reinforcement is placed first, thread CMU over or around reinforcement. Support vertical reinforcement at intervals not exceeding 192 bar diameters nor 10 feet.
      - (a) Where reinforcement is prefabricated into cage units before placing, fabricate units with vertical reinforcement bars and lateral ties of the size and spacing shown.
    - (6) Place horizontal beam reinforcement as the masonry units are laid.

- (7) Embed lateral tie reinforcement in mortar joints where shown. Place as masonry units are laid, at the vertical spacing shown.
- (8) Preparation of Grout Spaces: Before grouting, inspect and clean grout spaces. Remove dust, dirt, mortar droppings, loose pieces of masonry, and other foreign materials from grout spaces. Clean reinforcing and adjust to proper position. Clean top surface of structural members supporting masonry to ensure bond. After final cleaning and inspection, close clean-out holes and brace closures to resist grout pressures.
- (9) Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist displacement of masonry units and breaking of mortar bond. Install shores and bracing, if required, before starting grouting operations.
- (10) Place grout by pumping into grout spaces unless alternate methods are acceptable to the A/E.
- (11) Limit grout pours to sections, which can be completed in one working day with not more than one-hour interruption of pouring operation.
  - (a) Place grout in lifts, which do not exceed 4 feet.
  - (b) Allow not less than 30 minutes, nor more than one hour between lifts of a given pour.
  - (c) Vibrate each grout lift during pouring operation.
  - (d) Place grout in lintels or beams over openings in one continuous pour.
- (12) Where bond beam occurs more than one course below top of pour, fill bond beam course to within 1 inch of vertically reinforced cavities, during construction of masonry.
- (13) When more than one pour is required to complete a given section of masonry, extend reinforcement beyond masonry as required for splicing. Pour grout to within 1-1/2 inch of top course of first pour. After grouted masonry is cured, lay masonry units and place reinforcement for second pour section before grouting. Repeat sequence if more pours are required.

END OF SECTION

## SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Structural shapes.
  - 2. Channels and angles.
  - 3. Hollow structural sections.
  - 4. Structural pipe.
  - 5. Structural plates and bars.
  - 6. Bolts, connectors, and anchors.
  
- B. Related Requirements:
  - 1. Section 03 00 00 – Cast-in-place Concrete.
  - 2. Section 05 50 00 - Metal Fabrications.

#### 1.2 REFERENCE STANDARDS

- A. American Institute of Steel Construction:
  - 1. AISC 303 - Code of Standard Practice for Structural Steel Buildings and Bridges.
  - 2. AISC 360 - Specification for Structural Steel Buildings.
  
- B. American Welding Society:
  - 1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
  - 2. AWS D1.1 - Structural Welding Code - Steel.
  - 3. AWS D1.6 - Structural Welding Code – Stainless Steel.
  
- C. ASTM International:
  - 1. ASTM A36 - Standard Specification for Carbon Structural Steel.
  - 2. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  - 3. ASTM A123 - Standard Specification for ZincHot-Dip Galvanized Coatings on Iron and Steel Products.
  - 4. ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
  - 5. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
  - 6. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
  - 7. ASTM A276 – Standard specification for Stainless Steel Bars and Shapes.
  - 8. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.



9. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
10. ASTM A449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use.
11. ASTM A490 - Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
12. ASTM A588 - Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi Minimum Yield Point, with Atmospheric Corrosion Resistance.
13. ASTM A709 - Standard Specification for Structural Steel for Bridges
14. ASTM A992 - Standard Specification for Structural Steel Shapes.
15. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
16. ASTM F1852 - Standard Specification for "Twist Off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

D. Research Council on Structural Connections:

1. RCSC - Specification for Structural Joints Using ASTM A325 or A490 Bolts.

E. SSPC: The Society for Protective Coatings:

1. SSPC - Steel Structures Painting Manual.
2. SSPC Paint 20 - Zinc-Rich Coating (Type I - Inorganic and Type II - Organic).
3. SSPC SP 1 - Solvent Cleaning.
4. SSPC SP 10 - Near-White Blast Cleaning.

### 1.3 COORDINATION

A. Section 01 30 00 - Administrative Requirements.

B. Coordinate Work of this Section with following:

1. Section 05 50 00 - Metal Fabrications.

### 1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures.

B. Shop Drawings:

1. Indicate profiles, sizes, spacing, and location of structural members, openings, and bolts.
2. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.

C. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

D. Mill Test Reports: Submit indicating structural strength, destructive and non-destructive test analysis.

## 1.5 QUALITY ASSURANCE

- A. Perform Work according to following:
  - 1. Structural Steel: AISC 303 and AISC 360.
  - 2. High-Strength Bolted Connections: RCSC - Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts.

## 1.6 QUALIFICATIONS

- A. Fabricator:
  - 1. Company specializing in fabricating products specified in this Section with minimum three years' documented experience with following current AISC Certification:
    - a. Standard Steel Building Structures (STD).
- B. Erector:
  - 1. Company specializing in performing Work of this Section with minimum three years' documented experience with following current AISC Certification:
    - a. Certified Steel Erector (CSE).
- C. Shop Painter:
  - 1. Company specializing in performing Work of this Section with minimum three years' documented experience with following current AISC Certification:
    - a. Sophisticated Paint Endorsement - Enclosed (P1).
    - b. Sophisticated Paint Endorsement - Covered (P2).
    - c. Sophisticated Paint Endorsement - Outside (P3).
- D. Welders and Welding Procedures: AWS D1.1 qualified within previous 12 months.

## PART 2 PRODUCTS

### 2.1 STRUCTURAL STEEL

- A. Structural W-Shapes: ASTM A572, Grade 50.
- B. Structural L, C, M, MC, S-Shapes: ASTM A36 or ASTM A276, Grade 316 or 316L,  $F_y=30$  ksi minimum where indicated on Drawings
- C. Weathering Steel: ASTM A588; Grade 50 where indicated on Drawings
- D. Round, Hollow Structural Sections: ASTM A500; Grade B or ASTM A269, Grade 316 or 316L,  $F_y=30$  ksi minimum where indicated on Drawings
- E. Structural Pipe: ASTM A53; Grade B.
- F. Structural Plates and Bars: ASTM A572; Grade 50, ASTM A709, Grade 100, or ASTM A240; Grade 316 or 316L,  $F_y = 30$  ksi minimum where indicated on Drawings.

## 2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. Bolts: Heavy-hex, structural type.
  - 1. ASTM A325; Type 1, plain hot-dip galvanized, or Type 3, plain.
  - 2. ASTM A490; Type 1 or 3, plain.
  - 3. ASTM 193; Stainless steel
  - 4. ASTM F593, Group 2; Stainless steel
- B. Nuts:
  - 1. ASTM A563; heavy-hex type; Finish: Hot-dip galvanized.
  - 2. ASTM A194; stainless steel
- C. Washers:
  - 1. ASTM F436.
  - 2. Type 1, circular.
  - 3. Finish: Hot-dip galvanized.
  - 4. Stainless steel washer, type 316
- D. Anchor Rods:
  - 1. ASTM F1554; Grade 55 or Grade 105 where indicated on Drawings
  - 2. Shape: Straight.

## 2.3 WELDING MATERIALS

- A. Welding Materials:
  - 1. AWS D1.1.
  - 2. Type required for materials being welded.

## 2.4 FINISHES

- A. Galvanizing: ASTM A123; hot-dip galvanize after fabrication.
- B. Galvanizing for Bolts, Connectors, and Anchors:
  - 1. Hot-Dip Galvanizing:
    - a. Bolts, Nuts, and Washers: ASTM F2329.
    - b. Connectors and Anchors: ASTM A153.
  - 2. Mechanical Galvanizing: ASTM B695; Class 50 minimum.

## 2.5 ACCESSORIES

- A. Touchup Primer for Galvanized Surfaces:
  - 1. SSPC Paint 20, Type I - Inorganic.
  - 2. Comply with ASTM A780.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements.
- B. Verify that bearing surfaces are at correct elevation.
- C. Verify that anchor rods are set in correct locations and arrangements, with correct exposure for steel attachment.

### 3.2 ERECTION

- A. Allow for erection loads and for sufficient temporary bracing to maintain structure safe, plumb, and in alignment until completion of erection and installation of permanent bracing.
- B. Field-connect members with threaded fasteners; torque to required resistance and snug-tighten for bearing-type connections.
- C. Do not field-cut or alter structural members without approval of Engineer.

### 3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements.
- B. Bolted Connections: Inspect according to AISC 303.
  - 1. Visually inspect all bolted connections.
  - 2. Direct Tension Indicators: Comply with requirements of ASTM F959, and verify that gaps are less than gaps specified in Table 2.
- C. Welding: Inspect welds according to AWS D1.1 or AWS D1.6.
  - 1. Use certified welders, and conduct inspections and tests as required. Record types and locations of defects found in Work. Record work required and performed to correct deficiencies.
  - 2. Visually inspect all welds.
  - 3. Ultrasonic Inspection: ASTM E164; perform on each full-penetration weld.
- D. Correct defective bolted connections and welds.

END OF SECTION

## SECTION 05 40 10 - NON-STRUCTURAL METAL FRAMING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Metal partition, ceiling, and soffit framing.
- B. Framing accessories.

#### 1.03 REFERENCE STANDARDS

- A. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement. (replaced SG-971)
- B. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2011a.
- C. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- D. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011.
- E. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2007.
- F. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- G. ASTM E413 - Classification for Rating Sound Insulation; 2010.
- H. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings; 2002 (Ed. 2004).

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
  - 1. Indicate prefabricated work, component details, framed openings, anchorage to structure, acoustic details, type and location of fasteners, accessories, and items of other related work.
  - 2. Describe method for securing studs to tracks, splicing, and for blocking and reinforcement of framing connections.
- C. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.
- D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

#### 1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum five years experience.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Metal Framing, Connectors, and Accessories:

1. Clarkwestern Dietrich Building Systems LLC: [www.clarkdeitrich.com](http://www.clarkdeitrich.com).
2. Dietrich Metal Framing: [www.dietrichindustries.com](http://www.dietrichindustries.com).
3. Marino: [www.marinoware.com](http://www.marinoware.com).
4. Substitutions: See Section 01 6000 - Product Requirements.

## 2.02 FRAMING MATERIALS

- A. Fire Rated Assemblies: Comply with applicable code and as indicated on drawings.
- B. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.
  1. Studs: C shaped with flat or formed webs with knurled faces.
  2. Runners: U shaped, sized to match studs.
  3. Ceiling Channels: C shaped.
  4. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
- C. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
- D. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
  1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI North American Specification for the Design of Cold-Formed Steel Structural Members.
  2. Material: ASTM A653/A653M steel sheet, SS Grade 50, with G60/Z180 hot dipped galvanized coating.
  3. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems indicated on drawings.
- E. Tracks and Runners: Same material and thickness as studs, bent leg retainer notched to receive studs with provision for crimp locking to stud.
- F. Furring and Bracing Members: Of same material as studs; thickness to suit purpose; complying with applicable requirements of ASTM C754.
- G. Fasteners: ASTM C1002 self-piercing tapping screws.
- H. Sheet Metal Backing: 0.036 inch thick, galvanized.
- I. Anchorage Devices: Power actuated.
- J. Acoustic Insulation: As specified in Section 07 2100.
- K. Acoustic Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board.
- L. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic.

## 2.03 FABRICATION

- A. Fabricate assemblies of framed sections to sizes and profiles required.
- B. Fit, reinforce, and brace framing members to suit design requirements.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that rough-in utilities are in proper location.

### 3.02 INSTALLATION OF STUD FRAMING

- A. Comply with requirements of ASTM C754.

- B. Extend partition framing to structure where indicated and to ceiling in other locations.
- C. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
- D. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
- E. Align and secure top and bottom runners at 24 inches on center.
- F. At partitions indicated with an acoustic rating:
  - 1. Place one bead of acoustic sealant between runners and substrate, studs and adjacent construction.
  - 2. Place one bead of acoustic sealant between studs and adjacent vertical surfaces.
- G. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
- H. Install studs vertically at spacing indicated on drawings.
- I. Align stud web openings horizontally.
- J. Secure studs to tracks using crimping method. Do not weld.
- K. Stud splicing is not permissible.
- L. Fabricate corners using a minimum of three studs.
- M. Double stud at wall openings, door and window jambs, not more than 2 inches from each side of openings.
- N. Brace stud framing system rigid.
- O. Coordinate erection of studs with requirements of door frames; install supports and attachments.
- P. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.

### 3.03 CEILING AND SOFFIT FRAMING

- A. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.
- B. Install furring independent of walls, columns, and above-ceiling work.
- C. Securely anchor hangers to structural members or embed in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.
- D. Space main carrying channels at maximum 72 inch on center, and not more than 6 inches from wall surfaces. Lap splice securely.
- E. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.
- F. Place furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.
- G. Reinforce openings in suspension system that interrupt main carrying channels or furring channels with lateral channel bracing. Extend bracing minimum 24 inches past each opening.

### 3.04 TOLERANCES

- A. Maximum Variation From True Position: 1/8 inch in 10 feet.

B. Maximum Variation From Plumb: 1/8 inch in 10 feet.

END OF SECTION



## SECTION 05 50 00 - METAL FABRICATIONS

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Shop-fabricated metal items.
  - 2. Electrical Vault Cover
  - 3. Elevator sill angles, hoist beams, and divider beams.
- B. Related Requirements:
  - 1. Section 03 30 00 - Cast-In-Place Concrete.
  - 2. Section 05 12 00 – Structural steel framing

#### 1.2 REFERENCE STANDARDS

- A. American Institute of Steel Construction:
  - 1. AISC 303 - Code of Standard Practice for Structural Steel Buildings and Bridges.
  - 2. AISC 360 - Specification for Structural Steel Buildings.
- B. American Welding Society:
  - 1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
  - 2. AWS D1.1 - Structural Welding Code - Steel.
  - 3. AWS D1.6 - Structural Welding Code – Stainless Steel.
- C. ASTM International:
  - 1. ASTM A36 - Standard Specification for Carbon Structural Steel.
  - 2. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  - 4. ASTM A123 - Standard Specification for ZincHot-Dip Galvanized Coatings on Iron and Steel Products.
  - 5. ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
  - 6. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
  - 7. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
  - 8. ASTM A276 – Standard specification for Stainless Steel Bars and Shapes.
  - 9. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
  - 10. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
  - 11. ASTM A449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use.

12. ASTM A490 - Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
  13. ASTM A588 - Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi Minimum Yield Point, with Atmospheric Corrosion Resistance.
  14. ASTM A709 - Standard Specification for Structural Steel for Bridges
  15. ASTM A992 - Standard Specification for Structural Steel Shapes.
  16. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
  17. ASTM F1852 - Standard Specification for "Twist Off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
- D. Research Council on Structural Connections:
1. RCSC - Specification for Structural Joints Using ASTM A325 or A490 Bolts.
- E. SSPC: The Society for Protective Coatings:
1. SSPC - Steel Structures Painting Manual.
  2. SSPC Paint 20 - Zinc-Rich Coating (Type I - Inorganic and Type II - Organic).
  3. SSPC SP 1 - Solvent Cleaning.
  4. SSPC SP 10 - Near-White Blast Cleaning

### 1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. All materials: Mill test certificates for each heat number.
- C. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.
- E. Welding procedures and qualification test records.
- F. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for Cavotec cover and aluminum stair for Switchgear Building.
- G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Steel:

1. Structural W Shapes: ASTM A992., ASTM A572, Grade 50
  2. Structural Shapes, L, M, C, MC, S: ASTM A36.
  3. Steel Plate: ASTM A572; Grade 50 Unless otherwise noted.
  4. Hollow Structural Sections: ASTM A500, Grade B.
  5. Steel Pipe: ASTM A53, Grade B
- B. Stainless Steel:
1. Bars and Shapes: ASTM A276, Type 316.
  2. Round, Hollow Structural Sections: ASTM A269, Grade 316 or 316L
  3. Plates and Bars: ASTM A240, Grade 316 or 316L
  4. Bolts, Nuts, and Washers: ASTM A193, ASTM F593, Group 2
  5. Welding Materials: AWS D1.6; type required for materials being welded.

## 2.2 ACCESSORIES

- A. Welding Rods: AWS E 70XX
- B. Welding electrodes shall conform to the requirements of AWS A5.1 for the manual shielded metal arc (SMA), or submerged arc (SA) welding process.
- C. Deformed bar anchors (DBA) shall be Nelson, Type D2L (or other approved make and type of the sizes indicated on the Plans. Headed anchor studs (HAS) shall be Nelson, Type S3L or H4L, or other approved make and type of the sizes indicated on the plans. Welds for DBA & HAS shall develop the full strength of the anchor and conform with manufacturers recommendations.
- D. Threaded Base Studs shall be Nelson Type CPL or equal. Welds shall develop the full strength of the anchor and conform with manufacturers recommendations.
- E. Bolts shall be ASTM A 325, unless otherwise noted
- F. Threaded rod anchors shall conform to ASTM A 449, unless otherwise noted.
- G. Provide nuts compatible with the specified bolts in accordance with ASTM A 563.
- H. Hardened washers shall conform to ASTM F 436, type to match bolt type and finish.
- I. Chain: Alloy steel chain shall conform to ASTM A391.
- J. Eye Bolts, Shackles, Rope Clips, and Turnbuckles shall be Crosby, or approved equal.
- K. Wire Rope shall be 6 x 7 type, Galvanized.
- L. Drilled-in concrete anchors shall be "Red Head", "Hilti", or approved equal.
- M. Utility box cover pins shall conform to AISI 1040, Cold Drawn. Fy = 100 ksi.
- N. Trench cover hinge pins shall be of cadmium plated stainless steel, Type 316, conforming to ASTM A 276. Material shall be annealed and cold-drawn, and shall receive No. 2B finish.

- O. Checkered plate shall be U. S. Steel “Multigrip”, Lukens “Sure Foot” or other approved make and type. It shall have a two-way pattern of minimum 3/16 inch high projections. The thickness as indicated on the Plans shall be for the base plate thickness, not including projections. The plate shall be ASTM A 572 Grade 50.
- P. Tension anchors: Plates, bolts, threaded rods and wedge anchors shall be stainless steel, Type 316, conforming to ASTM A 276. Welding rods: AWS E 316.

### 2.3 ELECTRICAL VAULT COVER DESIGN REQUIREMENTS

- A. Covers shall be as manufactured by Cavotec.
- B. Latches shall have recessed handles with no above-grade protrusions. Spring loaded handle shall return to closed position automatically. Mounting hardware shall be concealed with easy one bolt installation/replacement, and shall be all stainless steel construction.
- C. See drawings for cover panel layout.
- D. Hinges shall be heavy duty all stainless steel construction.
- E. Frames shall incorporate integral concrete anchors, a minimum of two for every 24” width of cover.
- F. A self-engaging hold-open bar shall be provided to safely hold the cover in the open position when subjected to the operating wind, as defined in paragraph I-2 below, and to protect against cover over-travel while opening.
- G. Each cover shall incorporate a stainless steel nameplate as detailed in the drawings.
- H. Covers shall have an all stainless steel gas spring lift assist, one-man lift capability, with a 35 lb. maximum opening or closing force through the full opening range.
- I. Design Calculations:
  - 1. Cover shall be designed for tire pressure as shown on the drawings placed to produce maximum stresses.
  - 2. Covers shall be designed for an operating 3 second gust 55 mph wind in the up and down position. The latch and hold-open bar assembly shall be tested for a load equivalent to the operating wind load.
  - 3. Allowable stresses shall be in accordance with the LRFD provisions of the AISC specification.
- J. A non-skid cover coating shall comply with American Safety Technologies AS-250 or approved equal.

### 2.4 ELEVATOR SILL ANGLES, HOIST BEAMS, AND DIVIDER BEAMS

- A. Sill Angles:
  - 1. Steel sections as indicated on Drawings for support of elevator sills.
  - 2. Finish: Galvanized.

- B. Hoist and Divider Beams:
  - 1. Steel, wide-flange sections.
  - 2. Shape and Size: As required to support applied loads with maximum deflection of 1/240 of the span.
  - 3. Finish: Prime paint, one coat.

## 2.5 FABRICATION

- A. Shop Assembly
  - 1. Fabricate and assemble structural assemblies in shop to greatest extent possible.
  - 2. Fabricate items of structural steel in accordance with AISC "Specification for Structural Steel for Buildings," latest editions, including current supplements and as indicated on final shop drawings.
  - 3. Welding shall conform to ANSI/AWS D1.1
    - a. Shop welding shall be performed by the manual shielded metal arc (SMA), or submerged arc (SA) welding process welding.
    - b. Welding procedures that conform in all respects to the provisions of Section 2, 3, and 4 of AWS D1.1, Structural Welding Code, will be deemed prequalified.
    - c. Procedures other than those prequalified shall be qualified by tests as specified in Section 5 of AWS D1.1. The written welding procedures and the qualification test records shall be submitted to the Engineer for prior approval.
    - d. Welding shall be performed only by welders or operators who have been qualified in accordance with Section 5 of AWS D1.1, and their qualification tests records shall be made available to the Engineer upon request.
    - e. Welds shall be of uniform width and size throughout their length. Each layer shall be smooth and free from slag, cracks, pinholes and undercut, and completely fused to the adjacent weld beads and base metal. The cover pass shall be free from coarse ripples, high crown, deep ridges and valleys between beads, and shall blend smoothly and gradually into the surface of the base metal.
    - f. Fillet and groove welds shall be of specified size with full throat and the legs of uniform length.
    - g. For all details to be joined by welding, and where other continuous welds are not indicated on Plans, provide continuous 3/16-inch seal welds
    - h. Repair, chipping or grinding of welds shall not gouge, groove or reduce the base metal thickness.
    - i. Non-destructive testing, if required, shall conform to Article 6.7 of AWS D1.1.
    - j. The manufacturer's recommendations shall be followed for both the oven-storage and reconditioning of electrodes.
  - 4. Holes: Cut, drill or punch holes perpendicular to metal surfaces. Drill holes in bearing plates.
  - 5. Tolerances: Conform to AISC specified requirements.
  - 6. Properly mark and match-mark materials for field assembly.

- B. Shop Finishing
  - 1. Where finishing is required, complete assembly, including welding of units, before start of finishing operations.
  - 2. Provide finish surfaces of members exposed in final structure free of markings, burrs and other defects.
  - 3. See section 2.5 below for galvanizing finishing requirements.

## 2.6 GALVANIZING

- A. All ferrous metal not specifically addressed in other specification sections, other than stainless steel or items to be epoxy coated, shall be galvanized.
- B. Hardware shall be galvanized in accordance with ASTM A153.
- C. Galvanizing shall be performed before shipment and shall be by a hot dip process conforming to ASTM A 123. Zinc shall conform to ASTM B 6. Each item shall be hot-dipped zinc coated (galvanized) to not less than two ounces per square foot.
- D. Preparation prior to galvanizing shall be by acid pickling. Galvanizing shall be performed the same day as pickling. After pickling and before galvanizing, all items shall be heated to 300 degrees F to expel hydrogen absorbed during pickling.
- E. Components of bolted assemblies shall be galvanized before assembly.
- F. Welded assemblies shall be galvanized after welding.
- G. The zinc coating shall adhere tenaciously to the steel surface, shall be free from blisters and excess zinc, and be even, smooth and uniform throughout. All cutting, punching, drilling and other machine work shall be performed as far as possible before galvanizing. Should any such work or any welding be necessary after galvanizing, the areas from which galvanizing has been removed shall be touched up in the manner described for damaged and rusted items.
- H. Galvanized items which have become damaged or rusted, shall be thoroughly cleaned by wire brushing or grinding. They shall then receive two-brush coats of one of the following formulations or an approved equal:
  - 1. DuPont No. 67-744, Deluxe Galvanized Metal Primer
  - 2. Glidden No. 5229, Galvanized Iron Primer
- I. The coats shall have a combined dry film thickness of not less than six (6) mils.
- J. Field welds shall be brush-coated in the same manner, after cleaning and the removal of all slag.

## PART 3 EXECUTION

### 3.0 ERECTION

- A. Erection shall conform to the provisions of the "Specification for Structural Steel Design - Allowable Stress Design and Plastic Design" of AISC, latest edition.
- B. Cavotec cover installation shall be in accordance with manufacturer's recommendation.
- C. Workmanship:
  - 1. Make all work square, plumb, straight and true, accurately fitted, with tight joints and intersections. Members shall have sharply defined profiles and be free from twists, bends and defects impairing strength and durability. Items not presenting a finished and workmanlike appearance will be rejected.
  - 2. Clip off projecting edges and corners. Finish and dress surfaces, edges and welds smoothly and neatly by grinding, chipping and wire brushing. Reduce sharp edges by grinding to 1/8" radius.
  - 3. Do not flame cut holes or enlarge holes by burning, unless approved by the Engineer.
- D. Field welding shall conform to the requirements of paragraph 2.03 A.3 and the following additional requirements:
  - 1. Field welded connections, if required, shall be of the type, size and in the locations shown on the Plans, and in accordance with AWS D1.
  - 2. Inspection will be visual examination. Non-destructive testing shall not be required, unless otherwise noted or specified elsewhere.

### 3.0 DISSIMILAR METALS

- A. Provide insulation materials to electrically insulate dissimilar metal in contact, such as stainless steel and reinforcing bars, aluminum and structural steel. Example of insulation materials electrical tape, pad, or bolt sleeve.

### 3.1 FIELD APPLICATION

- A. When field welding of galvanized metal is required, a heavy layer of zinc-lead alloy bar solder such as "Galvalloy" or similar approved zinc dust or zinc paste product shall be used.
- B. Touch up members after installation so that all exposed surfaces are primed.

### 3.2 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. All structural welding and high-strength bolting shall be inspected.
- C. Replace damaged or improperly functioning hardware.

### 3.3 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.

- B. Adjust operating hardware and lubricate as necessary for smooth operation.

END OF SECTION



SECTION 05 54 00 - CRANE RAILS AND ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

- A. Sections includes:
  - 1. Crane rails and all accessories.
- B. Related Requirements
  - 1. Section 03 30 00 - Cast-In-Place Concrete.
  - 2. Section 05 50 00 – Metal Fabrications.

1.2 REFERENCE STANDARDS

- A. American Railway Engineering Association (AREA) Manual of Standard Practice.
- B. American Society for Testing and Materials (ASTM) Specifications.
- C. American Welding Society (AWS) Specifications.
- D. Crane Manufacturer's Association of America, Inc. Specification #70.
- E. DIN 536, Part 1, Crane Rails, Hot rolled flat bottom crane rails (type A), September 1991

1.3 SUBMITTALS

- A. With bid submission, list of past rail projects. See section 1.4A.
- B. Evidence of conformance to the referenced standards shall be submitted in accordance with the requirements of Division 1 for the following:
  - 1. Rail and All Other Ferrous Items: Mill test certificates for each heat number.
  - 2. Chocking Compound: Test report from an independent laboratory.
  - 3. Details of the proposed rail-to-rail welding process, weld inspection, and surface finishing.
- C. Welder's certificate. Certificate shall show welder is qualified to perform the proposed rail to rail weld.
- D. Crane rail, standard rail clips, crane rail pads, rail clips at expansion joints, and all crane rail attachment accessories.
- E. Crane rail installation procedure. The procedure shall include description of the proposed method for setting the anchor bolts, installing the grout, and achieving final rail alignment.
- F. Asphaltic concrete. Submit asphaltic concrete mix design for the concrete that will be used to fill the trench around the rail.

- G. Submit written documentation from the rail clip manufacturer stating that personnel installing the crane rail are competent and experienced in the installation of their crane rail system.
- H. Submit written documentation from the grout manufacturer. See 1.4B.
- I. Weld inspection reports.
- J. After the rail installation is complete, the crane rail clip manufacturer shall review the installation and submit written documentation stating that the installation has been reviewed and certifying that the crane rail has been properly installed according to their recommendations and within the specified alignment.

#### 1.4 QUALITY ASSURANCE

- A. Contractor Qualifications: With bid submission, bidders shall provide a list with a minimum of three separate successfully completed gantry crane rail projects - new installation, repair, or replacement, within the most recent three year time period.
- B. Welder's Qualifications: Welders shall have current AWS certificates for the type of materials, welding process and welds performed.
- C. Field Inspection by Manufacturer's Representative: A technical representative of the chocking compound manufacturer shall supervise all chocking compound work and shall certify that all such work was performed in accordance with the manufacturer's specifications.
- D. See paragraph 3.01 for welding inspection.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

- A. Two types of rail shall be provided as follows:
  - 1. 100' gage rail: Rail shall be 171 pounds per yard. Material for the rail shall be new, open hearth, carbon steel, control-cooled, head hardened crane rail, conforming to ASTM A 759. The rail shall have a minimum Brinell Hardness Number (BHN) of 320. Alternatively, rail steel may be produced by the Vacuum Degas process, provided the chemical composition and mechanical properties of the rail are essentially equivalent to rail steel produced by the open-hearth method.
  - 2. 120' gage rail: Rail shall be DIN A150 rail. Material tensile strength shall be at least 128 ksi (880 MPa), with a hardness of at least 261 BHN.
- B. Rail ends shall be prepared for welding.

#### 2.2 ACCESSORIES

- A. Stainless steel filler plate shall be ASTM A 167, Type 316. All other ferrous items, except bolts, nuts and washers shall conform to Section 05 50 00 of these specifications.

- B. Bolts and anchors bolts shall conform to ASTM A 325, or ASTM A 449. Use nuts compatible with bolts in accordance with ASTM A 563.
- C. Chocking compound for support of rail shall be Gantrex K3 epoxy grout, “Chockfast Gray” or “Chockfast Red SG” as manufactured by ITW Polymer Resins, “Five Star HP Epoxy Grout (High Flow)” as manufactured by Five Star Products, Inc., or an approved equivalent. The approved equal shall meet the following requirements:

Parameter	ASTM Standard	Requirement
Compressive strength at 7 days	C579	12,000 psi minimum
Modulus of Elasticity at 7 days	C580	500,000 psi minimum
Linear shrinkage at 28 days	C531	0.0003 in/in maximum
Creep at one year at 80 degrees at 2,500 psi	C1181	0.003 in/in maximum

1. In addition, Contractor shall submit evidence that product has been used successfully for at least five years and has been used on a minimum of three wharves in the United States.
- D. Crane rail clips shall have a weldable lower component, an adjustable, cast upper component and minimum rated lateral load capacity of 50 kips.
1. The rail clips shall be Gantrex or an approved equal. The clips shall as a minimum be equal to Gantrex RailLok 25 as determined by the Engineer.
  2. Alternate crane rail trench and sole plate configurations, to suit rail clips different from those shown on the Plans, may be proposed by the Contractor. The Engineer’s decision regarding the acceptability of a proposed alternative shall be final.
- E. The crane rail pad shall be manufactured from a synthetic elastomer resistant to wear, shear and crushing, oil, grease, ozone, and ultra violet rays.
1. Pads shall be reinforced with a high strength galvanized or stainless steel strip that is at least 90% of the width of the pad and fully vulcanized to the elastomer.
  2. Edge seals on the top and bottom surfaces shall prevent intrusion of dirt and water.
  3. Pad shall be in minimum 39-foot lengths and shall conform to Gantrex RailLok pad, or approved equal.
  4. Any approved equal shall show proof of 3 comparable installations at container facilities, with at least a five-year history of successful performance.

## 2.3 FABRICATION

- A. All ferrous items, except rail, shall be galvanized in accordance with the requirements of Section 05 50 00 of these specifications.
- B. Rail clip lowers shall be welded to base plates in the shop prior to galvanizing.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Work shall conform to AREA standard practice, where applicable, and to the following requirements:
- B. Rail installation procedure shall be as described in the Contractor submittal approved by the Engineer. See 1.03 Submittals, above.
- C. Anchor bolts may be cast in place or drilled and grouted:
  - 1. Cast in place anchor bolts shall be accurately positioned with suitable templates. Each anchor bolt shall be held securely in place to prevent displacement during concrete placement and until the concrete has attained its final set.
  - 2. Placement of drilled anchor bolts shall be coordinated with the presence of existing reinforcement.
- D. Sole plates shall be located at the required elevations by the use of leveling nuts as shown or jacking bolts. Crane rail clips shall not be field welded.
- E. Rails shall be welded, set on the continuous pad and sole plates, and aligned before clips are initially tightened.
  - 1. At rail frogs, where rail sits on stainless steel shim plates, rail shall be lightly greased or oiled prior to installation.
- F. Rails shall not be held temporarily in place by welding.
- G. Attachment to the rail by welding, or any other modification to the rail, is not permitted without the written approval of the Engineer. Any damaged rail shall be repaired or replaced as directed by the Engineer
- H. Any necessary field cutting of rails shall be by sawing. No torch cutting will be permitted.
- I. Rail-to-rail welds shall be butt welds, and shall be Flash Welds or made by the U.S. Thermit, Calorite, or similar approved process. Welding shall be in accordance with the process Port's instructions. Welding shall not be performed with the rail in immediate contact with either the crane rail pad or the steel sole plates.

- J. Rail welds shall be ground smooth and flush to the shape of the rail, and NDT inspected as follows: 100% VT, 100% MT or DPT, and 100% UT of head from the sides and top, and flange from the top. The inspector shall also note and document the surface finishing of weld.
- K. The Port or Engineer may make additional tests to determine the adequacy of the welds. Any welds found defective shall be rewelded at the Contractor's expense.

3.02 PLACING TOLERANCES

- A. Crane rails shall be placed to line, gage and elevation as indicated on the Plans or approved elevations at transitions with the existing rail, with no more than one-eighth (1/8) of an inch variation in any direction from the locations shown on the Plans.

END OF SECTION

## SECTION 06 10 55 – MISCELLANEOUS ROUGH CARPENTRY

### PART 1 GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### PART 2 PRODUCTS

#### 2.1 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
  - 1. Species: Douglas Fir-Larch, unless otherwise indicated.
  - 2. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
  - 3. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee ([www.alsc.org](http://www.alsc.org)) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
  - 4. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.
- B. Lumber fabricated from old growth timber is not permitted.

#### 2.2 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Grading Agency: Southern Pine Inspection Bureau, Inc. (SPIB).
- B. Sizes: Nominal sizes as indicated on drawings, S4S.
- C. Moisture Content: S-dry or MC19.
- D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
  - 1. Lumber: S4S, No. 2 or Standard Grade.
  - 2. Boards: Standard or No. 3.

#### 2.3 EXPOSED DIMENSION LUMBER

- A. Sizes: Nominal sizes as indicated on drawings.
- B. Surfacing: S4S.

- C. Sizes: Nominal sizes as indicated on drawings, S4S.
- D. Moisture Content: Kiln-dry or MC15.

#### 2.4 EXPOSED BOARDS

- A. Submit manufacturer's certificate that products meet or exceed specified requirements, in lieu of grade stamping.
- B. Moisture Content: Kiln-dry (15 percent maximum).
- C. Surfacing: S4S.
- D. Species: Douglas Fir.
- E. Grade: No. 2, 2 Common, or Construction.

#### 2.5 CONSTRUCTION PANELS

- A. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

#### 2.6 ACCESSORIES

- A. Fasteners and Anchors:
  - 1. Metal and Finish: Hot-dipped galvanized steel per ASTM A 153/A 153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
- B. Sill Gasket on Top of Foundation Wall: 1/4 inch thick, plate width, closed cell plastic foam from continuous rolls.
- C. Sill Flashing: As specified in Section 07 6200.
- D. Building Paper: Water-resistant Kraft paper.

#### 2.7 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWWA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
  - 1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
  - 2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWWA standards.
- B. Fire Retardant Treatment:
- C. Preservative Treatment:

## PART 3 EXECUTION

### 3.1 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

### 3.2 INSTALLATION OF CONSTRUCTION PANELS

- A. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
  - 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
  - 2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
  - 3. Install adjacent boards without gaps.

END OF SECTION



## SECTION 06 20 13 - INTERIOR FINISH CARPENTRY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SECTION INCLUDES

- A. Finish carpentry items:

#### 1.3 REFERENCE STANDARDS

- A. ANSI A135.4 - American National Standard for Basic Hardboard; 2004.
- B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2009.
- C. AWPA U1 - Use Category System: User Specification for Treated Wood; American Wood-Preservers' Association; 2010.
- D. BHMA A156.9 - American National Standard for Cabinet Hardware; Builders Hardware Manufacturers Association; 2010 (ANSI/BHMA A156.9).
- E. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; Hardwood Plywood & Veneer Association; 2004.
- F. NEMA LD 3 - High-Pressure Decorative Laminates; National Electrical Manufacturers Association; 2005.
- G. NHLA G-101 - Rules for the Measurement & Inspection of Hardwood & Cypress; National Hardwood Lumber Association; 2007.
- H. PS 1 - Structural Plywood; 2007.
- I. PS 20 - American Softwood Lumber Standard; National Institute of Standards and Technology (Department of Commerce); 2005.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with plumbing rough-in, electrical rough-in, and installation of associated and adjacent components.
- B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

#### 1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.

## 1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of experience.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect work from moisture damage.

## PART 2 PRODUCTS

### 2.1 FINISH CARPENTRY ITEMS

- A. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI/AWMAC/WI Architectural Woodwork Standards for Premium Grade.
- B. Surface Burning Characteristics: Provide materials having fire and smoke properties as required by applicable code.

### 2.2 WOOD-BASED COMPONENTS

- A. Wood fabricated from old growth timber is not permitted.
- B. Provide sustainably harvested wood, certified or labeled as specified in Section 01 6000.

### 2.3 SHEET MATERIALS

- A. Softwood Plywood Not Exposed to View: Any face species, veneer core; PS 1 Grade A-B; glue type as recommended for application.

### 2.4 PLASTIC LAMINATE MATERIALS

- A. Plastic Laminate: NEMA LD 3, HGS; color as selected; finish as selected.
- B. Laminate Backing Sheet: NEMA LD 3, BKL; undecorated plastic laminate.
- C. Laminate Adhesive: Type recommended by laminate manufacturer to suit application; not containing formaldehyde or other volatile organic compounds.

### 2.5 FASTENINGS

- A. Fasteners: Of size and type to suit application; Chrome finish in concealed locations and satin stainless steel finish in exposed locations.
- B. Concealed Joint Fasteners: Threaded steel.

### 2.6 ACCESSORIES

- A. Plastic Edge Trim: Extruded convex shaped; smooth finish; self locking serrated tongue; of width to match component thickness; color as selected.

- B. Aluminum Edge Trim: Extruded convex shape; smooth surface finish; self locking serrated tongue; of width to match component thickness; natural mill finish.
- C. Primer: Alkyd primer sealer.
- D. Wood Filler: Solvent base, tinted to match surface finish color.

## 2.7 FABRICATION

- A. Shop assemble work for delivery to site, permitting passage through building openings.
- B. Cap exposed plastic laminate finish edges with plastic trim.
- C. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.
- D. Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
- E. Apply laminate backing sheet to reverse face of plastic laminate finished surfaces.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify adequacy of backing and support framing.

### 3.2 INSTALLATION

- A. Install work in accordance with AWI/AWMAC/WI Architectural Woodwork Standards requirements for grade indicated.
- B. Set and secure materials and components in place, plumb and level.
- C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.

### 3.3 TOLERANCES

- A. Maximum Variation from True Position: 1/16 inch.
- B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch.

END OF SECTION

## SECTION 06 40 00 - INTERIOR ARCHITECTURAL WOODWORK

### PART -1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and Division 0 General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Wood cabinets (casework).
  - 2. Laminate clad cabinets (plastic-covered casework).
  - 3. Cabinet tops (countertops).
  - 4. Interior miscellaneous ornamental items.
- B. Other sections of the specification that include requirements that relate to this section include but are not limited to the following:
  - 1. Division 6 Section "Rough Carpentry" for furring, blocking and other carpentry work that is not exposed to view.
  - 2. Division 9 Section "Painting" for final finishing of installed architectural woodwork.

#### 1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.
- B. It is a requirement of this section that shop drawings showing each woodwork item be coordinated with shop drawings for mechanical and electrical discipline's components. Shop drawings shall show location of each architectural item, dimensioned plans and elevations and large-scale details indicating terminations, reveal, material thickness, attachment devices and other related components. Shop drawings for this section shall also show items which are provided per mechanical and electrical sections and are required to be assembled with backing or other woodwork components provided per this Section. Indicate installation responsibility of each item.
- C. In order to review the coordination of all components of the interior architectural woodwork, shop drawings for this Section and associated mechanical and electrical sections shall be submitted to the Architect as part of a single, fully coordinated submittal package. Any submittal of shop drawings for either this Section which is not part of a fully coordinated submittal package will be considered incomplete and will be returned to the Contractor without review.
- D. Product data for each type of product and process specified in this section and incorporated into items of architectural metal work and woodwork during fabrication,

finishing, and installation.

- E. Fire-retardant treatment data for material impregnated by pressure process to reduce combustibility. Include certification by treating plant that treated materials comply with requirements.
- F. Shop drawing's showing location of each architectural woodwork, dimensioned plans and elevations, and large-scale details indicating terminations, reveals, material thickness, fire protection attachment devices, and other related components.
- G. Samples of the following:
  - 1. Lumber with or for transparent finish, 50 square inches, for each species and cut, finished on one side and one edge with specified color and finish.
  - 2. Wood veneer faced panel products applied to substrate specified with or for transparent finish, 36 inches by 84 inches, for each species and cut with one half of exposed surface finished, with separate samples of unfaced panel product used for core.
  - 3. Lumber and panel products with factory-applied opaque finish, 24 inches by 24 inches for panels and 50 square inches for lumber, for each finish system and color, with one half of exposed surface finished.
  - 4. Laminate clad panel products, 8-1/2 inches, by 11 inches for each type, color, pattern, and surface finish, with separate samples of unfaced panel product used for core.
  - 5. Full size drawer front and cabinet door front at each type and design of casework.
- H. Product certificates signed by woodwork manufacturer certifying that products comply with specified requirements.
- I. Woodwork Manufacturers recommendations for optimum temperature and humidity conditions for woodwork during storage and installation.
- J. Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners, and other information specified.
- K. Copies of Standards in accordance with Section 01421, Reference Standards and Definitions, and Section 01300, Submittals.

#### 1.4 QUALITY ASSURANCE

- A. **Manufacturer Qualifications:** Firm experienced in successfully producing both architectural woodwork similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the Work. Firm shall have been in the business of like manufacturing for a minimum of five years.
- B. **Single-Firm Production:** Production shall be by a single firm of architectural woodwork with in house production capacity of fabrication, finishing, sequence matched wood veneering, and assembling and finishing integral.

- C. AWI Quality Standard: Comply with applicable requirements of "Architectural Woodwork Quality Standards" published by the Architectural Woodwork Institute (AWI) except as otherwise indicated.
- D. Hardware Coordination: Distribute copies of approved schedule for cabinet hardware specified in Division 8 Section "Finish Hardware" to manufacturer of architectural woodwork; coordinate cabinet shop drawings and fabrication with hardware requirements.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soilage, and deterioration, including damage from sunlight.
- B. Do not deliver woodwork until painting, wet work, grinding, and similar operations that could damage, soil, or deteriorate woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified in "Project Conditions."

#### 1.6 PROJECT CONDITIONS

- A. Environmental Conditions: Obtain and comply with Woodwork Manufacturer's and Installer's coordinated advice for optimum temperature and humidity conditions for woodwork during its storage and installation. Do not install woodwork or until these conditions have been attained and stabilized so that woodwork is within plus or minus 1.0 percent of optimum moisture content from date of installation through remainder of construction period.
- B. Field Measurements: Where woodwork is indicated to be fitted to other construction, check actual dimensions of other construction by accurate field measurements before manufacturing woodwork; show recorded measurements on final shop drawings. Coordinate manufacturing schedule with construction progress to avoid delay of Work.
  - 1. Where field measurements cannot be made without delaying the Work, coordinate to agreed dimensions and proceed with manufacture of woodwork without field measurements. Coordinate other construction to ensure that actual dimensions correspond to agreed dimensions.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
  - 1. High pressure decorative laminates.
    - a. Laminart.
    - b. Nevamar Corp.
    - c. Wilsonart

- d. Formica
- 2. Solid Surfacing
  - a. Gibraltar
  - b. Avonite
  - c. Corian
  - d. Fountainhead
- 3. Hardwood Plywood
  - a. States Industries, P O Box 7037, Eugene, OR 97401

## 2.2 MATERIALS

- A. General: Provide materials that comply with requirements of the AWI woodworking standard for each type of woodwork and quality grade indicated and, where the following products are part of woodwork, with requirements of the referenced product standards, that apply to product characteristics indicated:
  - 1. High Pressure Laminate: NEMA LID 3, comply with manufacturers listed in 2.1-A above.
  - 2. Particleboard: ANSI A208.1
  - 3. Softwood Plywood: PS 1.
  - 4. Hardwood Plywood:
    - a. Material: Maple "Apple-ply".
    - b. Grade: C2
    - c. Thickness; 3/4"
    - d. Number of plys: 13
    - e. Frame Spread: 200
  - 5. Formaldehyde Emission Levels: Comply with formaldehyde emission requirements of each voluntary standard referenced below:
    - a. Particleboard: NPA 8.
    - b. Hardwood Plywood: HPMA FE.
- B. Fire-Retardant Particleboard: Where indicated, provide panels complying with the following requirements that have fire-retardant chemicals bonded to softwood particles at time of panel manufacture to achieve products identical to those tested for flame spread of 20 or less and for smoke developed of 25 or less per ASTM E 84 by UL or other testing and inspecting organization acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing and inspecting organization.
  - 1. Product: Subject to compliance with requirements, provide "Duraflake FR" by Duraflake Div.; Willamette Industries, Inc.

## 2.3 FABRICATION, GENERAL

- A. Wood Moisture Content: Comply with requirements of referenced quality standard for moisture content of lumber in relation to relative humidity conditions existing during time of fabrication and in installation areas.
- B. Fabricate woodwork to dimensions, profiles, and details indicated.
- C. Complete fabrication, including assembly, finishing, and hardware application, before shipment to project site to maximum extent possible. Wood paneling with metal screeds to be factory prefit and preassembled. Final assembly of screeds to occur at project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- D. Factory-cut openings; to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Smooth edges of cutouts and, where located in countertops and similar exposures, seal edges of cutouts with a water-resistant coating.

#### 2.4 ASSEMBLY OF WOODWORK

- A. Assemble woodwork to comply with requirements indicated for design, dimensions, materials, joinery, and performance.
  - 1. Plastic laminate sheets shall be laminated with adhesive over substrate backing of thickness and dimension detailed and finished units attached to wall substrate with adhesive and exposed countersunk fasteners as detailed.
  - 2. Adhesive: 3M transfer tape adhesive or equal.
  - 3. Fabrication, Assembly: The combination assembly and installation shall be completed in such a manner that will avoid any warping of sub-strate.

#### 2.5 STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

- A. Quality Standard: Comply with AWI Section 300.
- B. Groove backs of flat trim. members and kerf backs of other wide flat members, except for members with ends exposed in finished work to protect from warping after installation.
- C. Assemble casings in plant except where limitations of access to place of installation require field assembly.
- D. Grade: Premium.

#### 2.6 LAMINATE CLAD CASEWORK

- A. Quality Standard: Comply with AWI Section 400 and its Division 400B "Laminate Clad Cabinets."
- B. Grade: Premium.
- C. AWI Type of Cabinet Construction: Flush overlay.



- D. Laminate Cladding: High pressure decorative laminate complying with the following requirements:
1. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
    - a. Match Architect's sample.
    - b. Match color, pattern, and finish indicated by reference to laminate manufacturer's standard designations for these characteristics as listed.
    - c. Manufacture to specifications set by material provider to insure said provider's warranties. All panels shall have a balancing backer sheet.
    - d. Grain Direction: Parallel to longest dimension.
  2. Laminate Grade for Exposed Surfaces: Provide laminate cladding complying with the following requirements for type of surface and grade.
    - a. Horizontal Surfaces Including Tops: GP-50 (0.050-inch nominal thickness).
    - b. Vertical Surfaces: GP-28 (0.028-inch nominal thickness).
    - c. Edges: GP-50 (0.050-inch nominal thickness).
  3. Semi exposed Surfaces: Provide surface materials indicated below:
    - a. High pressure laminate, GP-28.
    - b. "Apple-ply" to receive metal facings and high pressure laminate.
- E. Finish for Interior and shelves of Cabinets: PL2
- F. Finish Schedule:
1. Selection of color and pattern pending final selection of Port and User. Color and pattern to be selected from manufacturer's standard line.

## 2.7 CABINET HARDWARE AND ACCESSORY MATERIALS

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 8 Section "Finish Hardware."
- B. Cabinet Hardware Schedule: Refer to schedule at end of this section for cabinet hardware required for architectural cabinets.
- C. Hardware Standard: Comply with ANSI/BHMA A1 56.9 "American National Standard for Cabinet Hardware" for items indicated by reference to BHMA numbers or referenced to this standard.
- D. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for BHMA code number indicated.

1. Satin Stainless Steel, Stainless Steel Base: BHMA 630.
  - E. Drawer Gliders: Alluride or approved equal, Box drawers, minimum of 75# load rating. File or drawers wider than 20 inches or deeper than 8 inches shall have minimum 100# rating.
  - F. For concealed hardware provide manufacturer's standard finish that complies with product class requirements of ANSI/BHMA A1 56.9.
- 2.8 INTERIOR MISCELLANEOUS ORNAMENTAL ITEMS FOR TRANSPARENT FINISH
- A. Quality Standard: Comply with AW I Section 700.
  - B. Grade: Premium.
  - C. Lumber Species: Match species and cut indicated for other types of transparent finished architectural woodwork located in same areas of building unless otherwise indicated.
- 2.9 INTERIOR MISCELLANEOUS ORNAMENTAL ITEMS FOR OPAQUE FINISH
- A. Quality Standard: Comply with AW I Section 700.
  - B. Grade: Premium.
  - C. Lumber Species: Any closed-grain hardwood listed in referenced woodworking standard.
- 2.10 INTERIOR DOOR FRAMES FOR OPAQUE FINISH
- A. Quality Standard: Comply with AW I Section 900B.
  - B. Grade: Premium.
  - C. Lumber Species: Poplar Wood.
  - D. Fire-Rated Door Frames: Provide fire-rated wood frames for wood doors that are identical to units tested in door and frame assemblies per ASTM E152 and that are labeled and listed for ratings indicated by UL, Warnock Hersey, or other testing and inspection organization acceptable to authorities having jurisdiction.
- 2.11 FASTENERS AND ANCHORS
- A. Screws: Select material, type, size, and finish required for each use. Comply with FS FF-S111 for applicable requirements.
    1. For metal framing supports, provide screws as recommended by metal framing manufacturer.
  - B. Nails: Select material, type, size, and finish required for each use. Comply with FS FF-N-105 for applicable requirements.
  - C. Anchors: Select material, type, size, and finish required by each substrate for secure

anchorage. Provide nonferrous metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts and anchors, as required, to be set into concrete or masonry work for subsequent woodwork anchorage.

- D. Exposed Fasteners A: #8 pan-head stainless steel screws with square drive. Length as required per details.
- E. Exposed Fasteners B: 1/4" hex head stainless steel screws with 3/4" O.D. stainless steel flat washers.

## 2.12 FACTORY FINISHING OF INTERIOR ARCHITECTURAL WOODWORK

- A. Quality Standard: Comply with AW I Section 1500 unless otherwise indicated.
- B. General: The primary finishing, pre-finishing and final finishing of interior architectural woodwork is required to be performed at factory and is specified in this section. Refer to Division 9 Section "Painting" for final finishing of installed architectural woodwork and for material and application requirements of prime coats for woodwork not specified to receive final finish in this section.
- C. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces and similar preparations for finishing of architectural woodwork, as applicable to each unit of work.
- D. Opaque Finish: Comply with requirements indicated below for grade and color. Refer to Section 09900 "Painting", Paragraph 3.8 (F) Woodwork-Opaque Finish.
  - 1. Grade: Premium.
  - 2. Color: Match Architect's sample.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Condition woodwork to average prevailing humidity conditions in installation areas before installing.
- B. Deliver concrete inserts and similar anchoring devices to be built into substrates well in advance of time substrates are to be built.
- C. Before installing architectural woodwork examine shop-fabricated work for completion and complete work as required, including back priming and removal of packing.
- D. Examine substrates and areas where Architectural Woodwork will be installed. Verify that installation` of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind the Architectural Woodwork completed. Do not proceed with installation until unsatisfactory conditions have been corrected. Beginning work constitutes acceptance of substrate.

### 3.2 INSTALLATION

- A. Quality Standard: Install woodwork to comply with AWI Section 1700 for same grade specified in Part 2 of this section for type of woodwork involved.
- B. Install woodwork plumb, level, true, and straight with no distortions. Shim as required with concealed shims. Install to a tolerance of 1/8 inch in 8'-0" for plumb and level (including tops) and with no variations in flushness of adjoining surfaces.
- C. Scribe and cut woodwork to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.
- D. Fire-Retardant-Treated Wood: Handle, store, and install fire- retardant-treated wood to comply with recommendations of chemical treatment manufacturer including those for adhesives where are used to install woodwork.
- E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where prefinished matching fastener heads are required, use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork and matching final finish where transparent finish is indicated. Coordinate work with wood blocking furnished in Section 06100, Rough Carpentry, to assure a secure installation.
- F. Standing and Running Trim and Rails: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to the greatest extent possible. Stagger joints in adjacent and related members. Cope at returns and miter at corners.
- G. Cabinets: Install without distortion so that doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete the installation of hardware and accessory items as indicated. Metal edge trim shall be aligned with 1/32" maximum tolerance. Maintain veneer sequence matching of cabinets with transparent finish.
- H. Tops: Anchor securely to base units and other support systems as indicated.
- I. Paneling: Install paneling with an extruded aluminum cleat system without visible connectors. Coordinate installation with wood blocking installation furnished in Section 06100, Rough Carpentry, to accommodate conditions and requirements for on-site attachments. Install panels in such a manner to allow removal at a later date for maintenance or repair.
- J. Complete the finishing work specified in this section to whatever extent not completed at shop or before installation of woodwork.
- K. Refer to the Division 9 sections for final finishing of installed architectural woodwork.

### 3.3 ADJUSTMENT AND CLEANING

- A. Repair damaged and defective woodwork where possible to eliminate defects functionally and visually; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semi exposed surfaces. Touch up factory applied finishes to restore damaged or soiled areas.

### 3.4 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensures that woodwork is being without damage or deterioration at time of Completion.

### 3.5 HARDWARE SCHEDULE

- A. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include but are not limited to the following:
  - 1. Drawer Slides: Julius Blum Inc., BS426
  - 2. Drawer Pulls: Hafele America Co., Western Division, [16926-A S. Keegan Ave., Carson, CA 90746 (Tel 310-604-8125)] Cat. No. to be selected from standard line.
  - 3. Casework and Adjustable Shelf Standards: Knape and Vogt Co., "255", with 4 "256" support clips per shelf.
  - 4. Hinges: Blum, Grass, or Stanley concealed hinges or approved; 175 degree opening, self closing. Number of hinges as recommended by the door manufacturer for the door size and weight.
  - 5. Bifold intermediate hinges: Universal Industries Products Co., "Soss Invisible" #204.
  - 6. Drawer Locks: Garcy 4077, Keyed in accordance with the Owner's requirements. Furnish two (2) keys per lock.
  - 7. Pressure Catches: Hafele.
  - 8. TV Pullout Shelf: Full extension type, approximate 12" length; swivel shelf end; minimum 100 lb capacity.
  - 9. Miscellaneous Hardware: As required; subject to Approval by the Architect.

END OF SECTION

## SECTION 07 14 16 - FLUID-APPLIED WATERPROOFING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SECTION INCLUDES

- A. Fluid applied membrane waterproofing.
- B. Cant strips and other accessories.
- C. Drainage panels and Protection boards.

#### 1.3 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. AATCC Test Method 30 - Antifungal Activity, Assessment on Textile Materials: Mildew and Rot Resistance of Textile Materials; 2004.
- C. ASTM C836/C836M - Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use With Separate Wearing Course; 2012.
- D. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension; 2006a.
- E. ASTM D429 - Standard Test Methods for Rubber Property--Adhesion to Rigid Substrates; 2008.
- F. ASTM D471 - Standard Test Method for Rubber Property--Effect of Liquids; 2012.
- G. ASTM D624 - Standard Test Method For Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers; 2000 (Reapproved 2012).
- H. ASTM D746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact; 2007.
- I. ASTM D2240 - Standard Test Method For Rubber Property--Durometer Hardness; 2005 (Reapproved 2010).
- J. ASTM D3468 - Standard Specification for Liquid-Applied Neoprene and Chlorosulfonated Polyethylene Used in Roofing and Waterproofing; 1999 (Reapproved 2006).
- K. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers; 2009.

- L. ASTM D5385 - Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes; 1993 (Reapproved 2006).
- M. ASTM E96/E96M - Standard Test Methods For Water Vapor Transmission of Materials; 2010.
- N. NRCA ML104 - The NRCA Roofing and Waterproofing Manual; National Roofing Contractors Association; Fifth Edition, with interim updates.

#### 1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for membrane, surface conditioner, flexible flashings, joint cover sheet, and joint and crack sealants.
- C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.
- D. Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and acceptable installation temperatures.
- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Broward County, Port Everglades's name and registered with manufacturer.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacture of fluid-applied waterproofing membranes with three years experience.
- B. Installer Qualifications: Company specializing in installation of fluid-applied waterproofing with minimum five years experience.

#### 1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until cured.

#### 1.7 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Contractor shall correct defective Work within a five year period after Date of Substantial Completion; remove and replace materials concealing waterproofing at no cost to Broward County, Port Everglades.
- C. Provide five year manufacturer warranty for waterproofing failing to resist penetration of water, except where such failures are the result of structural failures of building. Hairline cracking of concrete due to temperature change or shrinkage is not considered a structural failure.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Hot-Applied Rubberized Asphalt Waterproofing Manufacturers:
- B. Cold-Applied Rubberized Asphalt Waterproofing Manufacturers:
  - 1. American Hydrotech, Inc.: [www.hydrotechusa.com](http://www.hydrotechusa.com).
  - 2. Barrett Company: [www.barrettroofs.com](http://www.barrettroofs.com).
  - 3. Carlisle coatings & Waterproofing, Inc: [www.carlisle-ccw.com](http://www.carlisle-ccw.com).
- C. Synthetic Rubber Waterproofing Manufacturers:
  - 1. BASF Construction Chemicals-Building Systems;: [www.buildingsystems.basf.com](http://www.buildingsystems.basf.com)
- D. Polyurethane Waterproofing Manufacturers:
- E. Sprayed Thin-Film Elastomeric Waterproofing Manufacturers:
  - 1. Protective Coatings Technology, Inc: [www.poly-wall.com](http://www.poly-wall.com).

### 2.2 MEMBRANE AND FLASHING MATERIALS

- A. Hot-Applied Rubberized Asphalt Waterproofing: Elasticized rubberized asphaltic compound, hot-applied and quick setting.
  - 1. Cured Thickness: 0.03 inches, minimum.
  - 2. Suitable for installation over concrete substrates.
  - 3. Tensile Strength: 15 psi, measured in accordance with ASTM D412.
  - 4. Ultimate Elongation: 500 percent, measured in accordance with ASTM D412.
  - 5. Hardness: 60, measured in accordance with ASTM D2240, using Type A durometer.
  - 6. Tear Strength: 150 lbf/inch, measured in accordance with ASTM D624.
  - 7. Water Vapor Permeability: 0.014 perm inch, measured in accordance with ASTM E96/E96M.
  - 8. Adhesion: Greater than 150 psi, measured in accordance with ASTM D4541.
- B. Synthetic Rubber Waterproofing: Cold-applied neoprene or chlorosulfonated polyethylene complying with ASTM D3468; quick setting.
  - 1. Cured Thickness: 0.06 inch, minimum.
  - 2. Suitable for installation over concrete substrates.
  - 3. Tensile Strength: 15 psi, measured in accordance with ASTM D412.
  - 4. Ultimate Elongation: 500 percent, measured in accordance with ASTM D412.
  - 5. Tear Strength: 150 lbf/inch, measured in accordance with ASTM D624.
  - 6. Hardness: 60, measured in accordance with ASTM D2240, using Type A durometer.
  - 7. Water Vapor Permeability: 0.014 perm inch, measured in accordance with ASTM E96/E96M.



8. Adhesion: greater than 150 psi, measured in accordance with ASTM D4541.
  9. Brittleness Temperature: -40 F, measured in accordance with ASTM D746.
- C. Polyurethane Waterproofing: Cold-applied one or two component polyurethane, complying with ASTM C836/C836M.
1. Cured Thickness: 60 mils, minimum.
  2. Suitable for installation over concrete substrates.
  3. VOC Content: None.
  4. Tensile Strength: 400 psi, measured in accordance with ASTM D412.
  5. Ultimate Elongation: 500 percent, measured in accordance with ASTM D412.
  6. Hardness: 60, measured in accordance with ASTM D2240, using Type A durometer.
  7. Adhesion: greater than 150 psi, measured in accordance with ASTM D4541.
  8. Brittleness Temperature: -50 F, measured in accordance with ASTM D746.
- D. Sprayed Thin-Film Elastomeric Waterproofing: Elastomeric, UV-resistant coating capable of being applied to damp masonry and green concrete without adverse effect on adhesion; complying with requirements of ASTM C 836 except for minimum film thickness.
1. Film Thickness: 13 mils, minimum.
  2. Hydrostatic Pressure Resistance: 20 psi, minimum, when tested in accordance with ASTM D 5385.
  3. Permeance: 0.1 perm, maximum, when tested in accordance with ASTM E 96/E 96M.
  4. Adhesion: Not less than 350 pounds-force per square inch when tested in accordance with ASTM D 4541.
  5. Resistance to Fungal Growth: Pass AATCC Test Method 30.
  6. Application Temperature: From minus 10 degrees F to 100 degrees F.
  7. VOC Content: Less than 600 g/L when tested in accordance with 40 CFR 59 Subpart D (EPA Method 24).
  8. Suitable for use on concrete, masonry, and gypsum sheathing.

### 2.3 ACCESSORIES

- A. Surface Conditioner: type, compatible with membrane compound; as recommended by membrane manufacturer.
- B. Separation Sheet: Sheet polyethylene, 6 mil thick.
- C. Protection Board: Rigid insulation specified in Section 07 2100.
- D. Drainage Panel: 1/4 inch thick formed plastic, hollowed sandwich..
- E. Cant Strips: Premolded composition material.
- F. Counterflashings: Stainless steel or other approved by architect as specified in Section 07 6200.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify substrate surfaces are free of frozen matter, dampness, loose particles, cracks, pits, projections, penetrations, or foreign matter detrimental to adhesion or application of waterproofing system.
- C. Verify that substrate surfaces are smooth, free of honeycomb or pitting, and not detrimental to full contact bond of waterproofing materials.
- D. Verify that items that penetrate surfaces to receive waterproofing are securely installed.

### 3.2 PREPARATION

- A. Protect adjacent surfaces not designated to receive waterproofing.
- B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions. Vacuum substrate clean.
- C. Do not apply waterproofing to surfaces unacceptable to manufacturer.
- D. Seal cracks and joints with sealant using methods recommended by sealant manufacturer.
- E. Install cant strips at inside corners.

### 3.3 INSTALLATION

- A. Apply waterproofing in accordance with manufacturer's instructions to specified minimum thickness.
- B. Conform to NRCA Waterproofing and Dampproofing Manual drawing details as noted:
- C. Apply primer or surface conditioner at a rate recommended by manufacturer. Protect conditioner from rain or frost until dry.
- D. At joints and cracks less than 1/2 inch in width including joints between horizontal and vertical surfaces, apply 12 inch wide strip of joint cover sheet.
- E. Center joint cover sheet over joints. Roll sheet into 1/8 inch coating of waterproofing material. Apply second coat over sheet extending minimum of 6 inches beyond sheet edges.
- F. Apply extra thickness of waterproofing material at corners, intersections, and angles.
- G. Install flexible flashings and seal into waterproofing material. Seal items penetrating through membrane with flexible flashings.
- H. Extend waterproofing material and flexible flashing into drain clamp flange, apply adequate coating of liquid membrane to assure clamp ring seal. Coordinate with drain installation.

- I. Seal membrane and flashings to adjoining surfaces. Install termination bar at all edges. Install counterflashing over all exposed edges.

#### 3.4 INSTALLATION - DRAINAGE PANEL AND PROTECTION BOARD

- A. Immediately after cooling, dust membrane with tack-reducing surfacing at rate of approximately 10 lbs/100 sq ft.
- B. After membrane has cooled, but before it becomes dusty, apply separation sheet. Lap joints to ensure complete coverage.
- C. Place drainage panel directly against membrane, butt joints, place to encourage drainage downward. Scribe and cut boards around projections, penetrations, and interruptions.
- D. Place protection board directly against drainage panel; butt joints. Scribe and cut boards around projections, penetrations, and interruptions.
- E. Adhere protection board to substrate with compatible adhesive.

#### 3.5 FIELD QUALITY CONTROL

- A. On completion of horizontal membrane installation, dam installation area in preparation for flood testing.
- B. Flood to minimum depth of 1 inch with clean water. After 48 hours, inspect for leaks.
- C. If leaking is found, remove water, repair leaking areas with new waterproofing materials as directed by Bermello, Ajamil & Partners; repeat flood test. Repair damage to building.
- D. When area is proven watertight, drain water and remove dam.

#### 3.6 PROTECTION

- A. Do not permit traffic over unprotected or uncovered membrane.

END OF SECTION

## SECTION 07 21 13 - THERMAL INSULATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SECTION INCLUDES

- A. Board insulation at cavity wall construction, perimeter foundation wall, underside of floor slabs, and exterior wall behind wall finish:

#### 1.3 REFERENCE STANDARDS

- A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2011be1.
- B. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2010.
- C. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- D. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2006.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2012.
- F. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2012.
- G. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.
- H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

#### 1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- C. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

## 1.5 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Insulation:
  - 1. Dow Chemical Inc.
  - 2. Owens-Corning Corp.
  - 3. Pactiv Building Products Inc.
  - 4. Substitutions: See Section 01 6000 - Product Requirements.

### 2.2 APPLICATIONS

- A. Insulation Inside Cavity Walls: Extruded polystyrene board.
- B. Insulation on Inside of Concrete and Masonry Exterior Walls: Extruded Polystyrene board.
- C. Insulation in Metal Framed Walls: Batt insulation with no vapor retarder.

### 2.3 FOAM BOARD INSULATION MATERIALS

- A. Extruded Polystyrene Board Insulation: ASTM C578, Type X; Extruded polystyrene board with either natural skin or cut cell surfaces; with the following characteristics:
  - 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
  - 2. Flame Spread Index: 75 or less, when tested in accordance with ASTM E84.
  - 3. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
  - 4. Board Size 48 x 96 inch.
  - 5. Board Thickness: 1-1/2 inches.
  - 6. Board Edges: Square.
  - 7. Thermal Conductivity (k factor) at 25 degrees F: 0.18.
  - 8. Compressive Resistance: 15 psi.
  - 9. Board Density: 1.3 lb/cu ft.
  - 10. Water Absorption, maximum: 0.3 percent, volume.
  - 11. Manufacturers:
    - a. Dow Chemical Co: [www.dow.com](http://www.dow.com).
    - b. Owens Corning Corp: [www.owenscorning.com](http://www.owenscorning.com).
    - c. Pactiv Building Products: [greenguard.pactiv.com](http://greenguard.pactiv.com).

### 2.4 FIBER BOARD INSULATION MATERIALS

### 2.5 BATT INSULATION MATERIALS

- A. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.

1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
4. Formaldehyde Content: Zero.
5. Facing: Unfaced.
6. Manufacturers:
  - a. CertainTeed Corporation: [www.certainteed.com](http://www.certainteed.com).
  - b. Johns Manville Corporation: [www.jm.com](http://www.jm.com).
  - c. Owens Corning Corp: [www.owenscorning.com](http://www.owenscorning.com).

## 2.6 ACCESSORIES

- A. Tape: Bright aluminum self-adhering type, mesh reinforced, 2 inch wide.
- B. Insulation Fasteners: Impaling clip of unfinished steel with washer retainer and clips, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.
- C. Adhesive: Type recommended by insulation manufacturer for application.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation and adhesive.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

### 3.2 BOARD INSTALLATION AT FOUNDATION PERIMETER

- A. Install boards horizontally on foundation perimeter.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

### 3.3 BOARD INSTALLATION AT EXTERIOR WALLS

- A. Adhere a 6 inch wide strip of polyethylene sheet over expansion joints with double beads of adhesive each side of joint.
  1. Tape seal joints between sheets.
  2. Extend sheet full height of joint.
- B. Apply adhesive to back of boards:
  1. Three continuous beads per board length.
  2. Full bed 1/8 inch thick.
- C. Install boards horizontally on walls.

1. Place boards to maximize adhesive contact.
  2. Install in running bond pattern.
  3. Butt edges and ends tightly to adjacent boards and to protrusions.
- D. Extend boards over expansion joints, unbonded to wall on one side of joint.
- E. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- F. Place 6 inch wide polyethylene sheet at perimeter of wall openings, from adhesive vapor retarder bed to window and door frames. Tape seal in place to ensure continuity of vapor retarder and air seal.
- G. Tape insulation board joints.

### 3.4 BOARD INSTALLATION AT CAVITY WALLS

- A. Secure impale fasteners to substrate at a frequency as follows:
1. 6 per insulation board.
- B. Adhere a 6 inch wide strip of polyethylene sheet over expansion joints with double beads of adhesive each side of joint.
1. Tape seal joints between sheets.
  2. Extend sheet full height of joint.
- C. Apply adhesive to back of boards:
1. Three continuous beads per board length.
  2. Full bed 1/8 inch thick.
- D. Install boards to fit snugly between wall ties.
- E. Install boards horizontally on walls.
1. Place boards to maximize adhesive contact.
  2. Install in running bond pattern.
  3. Butt edges and ends tightly to adjacent boards and to protrusions.
  4. Place impale fastener locking discs.
- F. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

### 3.5 BOARD INSTALLATION UNDER CONCRETE SLABS

- A. Place insulation under slabs on grade after base for slab has been compacted.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

### 3.6 BATT INSTALLATION

- A. Install insulation and vapor retarder in accordance with manufacturer's instructions.

- B. Install in exterior wall spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
- E. Tape insulation batts in place.
- F. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.
- G. At metal framing, place vapor retarder on warm side of insulation; lap and seal sheet retarder joints over member face.
- H. Tape seal tears or cuts in vapor retarder.
- I. Extend vapor retarder tightly to full perimeter of adjacent window and door frames and other items interrupting the plane of the membrane. Tape seal in place.

### 3.7 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION



## SECTION 07 55 50 - PROTECTED MEMBRANE ROOFING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes

- 1. Asphaltic modified bituminous roofing and lightweight insulating concrete

#### 1.3 REFERENCES

- A. Factory Mutual (FM Global) - Approval Guide
- B. Underwriters Laboratories (UL) - Roofing Systems and Materials Guide (TGFU R1306)
- C. American Society for Testing and Materials (ASTM) - Annual Book of ASTM Standards
- D. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) - Architectural Sheet Metal Manual
- E. Asphalt Roofing Manufacturers Association (ARMA)
- F. National Roofing Contractors Association (NRCA)
- G. American Society of Civil Engineers (ASCE)

#### 1.4 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D1079 and the glossary of the National Roofing Contractors Association (NRCA) Roofing and Waterproofing Manual for definitions of roofing terms related to this section.

#### 1.5 PERFORMANCE REQUIREMENTS

- A. Provide an installed roofing membrane and base flashing system that does not permit the passage of water, and will withstand the design pressures calculated in accordance with the most current revision of ASCE 7.
- B. GAFMC shall provide all primary roofing materials that are physically and chemically compatible when installed in accordance with manufacturers current application requirements.

#### 1.6 SUBMITTALS

- A. Product Data: Provide product data sheets for each type of product indicated in this section.

- B. Shop Drawings: Provide manufacturers standard details and approved shop drawings for the roof system specified.
- C. Samples: Provide samples of insulation(s), fasteners and roll goods for verification of quality.
- D. Certificates: Installer shall provide written documentation from the manufacturer of their authorization to install the roof system, and eligibility to obtain the warranty specified in this section.

#### 1.7 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: GAFMC shall provide a roofing system that meets or exceeds all criteria listed in this section.
- B. Installer's Qualifications:
  - 1. Installer shall be classified as Master Select contractor as defined and certified by GAFMC.
- C. Source Limitations: All components listed in this section shall be provided by a single manufacturer or approved by the primary roofing manufacturer.
- D. Final Inspection
  - 1. Manufacturer's representative shall provide a comprehensive final inspection after completion of the roof system. All application errors must be addressed and final punch list completed.

#### 1.8 PRE-INSTALLATION CONFERENCE

- A. Prior to scheduled commencement of the roofing installation and associated work, conduct a meeting at the project site with the installer, architect, owner, GAFMC representative and any other persons directly involved with the performance of the work. The installer shall record conference discussions to include decisions and agreements, and furnish copies of recorded discussions to each attending party. The main purpose of this meeting is to review foreseeable methods and procedures related to roofing work.

#### 1.9 REGULATORY REQUIREMENTS

- A. All work shall be performed in a safe, professional manner, conforming to all federal, state and local codes.

#### 1.10 DELIVERY, STORAGE AND HANDLING

- A. Deliver all roofing materials to the site in original containers, with factory seals intact. All products are to carry either a GAFMC or BMCA® label.
- B. Store all pail goods in their original undamaged containers in a clean, dry location within their specified temperature range.

- C. Store roll goods on end on pallets in a clean, dry, protected area. Take care to prevent damage to roll ends or edges. Do not double stack modified bitumen products.
- D. Do not expose materials to moisture in any form before, during, or after delivery to the site. Reject delivery of materials that show evidence of contact with moisture.
- E. Remove manufacturer supplied plastic covers from materials provided with such. Use “breathable” type covers such as canvas tarpaulins to allow venting and protection from weather and moisture. Cover and protect materials at the end of each work day. Do not remove any protective tarpaulins until immediately before the material is to be installed.
- F. Materials shall be stored above 55°F (12.6°C) a minimum of 24 hours prior to application.

#### 1.11 PROJECT CONDITIONS

##### A. Weather

- 1. Proceed with roofing only when existing and forecasted weather conditions permit.
- 2. Ambient temperatures must be above 45°F (7.2°C) when applying hot asphalt or water based adhesives.

#### 1.12 WARRANTY

- A. Provide Manufacturers standard WeatherStopper® Diamond Pledge® Guarantee with single source coverage and no monetary limitation, where the manufacturer agrees to repair or replace components in the roofing system, which cause a leak due to a failure in materials or workmanship.
  - 1. Duration: Twenty (20) years from the date of completion.
  - 2. Materials and workmanship of listed products within this section when installed in accordance with current GAFMC application and specification requirements.

### PART 2 PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURER

- A. GAF Materials Corporation - 1361 Alps Road, Wayne, NJ 07470

#### 2.2 INSULATION ACCESSORIES

- A. Cant Strip: Factory fabricated rigid perlite strip cut at angles to provide a true 45° Angle between horizontal and vertical surfaces, EnergyGuard Perlite Cant Strip, by BMCA®
- B. Tapered Edge Strip: Factory fabricated rigid perlite strip cut at angles to provide a smooth transition between differences in elevation. EnergyGuard Tapered Edge Strip, by BMCA®

#### 2.3 BASE / PLY SHEETS

- A. Moisture resistant and flame retardant inorganic base sheet, asphalt coated with mineral granules: Conforms to or exceeds requirements of ASTM D 3672 Type II and ASTM D 4897,

Type II and UL Type G2 BUR. Each roll contains one and one-quarter squares of material, approximately 39.4' x 40' 8" (1 m x 12.4 m); 80 lbs. (36 kg), GAFGLAS STRATAVENT Eliminator Nailable base sheet.

- B. Premium glass fiber asphalt saturated ply sheet with flexible design: Conforms to or exceeds requirements of ASTM D 2178 Type VI and UL Type G1 BUR. Each roll contains five (5) squares (530 sq. ft.) of material, approximately 39.4' x 161.8' (1.0m x 49.3m), 44 lbs. (20 kg), GAFGLAS FlexPly 6.

## 2.4 MEMBRANE MATERIALS

- A. Premium, heavy-duty asphalt modified bitumen membrane containing a core of non-woven polyester mat coated with flexible, SBS polymer-modified asphalt. Conforms to or exceeds requirements of ASTM D 6164 Type II Grade G. Each roll contains one square of material, approximately 39.4' x 33.6' (1 m x 10.3 m), 102 lbs. (46.4 kg), Ruberoidâ Mop Plus roof membrane.

## 2.5 FLASHING MATERIALS

- A. Premium glass fiber asphalt saturated ply sheet with flexible design: Conforms to or exceeds requirements of ASTM D 2178 Type VI and UL Type G1 BUR. Each roll contains five (5) squares (530 sq. ft.) of material, approximately 39.4' x 161.8' (1.0m x 49.3m), 44 lbs. (20 kg), GAFGLASâ FlexPlyÔ 6.
- B. Premium, heavy-duty asphalt modified bitumen membrane containing a core of non-woven polyester mat coated with flexible, SBS polymer-modified asphalt. Conforms to or exceeds requirements of ASTM D 6164 Type II Grade G. Each roll contains one square of material, approximately 39.4' x 33.6' (1 m x 10.3 m), 102 lbs. (46.4 kg), Ruberoidâ Mop Plus flashing membrane.

## 2.6 BITUMEN / ADHESIVES

- A. Asphalt Bitumen: ASTM D 312 Type III or IV
- B. Asphalt Primer: ASTM D 41 Leakbuster™ MatrixÔ 307 Premium Asphalt Primer, by BMCA®

## 2.7 ACCESSORIES

### A. Mechanical Fasteners

1. Drill•Tec CR Base Sheet Fastener: G-90 galvanized, CR-10 Corrosion resistant coating with 1.125" x 1" head and 1.75" leg length. Uses 2.75" Diameter Galvalume steel roof disc.
2. Drill•Tec Base Sheet Plate: 2.75" Disk for use with CR Base Sheet Fasteners.

### B. Standard Vents

1. A spun aluminum vent, pre-flashed with modified bitumen designed to waterproof soil pipes and roofing protrusions. The Standard MVent, by Mwelld.
  - a. NOTE: Not for use over active pipes that emit steam or excessive moisture vapor, condensation may occur. Not for use over boiler or heater/furnace vent pipes.

C. Plumbing Vents

1. A pre-flashed with modified bitumen membrane and is designed to waterproof vent pipes. It can be used as a pipe cover to replace finger and cap flashing on standard vent pipe details. The Pre-Flashed Plumbing Vent, by Mweld.

D. Sealant Pans

1. A structural urethane outer shell, bonded to the roof surface, filled with a urethane rubber sealant. The urethane sealant conforms to the shape of any roof penetration through a roof surface to protect the roof system from moisture. The M-Curb and M-Thane, by Mweld

E. Expansion Joint Covers

1. Factory fabricated assemblies used to accommodate three-dimensional joints in a roof structure. Heavy reinforced flexible cover with a flexible flame retardant foam bellows for support. Nailing flanges conform to curb irregularities. The Metalastic Expansion Joint Cover, by BMCA®.

F. SeamCote™ Elastomeric Protective Coating, coats the exposed asphalt bleed-out at the seams of BUR and Modified Bitumen roofs. Color matched to help the seams blend in over time with the color of white cap sheets and special order colors. Will not stain due to asphalt bleed-thru.

G. TOPCOAT® Flexseal

1. Solvent-based synthetic elastomeric sealant.

H. TOPCOAT® Topester Fabric

1. Non-woven, 100% fully spun-bonded polyester fabric.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that the surfaces and site conditions are ready to receive work.
- B. Verify that the deck is supported and secured.
- C. Verify that the deck is cleaned and smooth, free of depressions, waves, or projections, and properly sloped to drains, valleys, eaves, scuppers or gutters.
- D. Verify that the deck surfaces are dry and free of ice or snow.
- E. Verify that all roof openings, curbs, pipes, sleeves, ducts, vents or other penetrations through the roof are solidly set, and that all flashings are tapered.

### 3.2 SUBSTRATE PREPARATION

- A. Lightweight Insulating Concrete Deck

1. Lightweight insulating concrete decks are required to have a minimum thickness of 2" (5.1 cm), a minimum compressive strength of 125 psi (87,000 kg/m<sup>2</sup>) and a minimum density of 22 pcf (352 kg/m<sup>2</sup>).
2. The lightweight insulating deck/fill must be installed by an applicator approved by the deck manufacturer.
3. The roof system shall be installed immediately following deck curing to prevent damage from exposure to precipitation. The deck manufacturer determines the minimum curing time and maximum exposure limitations.
4. LWIC should not be poured during rainy periods. Deck areas that have frozen before they have cured must be removed and replaced. Decks which receive precipitation prior to installation of the roof membrane, must be checked for moisture content and dryness.
5. Where the mean January temperature (Reference current ASHRAE Fundamentals Handbook) is below 40° F (4.4°C), lightweight insulating concrete decks must be poured and roofed between April 1st and October 31st
6. Do not attach insulation directly to lightweight concrete decks. Over old, dry decks, additional board insulation may be solidly mopped to an approved mechanically attached anchor sheet (base sheet).
7. Local building code or individual deck manufacturer's standards apply when their specifications exceed the minimum thickness, compressive strength, or density requirements listed in this section.

### 3.3 INSTALLATION - GENERAL

- A. Install GAFMC's Ruberoid® roofing system according to all current application requirements in addition to those listed in this section.
- B. GAFMC Ruberoid Specification #: N-3-1-MGP
- C. When the slope of the roof is ½" per foot or greater, install all plies parallel with the slope of the roof, and install intermediate wood nailers as required for the specific roof slope. Plies must extend over ridges and nailed on 6" centers.
- D. Start the application of membrane plies at the low point of the roof or at the drains, so that the flow of water is over or parallel to, but never against the laps.

### 3.4 BITUMEN

- A. Do not mix different types of asphalt.
- B. Use only ASTM D 312, Type III or Type IV Steep Asphalt. Type III asphalt may be used on slopes up to ½" per foot (4cm/m). Type IV asphalt must be used on all slopes greater than ½" per foot (4 cm/m).
- C. Application with hot asphalt requires continuous, uniform interply mopping rates of 25 lbs. +/- 20% per 100 square feet of roof area (1.2 kg/m<sup>2</sup>).
- D. Application temperature of the asphalt must be at the Equiviscous Temperature (EVT) with a tolerance of +/- 25°F (13.9°C), at which a viscosity of 125 centipoise is attained. When using mechanical asphalt applicators, the target viscosity should be 75 centipoise.

- E. For all SBS modified asphalt flashings; the minimum application temperature of the asphalt must be at the EVT or 425°F (218°C), whichever is greater, with a rolling bank (puddle) of mopping asphalt across the full width of the roll.
- F. Do not heat the asphalt to or above its flash point or hold the asphalt at temperatures above the finished blowing temperature for more than 4 hours.
- G. Do not keep heated tankers above 325°F (163°C) overnight.

### 3.5 BASE SHEET

- A. Roll the base sheet out over the lightweight insulating concrete deck and allow it to relax. Lap the base sheet so the flow of water is over or parallel to, but never against the laps.
- B. Lap the base sheet 2" (5.1 cm), and 4" (10.2 cm) on the ends. Keeping the base sheet taut, push out all wrinkles and buckles ahead as fastening proceeds.
- C. Turn base sheet up to the top of the cant and continue up the vertical wall terminating at final base flashing height.
- D. Stagger adjacent end laps a minimum of 18" (45.7 cm).
- E. A minimum FMRC 1-60 attachment is recommended. Refer to FMRC Approval Guide for FM Fastening patterns. Factory Mutual requires fastener density increases in perimeter and corner zones for FM 1-60 and FM 1-90 or greater. Refer to FM Loss Prevention Data Sheets 1-7, 1-28, 1-29 and 1-49.

### 3.6 INTERPLY SHEETS

- A. Two-ply interply application: Install 19 11/16" (50 cm) and 39 3/8" (100.0 cm) width starter plies, and follow with a second 39 3/8" (100.0 cm) width sheet with a maximum of 17 11/16" (44.9 cm) exposure, applied shingle fashion. Lap felts 20 11/16" (52.6 cm) with an 18 11/16" (47.5 cm) exposure and 6" (15.2 cm) on end laps. Stagger adjacent end laps a minimum of 18" (45.7 cm).

### 3.7 CAP SHEET

- A. For slopes less than 1/2" per foot (4.2 cm per meter), Type III or IV asphalt may be used. Type IV must be used on all slopes 1/2" per foot (4.2 cm per meter) and over. Asphalt shall be applied at its EVT temperature or 425°F (218°C), whichever is greater, in a uniform layer, without voids, at a rate of 25 lb/square (1.2 kg/m<sup>2</sup>) ±20%. See Article 3.04 "Bitumen". The mopping stroke will be such that the side lap is covered with asphalt last. A rolling bank (puddle) of mopping asphalt must be maintained across the full width of the roll.
- B. Cap sheet application: Install full width cap sheets, lapping 4" (10.2 cm) on the sides and 6" (15.2 cm) on ends. Stagger adjacent end laps a minimum of 18" (45.7 cm) apart. All side and end laps must be staggered from underlying plies.
- C. All laps must be parallel or perpendicular to the slope of the roof such that the flow of water is never against the lap.

- D. SBS membranes must not be applied during adverse weather or without precautionary measures in temperatures below 45°F (7.2°C). Contact GAFMC Contractor Services for details.
- E. Coiled rolls should be unrolled, placed upside down and allowed to “relax” prior to installation. Then re-roll to apply.
- F. Care should be taken to insure that the cap sheet lays flat in the asphalt. There must be complete adhesion between the cap sheet and the mopping asphalt. Brooming of the plies may be necessary under certain conditions to insure that the cap sheet adheres solidly to the asphalt. Apply extra pressure to avoid creating open channels, where three or more membranes are lapped.
- G. A minimum 3/8” (10 mm) asphalt flow-out must be obtained at all laps. Dry laps are not acceptable. Check all seams for full and uniform adhesion.
- H. All end laps must be staggered a minimum of 18” (45.7 cm) so that no adjacent end laps coincide. If end laps fall in line or are not staggered the proper distance, a full width of Ruberoid® Mop SBS membrane must be installed over the end laps.

### 3.8 BITUMINOUS BASE FLASHINGS

- A. Install GAFMC base flashing specification 3X66M over all cant strips, horizontal to vertical transitions, roof edges and roof penetrations. Flashings are to be secured in accordance with current GAFMC application guidelines.
- B. Nailable curbs and walls must be covered with a layer of approved GAFGLAS Base Sheet or backer ply fastened 8” (20.3 cm) o.c. in all directions with approved fasteners. All vertical laps shall be 4” (10.2 cm). Base sheet or backer ply must extend out onto the field of the roof as shown in the applicable GAFMC construction detail.
- C. Prime all metal and masonry surfaces with asphalt primer, and allow adequate drying time prior to adhering flashing plies.
- D. Backer plies installed over masonry or other non-nailable substrates must be cut into manageable lengths to ensure adequate adhesion to the cant strip and vertical surfaces without excessive voids. All vertical laps shall be 4” (10.2 cm). Backer plies shall extend onto the field of the roof as shown in the applicable GAFMC construction detail.
- E. The finished ply of base flashing shall be run vertically to provide a selvage edge that will aid in achieving proper adhesion at the 3” (7.6 cm) vertical laps. If the sheet is run horizontally, the vertical laps must be a minimum of 6” (15.2 cm) and the selvage edge must be removed from the sheet or fully covered by the counterflashing. The finished flashing ply must extend out onto the field of the roof as shown in the applicable GAFMC construction detail, and must be extended a minimum of 4” (10.2 cm) beyond the edge of the prior flashing plies. The flashing must be soundly adhered to the parapet, cant area and roof surface to result in a minimum void, non-bridging construction.
- F. Base flashing heights must be a minimum of 8” (20.3 cm) and a maximum of 24” (61.0 cm) above the roofline.



- G. Use only Type IV hot asphalt. Maintain asphalt at the Equiviscous Temperature (EVT) +/- 25°F (13.9°C) for all base and ply sheets used in flashing details. Apply flashing membranes at the EVT temperature or 425°F (218°C) whichever is greater. Firmly press sheets into the adhesive, and immediately nail the top of the flashing as specified in the appropriate flashing detail.
- H. Corner membrane flashings, such as “bow ties” for outside corners and “footballs” for inside corners or other membrane reinforcements are required to ensure that base flashing corners are sealed at cant areas. An alternate method of corner reinforcing is to install a smooth MB membrane reinforcement piece on the prepared corner substrate prior to final surfacing membrane. Refer to MB Flashing Details section of the GAFMC Application and Specifications Manual.

### 3.9 PENETRATIONS

- A. Horizontal penetrations shall be flashed with M-Curbs filled with M-Thane sealant, then coated with Topcoat® Flexseal.
- B. Vertical penetrations shall be flashed with Topcoat® Topester Fabric embedded between two coats of Topcoat® Flexseal.

### 3.10 SHEET METAL

- A. Metal should not be used as a component of base flashing. Because of the high coefficient of expansion of sheet metals and the large temperature changes that can be experienced on a roof, sheet metal or exposed metal components must be isolated from the waterproofing components of the roofing and flashing system as efficiently as possible to prevent the metal from splitting the membranes. GAFMC assumes no responsibility for damage to the roofing system caused by the movement of accessory metal.
- B. When it is unavoidable to use metal in the roofing system (i.e., lead flange at drains, gravel stops), treated wood nailers and insulation stops, 1” (25 mm) wider than the metal flange, should be provided for metal flange attachment. Metal flanges must always be set on top of the roof membrane with modified trowel grade cold adhesive applied material for SBS roof systems. The metal flange is then sealed using the applicable construction detail to meet applicable guarantee requirements. Metal accessories (gravel stops, counter flashing, etc.) should be 16 oz. (0.56 mm) copper, 24 gauge (0.71 mm) galvanized or stainless steel, 2 1/2 to 4 lb (1.1-1.8 kg) lead, or 0.032” (0.81 mm) aluminum.
- C. Fabricate and install all sheet metal materials as shown in applicable construction details. Refer to SMACNA (Sheet Metal and Air Conditioning Contractors National Association, Inc.) for guidance on sheet metal treatments not addressed in this specification.
- D. Clean metal and apply asphalt primer to all sheet metal surfaces that will come into contact with asphalt or other bituminous materials; allow the primer adequate time to dry.
- E. Use fastener types compatible with the sheet metal type.
  - 1. Copper or lead-coated copper: use copper or bronze fasteners.
  - 2. Lead and galvanized steel: use galvanized or cadmium-plated sheet fasteners.

3. Aluminum: use aluminum fasteners.
  4. Stainless steel: use stainless steel fasteners.
- F. Metal counter-flashing shall have a minimum 4" (10.2 cm) face with a drip lip. The bottom edge of the counterflashing shall cover the roofing membrane and/or base flashing by a minimum of 4" (10.2 cm). Metal counter flashing used for masonry walls, wooden walls, or through wall metal flashings should be a two piece design to allow for installation and later removal. Metal counter-flashings for stucco, EIFS, wood siding or similar materials should be designed appropriately, such as "Z" type flashing. End joints shall be lapped 3" (7.6 cm) or more. Adequate fasteners must be provided to secure against wind forces. Skirt fasteners shall be watertight.
- G. Metal termination bars shall be a minimum of 1/10" (3 mm) thick x 1" (25 mm) wide with preformed sealant edge lap. Bar should have 1/4" (6 mm) x 3/8" (10 mm) slotted holes on 4" (10.2 cm) centers to facilitate mechanical anchorage.
1. Note: Termination bars are not suitable in all base flashing and wall flashing conditions. Termination bars may only be used in conjunction with an appropriate counter-flashing extending a minimum of 4" (10.2 cm) below the termination bar.
- H. Metal flanges for gravel stops, eave strips, and pitch pockets to be used in conjunction with roofing shall be primed (both sides), set in modified trowel grade cold adhesive applied material for SBS roof systems. Flanges shall be a minimum of 3 1/2" (8.9 cm) wide for gravel stops or eave strips and 4" (10.2 cm) wide for projections and extensions through the roof. The gravel stop lip should be at least 3/4" (19 mm) high. Eave strip lips shall be at least 3/8" (10 mm) high. Provisions must be made for securing the skirt to the face of the wall. This may be a wood nailer strip for masonry and metal construction. In all cases, gravel stop and eave strip nailer should be fastened to the deck or deck system with adequate resistance against wind forces.
- I. Stacks shall have metal sleeve flashing a minimum of 8" (20.3 cm) high. Pitch pockets for brackets, supports, pad-eyes, etc., shall have a 4" (10.2 cm) minimum height metal sleeve.
- J. On re-roofing projects, provisions shall be made for reinstallation of existing sheet metal duct work, equipment, coping metal and counter-flashing removed in conjunction with the new work. Also, provide for cleaning and repairing of existing defective sheet metal, and replacement of missing and irreparable sheet metal to match existing types. Light gauge sheet metal flashings which are incorporated into the Ruberoid® roof system are not suitable for re-use and must be replaced with new material.
- K. Conduits and piping such as electrical and gas lines must be set on wood blocking or some other form of support. Wood blocking/supports must be set on pads constructed of an additional layer of roof membrane material.

### 3.11 WALKWAYS

- A. Walkways for normal rooftop traffic may be constructed from two plies of modified bituminous membrane of the same type as the field of the roof. This type of walkway is not for sidewalk or patio-type use.

- B. Construct walkways by solidly adhering a first ply of smooth surfaced membrane to the field of the roof followed by a granule surfaced membrane to the surface of the first ply.
- C. Walkway sections should be no longer than 10' (3 m), with a 6" (15.2 cm) minimum gap between each section to allow for drainage.

### 3.12 ROOF PROTECTION

- A. Protect all partially and fully completed roofing work from other trades until completion.
- B. Whenever possible, stage materials in such a manner that foot traffic is minimized over completed roof areas.
- C. When it is not possible to stage materials away from locations where partial or complete installation has taken place, temporary walkways and platforms shall be installed in order to protect all completed roof areas from traffic and point loading during the application process.
- D. Temporary tie-ins shall be installed at the end of each workday and removed prior to commencement of work the following day.

### 3.13 CLEAN-UP

- A. All work areas are to be kept clean, clear and free of debris at all times.
- B. Do not allow trash, waste, or debris to collect on the roof. These items shall be removed from the roof on a daily basis.
- C. All tools and unused materials must be collected at the end of each workday and stored properly off of the finished roof surface and protected from exposure to the elements.
- D. Dispose of or recycle all trash and excess material in a manner conforming to current EPA regulations and local laws.
- E. Properly clean the finished roof surface after completion, and make sure the drains and gutters are not clogged.
- F. Clean and restore all damaged surfaces to their original condition.

END OF SECTION

## SECTION 07 62 13 - SHEET METAL FLASHING AND TRIM

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SECTION INCLUDES

- A. Fabricated sheet metal items, including flashings, counter flashings, gutters, downspouts, sheet metal roofing, and other items indicated in Schedule.
- B. Reglets and accessories.
- C. Precast concrete splash pads.

#### 1.3 RELATED REQUIREMENTS

- A. Section 01 8113.13 - Sustainable Design Requirements

#### 1.4 REFERENCE STANDARDS

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; American Architectural Manufacturers Association; 2012.
- B. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels; 2002.
- C. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels; 2010.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2011.
- E. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2010.
- F. ASTM B32 - Standard Specification for Solder Metal; 2008.
- G. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2010.
- H. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2010.
- I. ASTM D226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2009.

- J. ASTM D2178 - Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing; 2004.
- K. ASTM D4479/D4479M - Standard Specification for Asphalt Roof Coatings - Asbestos-Free; 2007 (Reapproved 2012)e1.
- L. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2012)e1.
- M. SMACNA (ASMM) - Architectural Sheet Metal Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2003.

#### 1.5 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.

#### 1.6 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

#### 1.7 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA Architectural Sheet Metal Manual requirements and standard details, except as otherwise indicated.
- B. Maintain one copy of each document on site.
- C. Fabricator and Installer Qualifications: Company specializing in sheet metal work with five years of documented experience.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that could cause discoloration or staining.

### PART 2 PRODUCTS

#### 2.1 SHEET MATERIALS

- A. Aluminum: ASTM B209 (ASTM B209M); 0.032 inch thick; anodized finish of color as selected.
  - 1. Clear Anodized Finish: AAMA 611 AA-M12C22A41 Class I clear anodic coating not less than 0.7 mils thick.

- B. Pre-Finished Aluminum: ASTM B209 (ASTM B209M); 0.032 inch thick; plain finish shop pre-coated with fluoropolymer coating.
  - 1. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system.
- C. Stainless Steel: ASTM A666 Type 304, soft temper, 0.015 inch thick; smooth No. 4 finish.
- D. Terne Coated Stainless Steel: 0.015 inch ASTM A666 Type 304 core material with 0.092 lb/sq ft terne alloy coating on both sides of core metal.

## 2.2 ACCESSORIES

- A. Fasteners: Same material and finish as flashing metal, with soft neoprene washers.
- B. Underlayment: Polyethylene, 6 mils.
- C. Primer: Zinc chromate type.
- D. Protective Backing Paint: Zinc molybdate alkyd.
- E. Sealant: Type specified in Section 07 9005.
- F. Plastic Cement: ASTM D4586, Type I.
- G. Reglets: Surface mounted type, galvanized steel; face and ends covered with plastic tape.
- H. Solder: ASTM B32; Sn50 (50/50) type.

## 2.3 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest possible lengths.
- C. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- D. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- E. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.
- F. Fabricate vertical faces with bottom edge formed outward 1/4 inch (6 mm) and hemmed to form drip.
- G. Fabricate flashings to allow toe to extend 2 inches over roofing gravel. Return and brake edges.

## 2.4 GUTTER AND DOWNSPOUT FABRICATION

- A. Gutters: Profile as indicated.

- B. Downspouts: Profile as indicated.
- C. Gutters and Downspouts: Size indicated.
- D. Accessories: Profiled to suit gutters and downspouts.
  - 1. Anchorage Devices: In accordance with SMACNA requirements.
- E. Splash Pads: Precast concrete type, of size and profiles indicated; minimum 3000 psi at 28 days, with minimum 5 percent air entrainment.
- F. Seal metal joints.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

#### 3.2 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Install surface mounted reglets true to lines and levels. Seal top of reglets with sealant.
- C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

#### 3.3 INSTALLATION

- A. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted.
- B. Apply plastic cement compound between metal flashings and felt flashings.
- C. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- D. Solder metal joints for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water.
- E. Secure gutters and downspouts in place using concealed fasteners. Slope gutters ¼ inch per foot minimum.
- F. Set splash pads under downspouts.

END OF SECTION

## SECTION 07 84 13 – PENETRATION FIRESTOPPING

### SECTION 024116 - STRUCTURE DEMOLITION

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### 1.2 SECTION INCLUDES

- A. Firestopping systems.
- B. Firestopping of all joints and penetrations in fire-resistance rated and smoke-resistant assemblies, whether indicated on drawings or not, and other openings indicated.

##### 1.3 REFERENCE STANDARDS

- A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2012.
- B. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops; 2011a.
- C. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.
- D. FM 4991 - Approval of Firestop Contractors; Factory Mutual Research Corporation; 2001.
- E. FM P7825 - Approval Guide; Factory Mutual Research Corporation; current edition.
- F. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition; [www.aqmd.gov](http://www.aqmd.gov).
- G. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

##### 1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
- C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- D. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.



- F. Certificate from authority having jurisdiction indicating approval of materials used.
- G. Qualification statements for installing mechanics.

## 1.5 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
  - 1. Listing in the current-year classification or certification books of UL, FM, or ITS (Warnock Hersey) will be considered as constituting an acceptable test report.
  - 2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at [www.icc-es.org](http://www.icc-es.org) will be considered as constituting an acceptable test report.
  - 3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section and:
  - 1. Approved by Factory Mutual Research under FM Standard 4991, Approval of Firestop Contractors, or meeting any two of the following requirements:.
  - 2. With minimum 3 years documented experience installing work of this type.
  - 3. Able to show at least 5 satisfactorily completed projects of comparable size and type.
  - 4. Licensed by authority having jurisdiction.
  - 5. Approved by firestopping manufacturer.

## 1.6 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for 3 days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

## PART 2 PRODUCTS

### 2.1 FIRESTOPPING - GENERAL REQUIREMENTS

- A. Firestopping Materials with Volatile Content: Provide only products having lower volatile organic compound (VOC) content than required by South Coast Air Quality Management District Rule No.1168.
- B. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.

## 2.2 FIRESTOPPING SYSTEMS

- A. Firestopping at Uninsulated Metallic Pipe and Conduit Penetrations, of diameter 4 inches or less: Caulk or putty.
- B. Firestopping at Cable Tray Penetrations: Any material meeting requirements.
- C. Firestopping at Cable Penetrations, not in Conduit or Cable Tray: Caulk or putty.
- D. Firestopping at Control Joints (without Penetrations): Any material meeting requirements.
  - 1. Between top of fire rated walls and bottom of slab above: UL Design No. as indicated in the drawings, F Rating 1 hour.

## 2.3 MATERIALS

- A. Firestopping Sealants: Provide only products having lower volatile organic compound (VOC) content than required by South Coast Air Quality Management District Rule No.1168.
- B. Elastomeric Silicone Firestopping: Single component silicone elastomeric compound and compatible silicone sealant; conforming to the following:
  - 1. Color: dark grey.
  - 2. Manufacturers:
    - a. A/D Fire Protection Systems Inc: [www.adfire.com](http://www.adfire.com).
    - b. 3M Fire Protection Products: [www.3m.com/firestop](http://www.3m.com/firestop).
    - c. Hilti, Inc: [www.us.hilti.com](http://www.us.hilti.com).
    - d. Substitutions: See Section 01 6000 - Product Requirements.
- C. Foam Firestopping: Single component silicone foam compound; conforming to the following:
  - 1. Color: Dark grey.
  - 2. Manufacturers:
    - a. 3M Fire Protection Products: [www.3m.com/firestop](http://www.3m.com/firestop).
    - b. Hilti, Inc: [www.us.hilti.com](http://www.us.hilti.com).
    - c. Specified Technologies, Inc: [www.stifirestop.com](http://www.stifirestop.com).
    - d. Substitutions: See Section 01 6000 - Product Requirements.
- D. Fibered Compound Firestopping: Formulated compound mixed with incombustible non-asbestos fibers; conforming to the following:
  - 1. Color: Dark grey.
  - 2. Manufacturers:
    - a. A/D Fire Protection Systems Inc: [www.adfire.com](http://www.adfire.com).
    - b. USG: [www.usg.com](http://www.usg.com).
    - c. Substitutions: See Section 01 6000 - Product Requirements.

- E. Fiber Firestopping: Mineral fiber insulation used in conjunction with elastomeric surface sealer forming airtight bond to opening; conforming to the following:
1. Durability and Longevity: Permanent.
  2. Manufacturers:
    - a. A/D Fire Protection Systems Inc: [www.adfire.com](http://www.adfire.com).
    - b. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
    - c. Thermafiber, Inc: [www.thermafiber.com](http://www.thermafiber.com).
    - d. Substitutions: See Section 01 6000 - Product Requirements.
- F. Firestop Devices - Wrap Type: Mechanical device with incombustible filler and sheet stainless steel jacket, intended to be installed after penetrating item has been installed; conforming to the following:
1. Durability and Longevity: Permanent; suitable for pedestrian traffic.
  2. Manufacturers:
    - a. 3M Fire Protection Products: [www.3m.com/firestop](http://www.3m.com/firestop).
    - b. Hilti, Inc: [www.us.hilti.com](http://www.us.hilti.com).
    - c. Specified Technologies, Inc: [www.stifirestop.com](http://www.stifirestop.com).
    - d. Substitutions: See Section 01 6000 - Product Requirements.
- G. Firestop Devices - Cast-In Type: Sleeve and sealing material, intended to be cast in concrete floor forms or in concrete on metal deck, not requiring any additional materials to achieve penetration seal.
1. Durability and Longevity: Permanent.
  2. Manufacturers:
    - a. 3M Fire Protection Products: [www.3m.com/firestop](http://www.3m.com/firestop).
    - b. Hilti, Inc: [www.us.hilti.com](http://www.us.hilti.com).
- H. Intumescent Putty: Compound that expands on exposure to surface heat gain; conforming to the following:
1. Potential Expansion: Minimum 1000 percent.
  2. Durability and Longevity: Permanent.
  3. Color: Black, dark gray, or red.
  4. Manufacturers:
    - a. 3M Fire Protection Products: [www.3m.com/firestop](http://www.3m.com/firestop).
    - b. Hilti, Inc: [www.us.hilti.com](http://www.us.hilti.com).
    - c. Specified Technologies, Inc: [www.stifirestop.com](http://www.stifirestop.com).
    - d. Substitutions: See Section 01 6000 - Product Requirements.
- I. Reusable Firestopping: Removable intumescent compressible shapes, pillows, or blocks specifically tested in removable configuration; conforming to the following:

1. Manufacturers:

- a. Hilti, Inc: [www.us.hilti.com](http://www.us.hilti.com).
- b. Nelson FireStop Products: [www.nelsonfirestop.com](http://www.nelsonfirestop.com).
- c. Specified Technologies, Inc: [www.stifirestop.com](http://www.stifirestop.com).
- d. Substitutions: See Section 01 6000 - Product Requirements.

- J. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

#### 3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.
- C. Install backing materials to arrest liquid material leakage.

#### 3.3 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authority having jurisdiction.
- C. Install labeling required by code.

#### 3.4 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

#### 3.5 PROTECTION

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 07 90 05 - JOINT SEALERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Sealants and joint backing.
- B. Precompressed foam sealers.
- C. Hollow gaskets.

1.3 REFERENCE STANDARDS

- A. ASTM C834 - Standard Specification for Latex Sealants; 2010.
- B. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2012.
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2011.
- D. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2011a.
- E. ASTM D1056 - Standard Specification for Flexible Cellular Materials--Sponge or Expanded Rubber; 2007.
- F. ASTM D1667 - Standard Specification for Flexible Cellular Materials--Poly(Vinyl Chloride) Foam (Closed-Cell); 2005 (Reapproved 2011).
- G. ASTM D2628 - Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for concrete Pavements; 1991 (Reapproved 2011).
- H. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition; [www.aqmd.gov](http://www.aqmd.gov).

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with all other trades.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating sealant chemical characteristics.
- C. LEED Report: Submit VOC content documentation for all non-preformed sealants and primers.

- D. Manufacturer's Installation Instructions: Indicate special procedures, surface preparation, and perimeter conditions requiring special attention.

## 1.6 QUALITY ASSURANCE

- A. Maintain one copy of each referenced document covering installation requirements on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.
- C. Applicator Qualifications: Company specializing in performing the work of this section with minimum five years experience.

## 1.7 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

## 1.8 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a one year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

# PART 2 PRODUCTS

## 2.1 MANUFACTURERS

### A. Silicone Sealants:

1. Bostik Inc: [www.bostik-us.com](http://www.bostik-us.com).
2. Momentive Performance Materials, Inc (formerly GE Silicones): [www.momentive.com](http://www.momentive.com).
3. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
4. BASF Construction Chemicals-Building Systems: [www.buildingsystems.basf.com](http://www.buildingsystems.basf.com).

### B. Polyurethane Sealants:

1. Bostik Inc: [www.bostik-us.com](http://www.bostik-us.com).
2. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
3. BASF Construction Chemicals-Building Systems: [www.buildingsystems.basf.com](http://www.buildingsystems.basf.com).

### C. Polysulfide Sealants:

1. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
2. BASF Construction Chemicals-Building Systems: [www.chemrex.com](http://www.chemrex.com).

### D. Acrylic Sealants (ASTM C920):

1. Tremco Global Sealants: [www.tremcosealants.com](http://www.tremcosealants.com).

E. Butyl Sealants:

1. Bostik Inc: [www.bostik-us.com](http://www.bostik-us.com).
2. Pecora Corporation: [www.pecora.com](http://www.pecora.com).

F. Acrylic Emulsion Latex Sealants:

1. Bostik Inc: [www.bostik-us.com](http://www.bostik-us.com).
2. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
3. BASF Construction Chemicals-Building Systems: [www.buildingsystems.basf.com](http://www.buildingsystems.basf.com).

G. Preformed Compressible Foam Sealers:

1. EMSEAL Joint Systems, Ltd: [www.emseal.com](http://www.emseal.com).
2. Sandell Manufacturing Company, Inc: [www.sandellmfg.com](http://www.sandellmfg.com).
3. Dayton Superior Corporation: [www.daytonsuperior.com](http://www.daytonsuperior.com).

## 2.2 SEALANTS

A. Sealants and Primers - General: Provide only products having lower volatile organic compound (VOC) content than required by South Coast Air Quality Management District Rule No.1168.

B. General Purpose Exterior Sealant: Polyurethane; ASTM C920, Grade NS, Class 25, Uses M, G, and A; single component.

1. Color: Match adjacent finished surfaces.
2. Applications: Use for:
  - a. Control, expansion, and soft joints in masonry.
  - b. Joints between concrete and other materials.
  - c. Joints between metal frames and other materials.
  - d. Other exterior joints for which no other sealant is indicated.

C. Exterior Expansion Joint Sealer: Precompressed foam sealer; urethane with water-repellent;

1. Face color: Match adjacent surface color..
2. Size as required to provide weathertight seal when installed.
3. Provide product recommended by manufacturer for traffic-bearing use.
4. Applications: Use for:
  - a. Exterior wall expansion joints.
  - b. Skylights.

D. Exterior Metal Lap Joint Sealant: Butyl or polyisobutylene, nondrying, nonskinning, noncuring.

1. Applications: Use for:

- a. Concealed sealant bead in sheet metal work.
- b. Concealed sealant bead in siding overlaps.

E. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, Type OP, Grade NF single component, paintable.

1. Color: Match adjacent finished surfaces.
2. Applications: Use for:

- a. Interior wall and ceiling control joints.
  - b. Joints between door and window frames and wall surfaces.
  - c. Other interior joints for which no other type of sealant is indicated.
- F. Bathtub/Tile Sealant: White silicone; ASTM C920, Uses I, M and A; single component, mildew resistant.
1. Applications: Use for:
    - a. Joints between plumbing fixtures and floor and wall surfaces.
    - b. Joints between kitchen and bath countertops and wall surfaces.
- G. Acoustical Sealant for Concealed Locations:
1. Applications: Use for concealed locations only:
    - a. Sealant bead between top stud runner and structure and between bottom stud track and floor.
- H. Interior Floor Joint Sealant: Polyurethane, self-leveling; ASTM C920, Grade P, Class 25, Uses T, M and A; single component.
1. Approved by manufacturer for wide joints up to 1-1/2 inches.
  2. Color: Match adjacent finished surfaces.
  3. Applications: Use for:
    - a. Expansion joints in floors.
- I. Concrete Paving Joint Sealant: Polyurethane, self-leveling; ASTM C920, Class 25, Uses T, I, M and A; single component.
1. Color: Gray.
  2. Applications: Use for:
    - a. Joints in sidewalks and vehicular paving.
- J. Acrylic Emulsion Latex: ASTM C834, single component, non-staining, non-bleeding, non-sagging.
1. Color: Standard colors matching finished surfaces, Type OP (opaque).
  2. Movement Capability: 2 to 5 percent.
  3. Grade: ASTM C834 Grade minus 18 degrees C
  4. Shore A Hardness Range: 15 to 40.
- K. Acrylic Sealant: ASTM C920, Grade NS, Class 12-1/2, Uses NT, M, A, 0; single component, solvent curing, non-staining, non-bleeding, non-sagging.
1. Color: Match adjacent finished surfaces.
  2. Movement Capability: Plus and minus 12-1/2 percent.
  3. Service Temperature Range: -13 to 180 degrees F.
  4. Shore A Hardness Range: 25 to 50.
- L. Butyl Sealant: ASTM C920, Grade NS, Class 12-1/2, Uses NT M A G 0; single component, solvent release, non-skinning, non-sagging.
1. Color: Match adjacent finished surfaces.



2. Movement Capability: Plus and minus 12-1/2 percent.
3. Service Temperature Range: -13 to 180 degrees F.
4. Shore A Hardness Range: 10 to 30.

M. Nonsag Polysulfide Sealant: ASTM C920, Grade NS, Class 25, Uses NT, I, M, A, G, 0; two component, chemical curing, non-staining, non-bleeding, capable of continuous water immersion, non-sagging type.

1. Color: Match adjacent finished surfaces.
2. Movement Capability: Plus and minus 25 percent.
3. Service Temperature Range: -40 to 180 degrees F.
4. Shore A Hardness Range: 20 to 35.

N. Self-Leveling Polysulfide Sealant: ASTM C920, Grade P, Class 25, Uses T I MA 0; two component, chemical curing, non-staining, non-bleeding, capable of continuous water immersion, self-leveling type.

1. Color: Match adjacent finished surfaces.
2. Movement Capability: Plus and minus 25 percent.
3. Service Temperature Range: -40 to 180 degrees F.
4. Shore A Hardness Range: 20 to 35.

O. Nonsag Polyurethane Sealant: ASTM C920, Grade NS, Class 25, Uses NT, I, M, A, G, 0; single component, chemical curing, non-staining, non bleeding, capable of continuous water immersion, non-sagging type.

1. Color: Match adjacent finished surfaces.
2. Movement Capability: Plus and minus 25 percent.
3. Service Temperature Range: -40 to 180 degrees F.
4. Shore A Hardness Range: 20 to 35.

P. Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Class 25, Uses T, I, M, A, 0; single component, chemical curing, non staining, non bleeding, capable of continuous water immersion, self-leveling type.

1. Color: Gray.
2. Movement Capability: Plus and minus 25 percent.
3. Service Temperature Range: -40 to 180 degrees F.
4. Shore A Hardness Range: 20 to 35.

Q. Silicone Sealant: ASTM C920, Grade NS, Class 25, Uses NT, A, G, M, 0; single component, chemical curing, non-sagging, non-staining, non-bleeding.

1. Color: Match adjacent finished surfaces.
2. Movement Capability: Plus and minus 25 percent.
3. Service Temperature Range: -65 to 180 degrees F.
4. Shore A Hardness Range: 15 to 35.

## 2.3 ACCESSORIES

A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant 0; compatible with joint forming materials.
- C. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

## PART 3 EXECUTION

### 3.1 EXAMINATION

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

### 3.2 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean and prime joints in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Protect elements surrounding the work of this section from damage or disfigurement.

### 3.3 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Perform acoustical sealant application work in accordance with ASTM C919.
- D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- E. Install bond breaker where joint backing is not used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- G. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- H. Tool joints concave.
- I. Precompressed Foam Sealant: Do not stretch; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.

- J. Compression Gaskets: Avoid joints except at ends, corners, and intersections; seal all joints with adhesive; install with face 1/8 to 1/4 inch below adjoining surface.
- K. Do not use double backer rod in "Hot Dog" fashion.

#### 3.4 CLEANING

- A. Clean adjacent soiled surfaces.

#### 3.5 PROTECTION

- A. Protect sealants until cured.

END OF SECTION

## SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Non-fire-rated steel doors and frames.
- B. Fire-rated steel doors and frames.
- C. Thermally insulated steel doors.
- D. Steel glazing frames.
- E. Accessories, including glazing, louvers, and matching panels.

#### 1.02 REFERENCE STANDARDS

- A. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2009.
- B. ANSI A250.3 - Test Procedure and Acceptance Criteria for Factory-Applied Finish Painted Steel Surfaces for Steel Doors and Frames; 2007 (R2011).
- C. ANSI A250.8 - SDI-100 Recommended Specifications for Standard Steel Doors and Frames; 2003.
- D. ANSI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 1998 (R2011).
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2011.
- F. ASTM C1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus; 2011.
- G. ASTM E413 - Classification for Rating Sound Insulation; 2010.
- H. ASTM E1408 - Standard Test Method for Laboratory Measurement of the Sound Transmission Loss of Door Panels and Door Systems; 1991 (Reapproved 2000).
- I. BHMA A156.115 - Hardware Preparation in Steel Doors and Steel Frames; 2006.
- J. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers; 2007.
- K. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers; 2006.
- L. NAAMM HMMA 862 - Guide Specifications for Commercial Security Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers; 2003.
- M. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2013.
- N. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association; 2012.
- O. UL (BMD)- Building Materials Directory; Underwriters Laboratories Inc.; current edition.
- P. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

- Q. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- R. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced grade standard.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.
- D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
- E. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.
- F. Product approvals and written descriptions of the tests performed to comply with the Miami-Dade Product Approvals and Notice of Acceptance (NOA) for the entire system.

### 1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years documented experience.
- B. Maintain at the project site a copy of all reference standards dealing with installation.

### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store in accordance with NAAMM HMMA 840.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Steel Doors and Frames:
  - 1. Assa Abloy Gem, Curries, or Fleming: [www.assaabloydss.com](http://www.assaabloydss.com).
  - 2. Republic Doors: [www.republicdoor.com](http://www.republicdoor.com).
  - 3. Steelcraft: [www.steelcraft.com](http://www.steelcraft.com).

### 2.02 DOORS AND FRAMES

- A. Requirements for All Doors and Frames:
  - 1. Accessibility: Comply with ANSI/ICC A117.1 and with the Americans with Disabilities Act of 1990, clarifications, additions and modifications.
  - 2. Door Top Closures: Flush with top of faces and edges.
  - 3. Door Edge Profile: Beveled on both edges.
  - 4. Door Texture: Smooth faces.
  - 5. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
  - 6. Hardware Preparation: In accordance with BHMA A156.115, with reinforcement welded in place, in addition to other requirements specified in door grade standard.
  - 7. Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed), A60/ZF180.
  - 8. Finish: Factory primed, for field finishing.

- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with all the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

### 2.03 STEEL DOORS

#### A. Exterior Doors:

1. Grade: ANSI A250.8 Level 2, physical performance Level B, Model 1, full flush.
2. Core: Polystyrene foam.
3. Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A60/ZF180 coating.
4. Insulating Value: U-value of 0.50, when tested in accordance with ASTM C1363.
5. Weatherstripping: Separate, see Section 08 7100.

#### B. Interior Doors, Non-Fire-Rated:

1. Grade: ANSI A250.8 Level 2, physical performance Level B, Model 1, full flush.
2. Core: Vertical steel stiffeners.
3. Thickness: 1-3/4 inches.

#### C. Interior Doors, Fire-Rated:

1. Grade: ANSI A250.8 Level 2, physical performance Level B, Model 1, full flush.
2. Fire Rating: As indicated on Door and Frame Schedule, tested in accordance with UL 10C ("positive pressure").
  - a. Provide units listed and labeled by UL.
  - b. Attach fire rating label to each fire rated unit.
3. Core: Mineral fiberboard.

#### D. Panels: Same construction, performance, and finish as doors.

### 2.04 STEEL FRAMES

#### A. General:

1. Comply with the requirements of grade specified for corresponding door. a. ANSI A250.8 Level 3 Doors: 14 gage frames.
2. Finish: Same as for door.
3. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
4. Frames Wider than 48 Inches: Reinforce with steel channel fitted tightly into frame head, flush with top.
5. Frames Installed Back-to-Back: Reinforce with steel channels anchored to floor and overhead structure.

#### B. Exterior Door Frames: Face welded, seamless with joints filled.

1. Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A60/ZF180 coating.
2. Weatherstripping: Separate, see Section 08 7100.

#### C. Interior Door Frames, Non-Fire-Rated: Fully welded type.

#### D. Interior Door Frames, Fire-Rated: Knock-down type. 1.

Fire Rating: Same as door, labeled.

#### E. Frames for Interior Glazing or Borrowed Lights: Construction and face dimensions to match door frames, and as indicated on drawings.

#### F. Transom Bars: Fixed, of profile same as jamb and head.

### 2.05 ACCESSORY MATERIALS

- A. Louvers: Roll formed steel with overlapping frame; factory-painted finish, color as scheduled; factory-installed.
  - 1. In Fire-Rated Doors: UL-listed fusible link louver, same rating as door.
- B. Glazing: As specified in Section 08 8000, factory installed.
- C. Astragals for Double Doors: Specified in Section 08 7100.
  - 1. Exterior Doors: Steel, Z-shaped.
  - 2. Fire-Rated Doors: Steel, shape as required to accomplish fire rating.
- D. Grout for Frames: Portland cement grout of maximum 4-inch slump for hand troweling; thinner pumpable grout is prohibited.
- E. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.
- F. Temporary Frame Spreaders: Provide for all factory- or shop-assembled frames.

#### 2.06 FINISH MATERIALS

- A. Primer: Rust-inhibiting, complying with ANSI A250.10.
- B. Factory Finish: Complying with ANSI A 250.3, thermosetting epoxy. 1. Color: To be selected by Bermello, Ajamil & Partners from manufacturer's full range.
- C. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

#### PART 3 EXECUTION 3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.

#### 3.02 PREPARATION

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

#### 3.03 INSTALLATION

- A. Install in accordance with the requirements of the specified door grade standard and NAAMM HMMA 840.
- B. In addition, install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- E. Coordinate installation of hardware.
- F. Coordinate installation of glazing.
- G. Coordinate installation of electrical connections to electrical hardware items.

H. Touch up damaged factory finishes.

#### 3.04 TOLERANCES

- A. Clearances Between Door and Frame: As specified in ANSI A250.8.
- B. Maximum Diagonal Distortion: 1/16 in measured with straight edge, corner to corner.

#### 3.05 ADJUSTING

- A. Adjust for smooth and balanced door movement.
- B. Adjust sound control doors so that seals are fully engaged when door is closed.
- C. Test sound control doors for force to close, latch, and unlatch; adjust as required to comply.

3.06 SCHEDULE

- A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION



## SECTION 08 12 13 - HOLLOW METAL FRAMES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Non-fire-rated steel frames for non-steel doors.
- B. Fire-rated steel door frames for non-steel doors.
- C. Frames for non-steel sound-rated doors.
- D. Interior glazed light frames.

#### 1.02 REFERENCE STANDARDS

- A. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2009.
- B. ANSI A250.8 - SDI-100 Recommended Specifications for Standard Steel Doors and Frames; 2003.
- C. ANSI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 1998 (R2011).
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2011.
- E. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength, Low Alloy, and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2012.
- F. BHMA A156.115 - Hardware Preparation in Steel Doors and Steel Frames; 2006.
- G. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers; 2007.
- H. NAAMM HMMA 860 - Guide Specifications for Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers; 1992.
- I. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers; 2006.
- J. NAAMM HMMA 865 - Guide Specifications for Sound Control Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers; 2003.
- K. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2013.
- L. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association; 2012.
- M. UBC Std 7-2, Part II - Test Standard for Smoke- and Draft-control Assemblies; International Conference of Building Officials; 1997.
- N. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.
- O. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- P. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- Q. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced grade standard.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.
- D. Samples: Submit one sample of frame metal, 2 x 2 inches in size showing factory finishes, colors, and surface textures.
- E. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
- F. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

#### 1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. Maintain at the project site a copy of all reference standards dealing with installation.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store in accordance with NAAMM HMMA 840.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Steel Frames with Integral Casings:
  - 1. Assa Abloy Ceco, Curries, or Fleming: [www.assaabloydss.com](http://www.assaabloydss.com).
  - 2. Windsor Republic Doors: [www.republicdoor.com](http://www.republicdoor.com).
  - 3. Steelcraft: [www.steelcraft.com](http://www.steelcraft.com).
- B. Steel Frames with Applied Casings, Prefinished:

#### 2.02 STEEL DOOR FRAMES - GENERAL REQUIREMENTS

- A. Refer to Door and Frame Schedule on the drawings for frame sizes, fire ratings, sound ratings, finishing, door hardware to be installed, and other variations, if any.
- B. Door Frame Type: Provide steel door frames with integral casings and with applied casings in locations indicated.
- C. Accessibility: Comply with ANSI/ICC A117.1.
- D. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with all the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.
- E. Hardware Preparation: In accordance with BHMA A156.115, with reinforcement welded in place, in addition to other requirements specified.

## 2.03 STEEL DOOR FRAMES WITH INTEGRAL CASINGS

- A. Finish: Factory primed, for field finishing.
- B. Requirements for All Frames:
1. Accessibility: Comply with ANSI/ICC A117.1.
  2. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
  3. Hardware Preparation: In accordance with BHMA A156.115, with reinforcement welded in place, in addition to other requirements specified in door grade standard.
  4. Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed) per ASTM A653/A653M, with A60/ZF180 coating.
  5. Finish: Factory primed, for field finishing.
  6. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with all the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.
  7. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
  8. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cuffing masonry units.
  9. Frames Wider than 48 Inches: Reinforce with steel channel fitted tightly into frame head, flush with top.
  10. Frames Installed Back-to-Back: Reinforce with steel channels anchored to floor and overhead structure.
- C. Exterior Door Frames: Face welded, seamless with joints filled.
1. Grade: Comply with frame requirements specified in ANSI A250.8 for Level 1, 16 gage
  2. Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed) per ASTM A653/A653M, with A60/ZF180 coating.
  3. Weatherstripping: Separate, see Section 08 7100.
- D. Interior Door Frames, Non-Fire-Rated: Fully welded type.
1. Grade: Comply with frame requirements specified in ANSI A250.8 for Level 1, 18 gage
  2. Terminated Stops: Provide at all interior doors; closed end stop terminated 6 inches above floor at 45 degree angle.
- E. Interior Door Frames, Fire-Rated: Fully welded type.
1. Grade: Comply with frame requirements specified in ANSI A250.8 for Level 1, 18 gage
  2. Fire Rating: As indicated on Door and Frame Schedule, tested in accordance with UL 10C ("positive pressure").
    - a. Provide units listed and labeled by UL.
    - b. Attach fire rating label to each fire rated unit.
  3. Smoke and Draft Control Doors: In addition to required fire rating, provide door assemblies tested in accordance with UL 1784 with maximum air leakage of 3.0 cfm per sq ft of door opening at 0.10 inch w g pressure at both ambient and elevated temperatures; with "S" label; if necessary, provide additional gasketing or edge sealing.
  4. Smoke and Draft Control Doors: Provide frames capable of enabling door assembly to comply with air leakage requirements of UBC Std 7-2, Part II; if necessary, provide additional gasketing or edge sealing.
- F. Sound-Rated Door Frames: Knock-down type.
1. Grade: Comply with frame requirements specified in ANSI A250.8 for Level 1, 16 6
  2. Sound Rating: Tested with the door to achieve the rating specified for the door opening.

## 2.04 STEEL DOOR FRAMES WITH APPLIED CASINGS

- A. Frame Type: Knock-down, slip-on frames; separate jambs and head with separate snap-on casings both sides; factory-applied finish on all exposed surfaces.
  - 1. Frame Material: Cold-rolled steel complying with ASTM A1008/A1008M.
  - 2. Casing Material: Formed steel.
  - 3. Casing Profile: As scheduled.
  - 4. Finish: Factory-applied baked enamel finish, or electrostatically applied water-based paint. a. Color: As selected from manufacturers full line.

## 2.05 ACCESSORY MATERIALS

- A. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.
- B. Grout for Frames: Portland cement grout of maximum 4-inch slump for hand troweling; thinner pumpable grout is prohibited.
- C. Temporary Frame Spreaders: Provide for all factory- or shop-assembled frames.

## 2.06 FINISH MATERIALS

- A. Primer: Rust-inhibiting, complying with ANSI A250.10, air dried.
- B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

### 3.02 PREPARATION

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.
- B. Coat inside of other frames with bituminous coating to a thickness of 1/16 inch.

### 3.03 INSTALLATION

- A. Install frames in accordance with manufacturer's instructions and recommendations and as follows.
- B. Install in accordance with the requirements of the specified door grade standard and NAAMM HMMA 840.
- C. In addition, install fire rated units in accordance with NFPA 80.
- D. Coordinate frame anchor placement with wall construction.
- E. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- F. Coordinate installation of glazing.
- G. Coordinate installation of hardware.
- H. Coordinate installation of electrical connections to electrical hardware items.

- I. Touch up damaged factory finishes.

#### 3.04 TOLERANCES

- A. Clearances Between Door and Frame: As specified in ANSI A250.8.
- B. Maximum Diagonal Distortion: 1/16 inch measured with straight edges, crossed corner to corner.

#### 3.05 SCHEDULE

- A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION

## SECTION 08 31 13 - ACCESS DOORS AND PANELS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Ceiling access door and frame units.

#### 1.02 REFERENCE STANDARDS

- A. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.
- B. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

#### 1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- C. Shop Drawings: Indicate exact position of all access door units.
- D. Manufacturer's Installation Instructions: Indicate installation requirements.
- E. Project Record Documents: Record actual locations of all access units.

### PART 2 PRODUCTS

#### 2.01 ACCESS DOOR AND PANEL APPLICATIONS

#### 2.02 WALL AND CEILING UNITS

- A. Manufacturers:
  - 1. Acudor Products Inc: [www.acudor.com](http://www.acudor.com).
  - 2. Karp Associates, Inc: [www.karpinc.com](http://www.karpinc.com).
  - 3. Milcor by Commercial Products Group of Hart & Cooley, Inc: [www.milcorinc.com](http://www.milcorinc.com).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Access Doors: Factory fabricated door and frame units, fully assembled units with corner joints welded, filled, and ground flush; square and without rack or warp; coordinate requirements with assemblies units are to be installed in.
  - 1. Material: Steel.
  - 2. Door Style: Single thickness with rolled or turned in edges.
  - 3. Frames and flanges: 0.058 inch steel.
  - 4. Door panels: 0.070 inch single thickness steel sheet.
  - 5. Units in Fire Rated Assemblies: Fire rating as required by applicable code for the fire rated assembly in which they are to be installed.
    - a. Provide products listed and labeled by UL or ITS (Warnock Hersey) as suitable for the purpose specified and indicated.
  - 6. Steel Finish: Primed.
  - 7. Primed Finish: Polyester powder coat; manufacturer's standard color.
  - 8. Sizes:
    - a. Ceilings: 12 x 12 inches.
  - 9. Hardware:
    - a. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
    - b. Hinge: Concealed constant force closure spring type.
    - c. Latch/Lock: Cylinder lock operated cam latch, two keys for each unit.
  - 10. Finish: One coat baked enamel, White color.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings are correctly sized and located.

3.02 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings. Secure rigidly in place.
- C. Position units to provide convenient access to the concealed work requiring access.

END OF SECTION

## SECTION 08 33 23 - OVERHEAD COILING DOORS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Overhead coiling doors, operating hardware, fire-rated, non-fire-rated, and exterior, manual, and electric operation.
- B. Wiring from electric circuit disconnect to operator to control station.

#### 1.02 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2008.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process; 2011.
- C. ASTM 8221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2012.
- D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2012.
- E. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2008.
- G. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC; National Electrical Manufacturers Association; 2000 (R2005).
- H. NFPA 80 - Standard for Fire Doors and Other Opening Protective; 2013.
- I. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.

#### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide general construction, component connections and details, electrical equipment, .
- C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.
- D. Submit calculations prepared by Florida license engineer that the door can withstand the design wind loads.
- E. Manufacturer's Instructions: Indicate installation sequence and procedures, adjustment and alignment procedures.
- F. Maintenance Data: Indicate lubrication requirements and frequency and periodic adjustments required.

#### 1.04 QUALITY ASSURANCE

- A. Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

### PART 2 PRODUCTS



## 2.01 MANUFACTURERS

### A. Overhead Coiling Doors:

1. Alpine Overhead Doors, Inc: [www.alpinedoors.com](http://www.alpinedoors.com).
2. Cornell Iron Works, Inc; Product Model ESD10: [www.cornelliron.com](http://www.cornelliron.com).
3. The Cookson Company: [www.cooksondoor.com](http://www.cooksondoor.com).
4. Wayne-Dalton, a Division of Overhead Door Corporation: [www.wayne-dalton.com](http://www.wayne-dalton.com).

## 2.02 COILING DOORS

### A. Exterior Coiling Doors: Aluminum slat curtain.

1. Capable of withstanding positive and negative pressures for this project. Refer to the drawings for this project's pressure requirements. Provide products that meet Miami-Dade County product approvals with current NOAs.
2. Provide products that meet FBC requirements and with approved NOAs.
3. Nominal Slat Size: 2 inches wide x required length.
4. Finish: Mill.
5. Guides: Angles; Structural Steel.
6. Hood Enclosure: Manufacturer's standard; galvanized steel.
7. Manual hand chain lift operation.
8. Mounting: As indicated.
9. Exterior lock and latch handle.

### B. Non-Fire-Rated Interior Coiling Doors: Aluminum slat curtain.

1. Nominal Slat Size: 2 inches wide x required length.
2. Finish: Factory painted, color as selected.
3. Guides: Angles; primed steel.
4. Hood Enclosure: Manufacturers standard; galvanized steel.
5. Electric operation.
6. Mounting: As indicated.

### C. Fire-Rated Coiling Doors: Aluminum slat curtain; conform to NFPA 80.

1. 2 hour fire rating.
2. Provide products listed and labeled by UL or ITS (Warnock Hersey) as suitable for the purpose specified and indicated.
3. Oversized Openings: Provide certificate of compliance from authority having jurisdiction indicating approval of fire rated units and operating hardware assembly.
4. Nominal Slat Size: 2 inches wide x required length.
5. Finish: Mill.
6. Finish: Factory painted, color as selected.
7. Guides: Angles; primed steel.
8. Hood Enclosure: Manufacturer's standard; galvanized steel.
9. Electric operation.
10. Mounting: As indicated.

## 2.03 MATERIALS

### A. Curtain Construction: Interlocking slats.

1. Slat Ends: Each slat fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
2. Curtain Bottom: Fitted with angles to provide reinforcement and positive contact in closed position.
3. Weatherstripping: Moisture and rot proof, resilient type, located at jamb edges, bottom of curtain, and where curtain enters hood enclosure of exterior doors.

### B. Steel Slats: ASTM A 653/A 653M galvanized steel sheet.

1. Galvanizing: Minimum G90/Z275 coating.

- C. Aluminum Slats: ASTM B221 (ASTM B221M), aluminum alloy Type 6063.
- D. Guide Construction: Continuous, of profile to retain door in place with snap-on trim, mounting brackets of same metal.
- E. Steel Guides: Formed from galvanized steel sheet, complying with ASTM A 653/A 653M.
  - 1. Galvanizing: Minimum G90/Z275 coating.
  - 2. Prepare for site painted finish.
- F. Hood Enclosure: Internally reinforced to maintain rigidity and shape.
  - 1. Prepare for site painted finish.
- G. Hardware:
  - 1. Latching: Inside mounted, adjustable keeper, spring activated latch bar with feature to keep in locked or retracted position.
  - 2. Latch Handle: Interior and exterior handle.
- H. Roller Shaft Counterbalance: Steel pipe and helical steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb nominal force to operate.

## 2.04 ELECTRIC OPERATION

- A. Electric Operators:
  - 1. Motor Rating: 1/2 hp; continuous duty.
  - 2. Motor Voltage: 230 volt, single phase, 60 Hz.
  - 3. Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.
  - 4. Controller Enclosure: NEMA 250 Type 1.
  - 5. Brake: Adjustable friction clutch type, activated by motor controller.
  - 6. Manual override in case of power failure.
- B. Control Station: Standard three button (OPEN-STOP-CLOSE) momentary control for each operator.
  - 1. 24 volt circuit.
- C. Safety Edge: Located at bottom of curtain, full width, electro-mechanical sensitized type, wired to stop operator upon striking object, hollow neoprene covered.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that opening sizes, tolerances and conditions are acceptable.

### 3.02 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. In addition, install fire-rated doors in accordance with NFPA 80.
- C. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- D. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- E. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- F. Complete wiring from disconnect to unit components.
- G. Install perimeter trim, closures, and related hardware.

### 3.03 TOLERANCES

- A. Maintain dimensional tolerances and alignment with adjacent work.
- B. Maximum Variation From Plumb: 1/16 inch.
- C. Maximum Variation From Level: 1/16 inch.
- D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 ft straight edge.

#### 3.04 ADJUSTING

- A. Adjust operating assemblies for smooth and noiseless operation.

#### 3.05 CLEANING

- A. Clean installed components.
- B. Remove labels and visible markings.

END OF SECTION

## SECTION 08 43 13 - ALUMINUM-FRAMED STOREFRONTS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass.
- B. Infill panels of metal and glass.
- C. Aluminum doors and frames.
- D. Weather stripping.
- E. Door hardware.
- F. Perimeter sealant.

#### 1.02 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; American Architectural Manufacturers Association; 2012.
- B. AAMA 501.2 - Field Check of Metal Storefronts, Curtain Walls, and Sloped Glazing Systems for Water Leakage; American Architectural Manufacturers Association; 2009 (part of AAMA 501).
- C. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; American Architectural Manufacturers Association; 2012.
- D. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; American Architectural Manufacturers Association; 2009.
- E. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; American Society of Civil Engineers; 2011.
- F. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2008.
- G. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2012.
- H. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2010.
- I. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2010.
- J. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2012.
- K. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2012.
- L. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- M. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2002 (Reapproved 2010).
- N. ASTM E547 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Differential; 2000 (Reapproved 2009).

- O. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2009).
- P. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2000 (Reapproved 2008).
- Q. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings; 2002 (Ed. 2004).
- R. SSPC-Paint 25 - Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II; Society for Protective Coatings; 1997 (Ed. 2004).

#### 1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, internal drainage details.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
- D. Design Data: Provide framing member structural and physical characteristics, engineering calculations, dimensional limitations.
- E. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
- F. Samples: Submit two samples 12 x 12 inches in size illustrating finished aluminum surface, glass, infill panels, glazing materials.
- G. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements including design wind loads.
- H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Broward County, Port Everglades's name and registered with manufacturer.

#### 1.05 QUALITY ASSURANCE

- A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed at Florida.
- B. Manufacturer and Installer Qualifications: Company specializing in manufacturing aluminum glazing systems with minimum three years of documented experience.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

## 1.07 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

## 1.08 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a one year period after Date of Substantial Completion.
- C. Provide one year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Basis of Design: See below under description of products.
- B. Other Acceptable Manufacturers:
  - 1. Kawneer North America: [www.kawneer.com](http://www.kawneer.com).
  - 2. United States Aluminum Corp: [www.usalum.com](http://www.usalum.com).
  - 3. Oldcastle BuildingEnvelope: [www.oldcastlebe.com](http://www.oldcastlebe.com).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.

### 2.02 STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
  - 1. Finish: Class I natural anodized.

### 2.03 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
  - 1. Framing members for interior applications need not be thermally broken.
  - 2. Glazing stops: Per NOA.
  - 3. Cross-Section: As indicated on drawings.
  - 4. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
- B. Doors: Glazed aluminum.
  - 1. Doors shall be aluminum and glass, medium stile, large missile resistant impact storefront.
  - 2. Assembly shall be as tested and per NOA.

### 2.04 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Sheet Aluminum: ASTM 8209 (ASTM B209M).
- C. Structural Steel Sections: ASTM A36/A36M; galvanized in accordance with requirements of ASTM A123/A123M.
- D. Fasteners: stainless steel.
- E. Exposed Flashings: 0.032 inch thick aluminum sheet; finish to match framing members.
- F. Concealed Flashings: 0.018 inch thick galvanized steel.
- G. Perimeter Sealant: Type specified in Section 07 9005.
- H. Glass: As specified in Section 08 8000.

- I. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements and in accordance with NOA.
- J. Glazing Accessories: As specified in Section 08 8000.
- K. Shop and Touch-Up Primer for Steel Components: SSPC-Paint 25, zinc oxide, alkyd, linseed oil primer.
- L. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

#### 2.05 FINISHES

- A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating or AAMA 612 clear anodic coating with electrolytically deposited organic seal; not less than 0.7 mils thick.
- B. Color: As shown on the drawings.
- C. Touch-Up Materials: As recommended by coating manufacturer for field application.

#### 2.06 HARDWARE

- A. Door Hardware: Storefront manufacturer's standard type to suit application.
  - 1. Finish on Hand-Contacted Items: Polished stainless steel.
  - 2. Include for each door weather stripping, sill sweep strip, threshold, butt hinges and electric door operators, controllers and overhead mounted sensors.
- B. Automatic Door Operators and Actuators: As specified in Section 08 4229.

#### 2.07 FABRICATION

- A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- C. Prepare components to receive anchor devices. Fabricate anchors.
- D. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
- E. Arrange fasteners and attachments to conceal from view.
- F. Reinforce components internally for door hardware and door operators.
- G. Reinforce framing members for imposed loads.
- H. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies. 1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

#### 3.02 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Coordinate attachment and seal of perimeter air and vapor barrier materials.
- I. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- J. Set thresholds in bed of mastic and secure.
- K. Install hardware using templates provided.
  - 1. See Section 08 4229 for operator and actuator installation requirements.
- L. Install glass in accordance with Section 08 8000, using glazing method required to achieve performance criteria.
- M. Install perimeter sealant in accordance with Section 07 9005.
- N. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

### 3.03 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 1/16 inches per 10 ft, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

### 3.04 ADJUSTING

- A. Adjust operating hardware and sash for smooth operation.

### 3.05 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
- C. Remove excess sealant by method acceptable to sealant manufacturer.

### 3.06 PROTECTION

- A. Protect installed products from damage during subsequent construction.

END OF SECTION



## SECTION 08 51 13 - ALUMINUM WINDOWS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Extruded aluminum windows with fixed sash, operating sash, and infill panels.
- B. Factory glazing.

#### 1.02 REFERENCE STANDARDS

- A. AAMA/WDMA/CSA 101/I.S.2/A440 - Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors; American Architectural Manufacturers Association; 2011.
- B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; American Architectural Manufacturers Association; 2012.
- C. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; American Architectural Manufacturers Association; 2009.
- D. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; American Architectural Manufacturers Association; 2012.
- E. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; American Society of Civil Engineers; 2011.
- F. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2010.
- G. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2010.
- H. ASTM 8221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2012.
- I. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2012.
- J. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- K. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2002 (Reapproved 2010).
- L. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2009).
- M. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2000 (Reapproved 2008).
- N. ASTM F588 - Standard Test Methods for Measuring the Forced Entry Resistance of Window Assemblies, Excluding Glazing Impact; 2007.

- O. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings; 2002 (Ed. 2004).

### 1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.

### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component dimensions.
- C. Shop Drawings: Indicate opening dimensions, elevations of different types, framed opening tolerances, method for achieving air and vapor barrier seal to adjacent construction, anchorage locations,, and installation requirements.
- D. Samples: Submit two samples, 12 x 12 inch in size illustrating typical corner construction, accessories, and finishes.
- E. Submit two samples of operating hardware.
- F. Certificates: Certify that windows meet or exceed specified requirements including design wind loads
- G. Manufacturer's Installation Instructions: Include complete preparation, installation, and cleaning requirements.

### 1.05 QUALITY ASSURANCE

- A. Manufacturer and Installer Qualifications: Company specializing in fabrication of commercial aluminum windows of types required, with not fewer than three years of experience.

### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of AAMA CW-10.
- B. Protect finished surfaces with wrapping paper or strippable coating during installation. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

### 1.07 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F.
- B. Maintain this minimum temperature during and 24 hours after installation of sealants.

### 1.08 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

## PART 2 PRODUCTS

## 2.01 MANUFACTURERS

A. Basis of Design: Crawford Tracey Glass Co.

## 2.02 WINDOWS

A. Windows: Tubular aluminum sections, factory fabricated, factory finished, thermally broken, vision glass, related flashings, anchorage and attachment devices.

B. Performance Requirements:

1. Design and size windows to withstand the following load requirements, when tested in accordance with ASTM E330 using test loads equal to 1.5 times the design wind loads with 10 second duration of maximum load:
  - a. Design Wind Loads: Comply with requirements of ASCE 7-10
  - b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
2. Movement: Accommodate movement between window and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
3. Water Leakage: None, when measured in accordance with ASTM E331 and E 547.
4. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly.
5. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, or migrating moisture occurring within system.
6. Forced Entry Resistance: Conform to ASTM F588 requirements for performance level 10.

C. Fixed, Non-Operable Type:

1. Construction: Thermally broken.
2. Exterior Finish: Class I natural anodized.
3. Interior Finish: Class I natural anodized.

## 2.03 COMPONENTS

- A. Fasteners: Stainless steel.
- B. Glass and Glazing Materials: As specified in Section 08 8000.
- C. Sealant and Backing Materials: As specified in Section 07 9005.

## 2.04 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
- B. Sheet Aluminum: ASTM 8209 (ASTM B209M), 5005 alloy, H12 or H14 temper.

## 2.05 FABRICATION

- A. Fabricate components with smallest possible clearances and shim spacing around perimeter of assembly that will enable window installation and dynamic movement of perimeter seal
- B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- C. Prepare components to receive anchor devices.

- D. Arrange fasteners and attachments to ensure concealment from view.
- E. Prepare components with internal reinforcement for operating hardware.
- F. Provide steel internal reinforcement in mullions as required to meet loading requirements.
- G. Factory glaze window units.

## 2.06 FINISHES

- A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.
- B. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that wall openings and adjoining air and vapor seal materials are ready to receive aluminum windows.

### 3.02 INSTALLATION

- A. Install windows in accordance with manufacturer's instructions.
- B. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.
- C. Align window plumb and level, free of warp or twist. Maintain dimensional tolerances and alignment with adjacent work.
- D. Install sill and sill end angles.
- E. Provide thermal isolation where components penetrate or disrupt building insulation. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- F. Coordinate attachment and seal of perimeter air barrier and vapor retarder materials.
- G. Install glass and infill panels in accordance with requirements specified in Section 08 8000.
- H. Install perimeter sealant in accordance with requirements specified in Section 07 9005.

### 3.03 TOLERANCES

- A. Maximum Variation from Level or Plumb: 1/16 inches every 3 ft non-cumulative or 1/8 inches per 10 ft, whichever is less.

### 3.04 CLEANING

- A. Remove protective material from factory finished aluminum surfaces.
- B. Wash surfaces by method recommended and acceptable to sealant and window manufacturer; rinse and wipe surfaces clean.
- C. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant and window manufacturer.

END OF SECTION

## SECTION 08 71 13 - DOOR HARDWARE

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Hardware for hollow steel, aluminum, and overhead coiling doors doors.
- B. Hardware for fire-rated doors.
- C. Electrically operated and controlled hardware.
- D. Lock cylinders for doors for which hardware is specified in other sections.
- E. Thresholds.
- F. Weatherstripping, seals and door gaskets.
- G. Gate locks.

#### 1.02 RELATED REQUIREMENTS

- A. Section 01 8113.13 - Sustainable Design Requirements

#### 1.03 REFERENCE STANDARDS

- A. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2009.
- B. BHMA A156.1 - American National Standard for Butts and Hinges; Builders Hardware Manufacturers Association, Inc.; 2006 (ANSI/BHMA A156.1).
- C. BHMA A156.2 - American National Standard for Bored and Preamsembled Locks & Latches; Builders Hardware Manufacturers Association; 2011 (ANSI/BHMA A156.2).
- D. BHMA A156.3 - American National Standard for Exit Devices; Builders Hardware Manufacturers Association; 2008 (ANSI/BHMA A156.3).
- E. BHMA A156.4 - American National Standard for Door Controls - Closers; Builders Hardware Manufacturers Association, Inc.; 2008 (ANSI/BHMA A156.4).
- F. BHMA A156.5 - American National Standard for Auxiliary Locks & Associated Products; Builders Hardware Manufacturers Association; 2010 (ANSI/BHMA A156.5).
- G. BHMA A156.6 - American National Standard for Architectural Door Trim; Builders Hardware Manufacturers Association; 2010 (ANSI/BHMA A156.6).
- H. BHMA A156.7 - American National Standard for Template Hinge Dimensions; Builders Hardware Manufacturers Association; 2003 (ANSI/BHMA A156.7).
- I. BHMA A156.8 - American National Standard for Door Controls - Overhead Stops and Holders; Builders Hardware Manufacturers Association, Inc.; 2010 (ANSI/BHMA A156.8).
- J. BHMA A156.9 - American National Standard for Cabinet Hardware; Builders Hardware Manufacturers Association; 2010 (ANSI/BHMA A156.9).
- K. BHMA A156.12 - American National Standard for Interconnected Locks & Latches; Builders Hardware Manufacturers Association; 2005 (ANSI/BHMA A156.12).
- L. BHMA A156.13 - American National Standard for Mortise Locks & Latches; Builders Hardware Manufacturers Association; 2005 (ANSI/BHMA A156.13).
- M. BHMA A156.16 - American National Standard for Auxiliary Hardware; Builders Hardware Manufacturers Association; 2008 (ANSI/BHMA A156.16).

- N. BHMA A156.18 - American National Standard for Materials and Finishes; Builders Hardware Manufacturers Association, Inc.; 2006 (ANSI/BHMA A156.18).
- O. BHMA A156.20 - American National Standard for Strap and Tee Hinges and Hasps; Builders Hardware Manufacturers Association; 2006 (ANSI/BHMA A156.20).
- P. BHMA A156.21 - American National Standard for Thresholds; Builders Hardware Manufacturers Association; 2009 (ANSI/BHMA A156.21).
- Q. BHMA A156.22 - American National Standard for Door Gasketing and Edge Seal Systems, Builders Hardware Manufacturers Association; 2012 (ANSI/BHMA A156.22).
- R. BHMA A156.31 - Electric Strikes and Frame Mounted Actuators; 2007 (ANSI/BHMA A156.31).
- S. BHMA A156.115 - Hardware Preparation in Steel Doors and Steel Frames; 2006.
- T. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames; Door and Hardware Institute; 2004.
- U. DHI WDHS.3 - Recommended Locations for Architectural Hardware for Flush Wood Doors; Door and Hardware Institute; 1993; also in WDHS-1/WDHS-5 Series, 1996.
- V. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.
- W. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2013.
- X. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures; National Fire Protection Association; 2012.
- Y. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the manufacture, fabrication, and installation of products onto which door hardware will be installed.
- B. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.
- C. Convey Broward County, Port Everglades's keying requirements to manufacturers.
- D. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; require attendance by all affected installers.
- E. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

#### 1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project.
- C. Samples: Prior to preparation of hardware schedule:
  - 1. Submit 1 sample of hinge, latchset, lockset, closer, and cylinder lock illustrating style, color, and finish.
  - 2. Samples will be returned to supplier.
- D. Hardware Schedule: Detailed listing of each item of hardware to be installed on each door. Use door numbering scheme as included in the Contract Documents. Identify electrically operated items and include power requirements.
- E. Keying Schedule: Submit for approval of Broward County, Port Everglades.

- F. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.
- G. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.
- H. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
- I. Keys: Deliver with identifying tags to Broward County, Port Everglades by security shipment direct from hardware supplier.
- J. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Broward County, Port Everglades's name and registered with manufacturer.
- K. Maintenance Materials and Tools: Furnish the following for Broward County, Port Everglades's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Extra Lock Cylinders: One for each master keyed group.
  - 3. Tools: One set of all special wrenches or tools applicable to each different or special hardware component, whether supplied by the hardware component manufacturer or not.

#### 1.06 QUALITY ASSURANCE

- A. Standards for Fire-Rated Doors: Maintain one copy of each referenced standard on site, for use by Bermello, Ajamil & Partners and Contractor.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- C. Hardware Supplier Qualifications: Company specializing in supplying commercial door hardware with five years of experience.
- D. Hardware Supplier Personnel: Employ an Architectural Hardware Consultant (AHC) to assist in the work of this section.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Package hardware items individually; label and identify each package with door opening code to match hardware schedule.

#### 1.08 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year warranty for door closers.

### PART 2 PRODUCTS

#### 2.01 DOOR HARDWARE - GENERAL

- A. Provide all hardware specified or required to make doors fully functional, compliant with applicable codes, and secure to the extent indicated.
- B. Provide all items of a single type of the same model by the same manufacturer.
- C. Provide products that comply with the following:
  - 1. Applicable provisions of federal, state, and local codes.
  - 2. ANSI/ICC A117.1, American National Standard for Accessible and Usable Buildings and Facilities.
  - 3. Applicable provisions of NFPA 101, Life Safety Code.
  - 4. Fire-Rated Doors: NFPA 80.

5. All Hardware on Fire-Rated Doors: Listed and classified by UL as suitable for the purpose specified and indicated.
  6. Hardware for Smoke and Draft Control Doors (Indicated as "S" on Drawings): Provide hardware that enables door assembly to comply with air leakage requirements of the applicable code.
  7. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.
- D. Function: Lock and latch function numbers and descriptions of manufactures series as listed in hardware schedule.
- E. Electrically Operated and/or Controlled Hardware: Provide all power supplies, power transfer hinges, relays, and interfaces required for proper operation; provide wiring between hardware and control components and to building power connection.
- F. Finishes: Identified in schedule.

## 2.02 HINGES

- A. Hinges: Provide hinges on every swinging door.
1. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
  2. Provide ball-bearing hinges at all doors.
  3. Provide hinges in the quantities indicated.
  4. Provide non-removable pins on exterior outswinging doors.
- B. Quantity of Hinges Per Door:
1. Doors From 60 inches High up to 90 inches High: Three hinges.
  2. Doors over 90 inches High: One additional hinge per each additional 30 inches in height.
- C. Manufacturers - Hinges:
1. Assa Abloy McKinney: [www.assaabloydss.com](http://www.assaabloydss.com).
  2. Bommer Industries, Inc: [www.bommer.com](http://www.bommer.com).
  3. C. R. Laurence Co., Inc: [www.crlaurence.com](http://www.crlaurence.com).
  4. Hager Companies: [www.hagerco.com](http://www.hagerco.com).
  5. Stanley Black & Decker: [www.stanleyblackanddecker.com](http://www.stanleyblackanddecker.com).

## 2.03 PUSH/PULLS

- A. Push/Pulls: Comply with BHMA A156.6.
1. Provide push and pull on doors not specified to have lockset, latchset, exit device, or auxiliary lock.
  2. On solid doors, provide matching push plate and pull plate on opposite faces.
- B. Manufacturers - Push/Pulls:
1. Assa Abloy McKinney: [www.assaabloydss.com](http://www.assaabloydss.com).
  2. C. R. Laurence Co., Inc: [www.crlaurence.com](http://www.crlaurence.com).
  3. Hager Companies: [www.hagerco.com](http://www.hagerco.com).
  4. Hiawatha, Inc: [www.hiawathainc.com](http://www.hiawathainc.com).
  5. Triangle Brass Manufacturing Co., Inc: [www.trimcobbw.com](http://www.trimcobbw.com).

## 2.04 LOCKS AND LATCHES

- A. Locks: Provide a lock for every door, unless specifically indicated as not requiring locking.
1. Hardware Sets indicate locking functions required for each door.
  2. If no hardware set is indicated for a swinging door provide an office lockset.
  3. Trim: Provide lever handle or pull trim on outside of all locks unless specifically stated to have no outside trim.



4. Lock Cylinders: Provide key access on outside of all locks unless specifically stated to have no locking or no outside trim.
  - B. Lock Cylinders: Manufacturer's standard tumbler type, seven-pin standard core.
    1. Provide cams and/or tailpieces as required for locking devices required.
  - C. Keying: Grand master keyed.
    1. Include construction keying.
    2. Key to existing keying system.
    3. Supply keys in the following quantities:
      - a. 3 master keys.
      - b. 2 grand master keys.
      - c. 9 construction keys.
      - d. 2 change keys for each lock.
    4. When providing keying information, comply with DHI Handbook "Keying systems and nomenclature".
  - D. Latches: Provide a latch for every door that is not required to lock, unless specifically indicated "push/pull" or "not required to latch".
- 2.05 CYLINDRICAL LOCKSETS
- A. Cylindrical Locksets: 1 5/32" rim
  - B. Manufacturers - Cylindrical Locksets:
    1. Best Access Systems, division of Stanley Security Solutions: [www.bestlock.com](http://www.bestlock.com).
- 2.06 MORTISE LOCKSETS
- A. Mortise Locksets: \_\_\_\_\_
  - B. Locking Functions: As defined in BHMA A156.13, and as follows:
    1. Passage: F01.
    2. Privacy: F19, or F02 with retraction of deadbolt by use of inside lever/knob.
    3. Office: F04, key not required to lock, remains locked upon exit.
    4. Classroom: F05, key required to lock.
    5. Entry, Deadbolt: F20, may be locked without key, free egress.
    6. Exit Only: F07 or F31, may have outside trim, may not be left unlocked.
  - C. Manufacturers - Mortise Locksets:
    1. Assa Abloy Corbin Russwin, Sargent, or Yale: [www.assaabloydss.com](http://www.assaabloydss.com).
    2. Best Access Systems, division of Stanley Security Solutions: [www.bestlock.com](http://www.bestlock.com).
    3. Hager Companies: [www.hagerco.com](http://www.hagerco.com).
    4. Schlage: [www.schlage.com](http://www.schlage.com).
- 2.07 FLUSHBOLTS
- A. Flushbolts: Lever extension bolts in leading edge of door, one bolt into floor, one bolt into top of frame.
    1. Pairs of Swing Doors: At inactive leaves, provide flush bolts of type as required to comply with code.
    2. Floor Bolts: Provide dustproof strike except at metal thresholds.
  - B. Automatic Flushbolts: Automatically latch upon closing of door; automatic retraction of bolts when active leaf is opened.
  - C. Coordinators: Provide on doors having closers and self-latching or automatic flushbolts to ensure that leaves close in proper order.

- D. Manufacturers - Flushbolts:
1. Assa Abloy McKinney: [www.assaabloydss.com](http://www.assaabloydss.com).
  2. Hager Companies: [www.hagerco.com](http://www.hagerco.com).
  3. Ives: [www.ives.ingersollrand.com](http://www.ives.ingersollrand.com).

## 2.08 ELECTRIC STRIKES

- A. Electric Strikes: Complying with BHMA A156.31 and UL listed as a Burglary-Resistant Electric Door Strike; style to suit locks.
- B. Manufacturers:
1. Assa Abloy Folger Adam EDC, HES, or Securitron: [www.assaabloydss.com](http://www.assaabloydss.com).
  2. Best Access System: [www.bestlock.com](http://www.bestlock.com).

## 2.09 EXIT DEVICES

- A. Locking Functions: Functions as defined in BHMA A156.3, and as follows:
1. Entry/Exit, Free Swing: Key outside retracts latch, latch holdback (dogging) for free swing during occupied hours, not fire-rated; outside trim must be specified as lever or pull.
  2. Exit Only, Secure: No outside trim, no key entry, no latch holdback, deadlocking latchbolt.
- B. Manufacturers:
1. Assa Abloy Corbin Russwin, Sargent, or Yale: [www.assaabloydss.com](http://www.assaabloydss.com).
  2. C. R. Laurence Co., Inc.;: [www.crlaurence.com](http://www.crlaurence.com).
  3. DORMA Group North America: [www.dorma-usa.com/usa](http://www.dorma-usa.com/usa).
  4. Hager Companies: [www.hagerco.com](http://www.hagerco.com).
  5. Von Duprin: [www.vonduprin.com](http://www.vonduprin.com).

## 2.10 CLOSERS

- A. Closers: Complying with BHMA A156.4.
1. Provide surface-mounted, door-mounted closers unless otherwise indicated.
  2. Provide a door closer on every exterior door.
  3. Provide a door closer on every fire- and smoke-rated door. Spring hinges are not an acceptable self-closing device unless specifically so indicated.
  4. On pairs of swinging doors, if an overlapping astragal is present, provide coordinator to ensure the leaves close in proper order.
  5. At corridors, locate door-mounted closer on room side of door.
  6. At outswinging exterior doors, mount closer in inside of door.
- B. Manufacturers - Closers:
1. Assa Abloy Corbin Russwin, Norton, Rixson, Sargent, or Yale: [www.assaabloydss.com](http://www.assaabloydss.com).
  2. LCN: [www.lcnclosers.com](http://www.lcnclosers.com).

## 2.11 STOPS AND HOLDERS

- A. Stops: Complying with BHMA A156.8; provide a stop for every swinging door, unless otherwise indicated.
1. Provide wall stops, unless otherwise indicated.
  2. If wall stops are not practical, due to configuration of room or furnishings, provide overhead stop.
  3. Stop is not required if positive stop feature is specified for door closer; positive stop feature of door closer is not an acceptable substitute for a stop unless specifically so stated.

- B. Overhead Holders/Stops: GH-90; Stainless Steel
- C. Manufacturers - Overhead Holders/Stops:
  - 1. Assa Abloy Rixson or Sargent: [www.assaabloydss.com](http://www.assaabloydss.com).
  - 2. C. R. Laurence Co., Inc;: [www.crlaurence.com](http://www.crlaurence.com).
  - 3. DORMA Group North America: [www.dorma-usa.com/usa](http://www.dorma-usa.com/usa).
  - 4. Glynn-Johnson: [www.glynn-johnson.com](http://www.glynn-johnson.com).
- D. Manufacturers - Wall and Floor Stops/Holders:
  - 1. Assa Abloy McKinney: [www.assaabloydss.com](http://www.assaabloydss.com).
  - 2. C. R. Laurence Co., Inc;: [www.crlaurence.com](http://www.crlaurence.com).
  - 3. Hager Companies: [www.hagerco.com](http://www.hagerco.com).
  - 4. Hiawatha, Inc: [www.hiawathainc.com](http://www.hiawathainc.com).
  - 5. Triangle Brass Manufacturing Co., Inc: [www.trimcobbw.com](http://www.trimcobbw.com).

## 2.12 GASKETING AND THRESHOLDS

- A. Gaskets: Complying with BHMA A156.22.
  - 1. On each door in smoke partition, provide smoke gaskets; top, sides, and meeting stile of pairs. If fire/smoke partitions are not indicated on drawings, provide smoke gaskets on each door identified as a "smoke door" and 20-minute rated fire doors.
  - 2. On each exterior door, provide weatherstripping gaskets, unless otherwise indicated; top, sides, and meeting stiles of pairs.
    - a. Where exterior door is also required to have fire or smoke rating, provide gaskets functioning as both smoke and weather seals.
  - 3. On each exterior door, provide door bottom sweep, unless otherwise indicated.
- B. Thresholds:
  - 1. At each exterior door, provide a threshold unless otherwise indicated.
- C. Manufacturers - Gasketing and Thresholds:
  - 1. Assa Abloy McKinney: [www.assaabloydss.com](http://www.assaabloydss.com).
  - 2. Hager Companies: [www.hagerco.com](http://www.hagerco.com).
  - 3. National Guard Products, Inc: [www.ngpinc.com](http://www.ngpinc.com).
  - 4. Pemko Manufacturing Co: [www.pemko.com](http://www.pemko.com).
  - 5. Zero International, Inc: [www.zerointernational.com](http://www.zerointernational.com).

## 2.13 PROTECTION PLATES AND ARCHITECTURAL TRIM

- A. Protection Plates:
  - 1. Kickplate: Provide on push side of every door with closer, except storefront and all-glass doors.
- B. Drip Guard: Provide projecting drip guard over all exterior doors unless they are under a projecting roof or canopy.
- C. Manufacturers - Protection Plates and Architectural Trim:
  - 1. Assa Abloy McKinney: [www.assaabloydss.com](http://www.assaabloydss.com).
  - 2. C. R. Laurence Co., Inc;: [www.crlaurence.com](http://www.crlaurence.com).
  - 3. Hager Companies: [www.hagerco.com](http://www.hagerco.com).
  - 4. Hiawatha, Inc: [www.hiawathainc.com](http://www.hiawathainc.com).
  - 5. Triangle Brass Manufacturing Co., Inc: [www.trimcobbw.com](http://www.trimcobbw.com).

## 2.14 KEY CONTROLS

- A. Key Management System: For each keyed lock on project, provide one set of consecutively numbered duplicate key tags with hanging hole and snap catch.

- B. Fire Department Lock Box: Heavy-duty, surface mounted, solid stainless-steel box with hinged door and interior gasket seal; single drill resistant lock with dust covers and tamper alarm.
  - 1. Capacity: Holds 10 keys.
  - 2. Finish: Manufacturer's standard dark bronze.
  - 3. Products:
    - a. Knox Company; Knox-Box Rapid Entry System: [www.knoxbox.com](http://www.knoxbox.com).

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that doors and frames are ready to receive work; labeled, fire-rated doors and frames are present and properly installed, and dimensions are as indicated on shop drawings.
- B. Verify that electric power is available to power operated devices and of the correct characteristics.

### 3.02 INSTALLATION

- A. Install hardware in accordance with manufacturer's instructions and applicable codes.
- B. Use templates provided by hardware item manufacturer.
- C. Install hardware on fire-rated doors and frames in accordance with code and NFPA 80.
- D. Mounting heights for hardware from finished floor to center line of hardware item: As listed in Schedule, unless otherwise noted:
  - 1. For steel doors and frames: Comply with DHI "Recommended Locations for Architectural Hardware for Steel Doors and Frames."

### 3.03 FIELD QUALITY CONTROL

- A. Provide an Architectural Hardware Consultant to inspect installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

### 3.04 ADJUSTING

- A. Adjust work under provisions of Section 01 7000.
- B. Adjust hardware for smooth operation.

### 3.05 CLEANING

- A. Clean adjacent surfaces soiled by hardware installation. Clean finished hardware per manufacturer's instructions after final adjustments has been made. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

### 3.06 PROTECTION

- A. Protect finished Work under provisions of Section 01 7000.
- B. Do not permit adjacent work to damage hardware or finish.

END OF SECTION

## SECTION 08 83 13 – HURRICANE RESISTANT GLAZING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Glass.
- B. Glazing compounds and accessories.

#### 1.02 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test; 2010.
- C. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2011).
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2011.
- E. ASTM C1036 - Standard Specification for Flat Glass; 2011e1.
- F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
- G. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2009e1.
- H. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2011a.
- I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2012.
- J. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2012a.
- K. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2010.
- L. GANA (GM) - GANA Glazing Manual; Glass Association of North America; 2009.
- M. GANA (SM) - GANA Sealant Manual; Glass Association of North America; 2008.
- N. GANA (LGDG) - Laminated Glazing Reference Manual; Glass Association of North America; 2009.

#### 1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data on Glass Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
- C. Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.
- D. Samples: Submit two samples 6 x 6 inch in size of glass and plastic units, showing coloration and design.
- E. Manufacturer's Certificate: Certify that all glass meets or exceeds specified requirements.

- F. Maintenance Materials: Furnish the following for Broward County, Port Everglades's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.

#### 1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA Glazing Manual and FGMA Sealant Manual for glazing installation methods.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum fifteen years documented experience.

#### 1.06 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 50 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

#### 1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Sealed Insulating Glass Units: Provide a five (5) year warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.
- C. Laminated Glass: Provide a five (5) year warranty to include coverage for delamination, including replacement of failed units.

### PART 2 PRODUCTS

#### 2.01 EXTERIOR GLAZING ASSEMBLIES

- A. Structural Design Criteria: Select type and thickness to withstand dead loads and wind loads acting normal to plane of glass at design pressures as indicated on the drawings.
  - 1. Use the procedure specified in ASTM E1300 to determine glass type and thickness.
  - 2. Limit glass deflection to 1/200 or flexure limit of glass, whichever is less, with full recovery of glazing materials.
  - 3. Thicknesses listed are minimum.
- B. Air and Vapor Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier:
  - 1. In conjunction with vapor retarder and joint sealer materials described in other sections.
  - 2. To maintain a continuous air barrier and vapor retarder throughout the glazed assembly from glass pane to heel bead of glazing sealant.

#### 2.02 GLASS MATERIALS

- A. Float Glass Manufacturers:
  - 1. AGC Flat Glass North America, Inc: [www.na.agc-flatglass.com](http://www.na.agc-flatglass.com).
  - 2. Pilkington North America Inc: [www.pilkington.com/na](http://www.pilkington.com/na).
  - 3. PPG Industries, Inc: [www.ppgideascales.com](http://www.ppgideascales.com).
- B. Float Glass: All glazing is to be float glass unless otherwise indicated.
  - 1. Annealed Type: ASTM C1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select).
  - 2. Heat-Strengthened and Fully Tempered Types: ASTM C1048.
- C. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
  - 1. Laminated Safety Glass: Comply with 16 CFR 1201 test requirements for Category II.
  - 2. Plastic Interlayer: 0.030 inch thick, minimum.

3. Where fully tempered is specified or required, provide glass that has been tempered by the tong-less horizontal method.

D. Two-Way Mirror Glass: Mirror quality float glass (Q2) with factory coating.

## 2.03 SEALED INSULATING GLASS UNITS

A. Manufacturers:

1. Cardinal Glass Industries: [www.cardinalcorp.com](http://www.cardinalcorp.com).
2. Viracon, Apogee Enterprises, Inc: [www.viracon.com](http://www.viracon.com).
3. Substitutions: Refer to Section 01 6000 - Product Requirements.

B. Sealed Insulating Glass Units: Types as indicated.

1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
2. Edge Spacers: Aluminum, bent and soldered corners.
3. Edge Seal: Glass to elastomer with supplementary silicone sealant.
4. Purge interpane space with dry hermetic air.

## 2.04 GLAZING COMPOUNDS

A. Manufacturers:

1. Bostik Inc: [www.bostik-us.com](http://www.bostik-us.com).
2. Momentive Performance Materials, Inc (formerly GE Silicones): [www.momentive.com](http://www.momentive.com).
3. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
4. BASF Construction Chemicals-Building Systems: [www.buildingsystems.basf.com](http://www.buildingsystems.basf.com).
5. Substitutions: Refer to Section 01 6000 - Product Requirements.

B. Polysulfide Sealant: Two component; chemical curing, non-sagging type; ASTM C 920, Type M, Grade NS, Class 25, Uses M, A, and G; cured Shore A hardness of 15 to 25; color as selected.

C. Polyurethane Sealant: Single component, chemical curing, non-staining, non-bleeding; ASTM C 920, Type S, Grade NS, Class 25, Uses M, A, and G; Shore A Hardness Range 20 to 35; color as selected.

D. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C 920, Type S, Grade NS, Class 25, Uses M, A, and G; cured Shore A hardness of 15 to 25; color as selected.

## 2.05 GLAZING ACCESSORIES

A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness, ASTM C864 Option I. Length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.

B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness, ASTM C 864 Option I. Minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.

C. Glazing Tape: Preformed butyl compound with integral resilient tube spacing device; 10 to 15 Shore A durometer hardness; coiled on release paper; black color.

1. Manufacturers:

- a. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
- b. Tremco Global Sealants: [www.tremcosealants.com](http://www.tremcosealants.com).
- c. Substitutions: Refer to Section 01 6000 - Product Requirements.

D. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option I; silver or silver-grey color.

E. Glazing Clips: Manufacturer's standard type.

## 2.06 SOURCE QUALITY CONTROL AND TESTS

- A. Provide shop inspection and testing for impact glass.

## PART 3 EXECUTION

### 3.01 INSTALLERS

- A. Acceptable Installers:

### 3.02 EXAMINATION

- A. Verify that openings for glazing are correctly sized and within tolerance.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

### 3.03 PREPARATION

- A. Prime surfaces scheduled to receive sealant.
- B. Install sealants in accordance with ASTM C1193 and GANA Sealant Manual.
- C. Install sealant in accordance with manufacturer's instructions.

### 3.04 INSTALLATION - EXTERIOR/INTERIOR DRY METHOD (GASKET GLAZING)

- A. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
- B. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- C. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

### 3.05 INSTALLATION - INTERIOR WET/DRY METHOD (TAPE AND SEALANT)

- A. Cut glazing tape to length and install against permanent stops, projecting 1/16 inch (1.6 mm) above sight line.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
- C. Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.
- D. Install removable stops, spacer shims inserted between glazing and applied stops at 24 inch intervals, 1/4 inch below sight line.
- E. Fill gaps between pane and applied stop with type sealant to depth equal to bite on glazing, to uniform and level line.
- F. Trim protruding tape edge.

### 3.06 MANUFACTURER'S FIELD SERVICES

- A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
- B. Monitor and report installation procedures and unacceptable conditions.

### 3.07 CLEANING

- A. Remove glazing materials from finish surfaces.
- B. Remove labels after Work is complete.
- C. Clean glass and adjacent surfaces.

END OF SECTION



## SECTION 08 83 23 – MİRRORED GLASS GLAZING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Glass mirrors.

#### 1.02 REFERENCE STANDARDS

- A. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test; 2010.
- B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2011.
- C. ASTM C1036 - Standard Specification for Flat Glass; 2011e1.
- D. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2011a.
- E. GANA (GM) - GANA Glazing Manual; Glass Association of North America; 2009.
- F. GANA (TIPS) - Mirrors Handle with Extreme Care: Tips For the Professional on the Care and Handling of Mirrors; National Association of Mirror Manufacturers; 2004  
(<http://www.mirrorlink.org/members/technical.h>)

#### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data on Mirror Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
- C. Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.
- D. Manufacturer's Certificate: Certify that mirrors, meets or exceeds specified requirements.

#### 1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA Glazing Manual for glazing installation methods.
  - 1. Maintain one copy on project site.
- B. Fabricate, store, transport, receive, install, and clean mirrors in accordance with recommendations of GANA (TIPS) "Mirrors Handle with Extreme Care: Tips For the Professional on the Care and Handling of Mirrors."

#### 1.05 FIELD CONDITIONS

- A. Do not install mirrors when ambient temperature is less than 50 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

#### 1.06 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for reflective coating on mirrors and replacement of same.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Mirrors:
  - 1. Arch Aluminum & Glass Co., Inc: [www.arch.amarlite.com](http://www.arch.amarlite.com).
  - 2. Binswanger Mirror/ACI Distribution: [www.binswangerglass.com](http://www.binswangerglass.com).

3. Lenoir Mirror Co: [www.lenoirmirror.com](http://www.lenoirmirror.com).
4. Substitutions: See Section 01 6000 - Product Requirements.

## 2.02 MATERIALS

- A. Mirror Glass - General: Select materials and/or provide supports as required to limit mirrored glass deflection to 1/200 or flexure limit of glass with full recovery of glazing materials, whichever is less.
- B. Mirror Glass: Clear float type with copper and silver coating, organic overcoating, arrised edges,.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that openings for mirrored glazing are correctly sized and within tolerance.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive mirrors.

### 3.02 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer. Prime surfaces scheduled to receive sealant.
- C. Perform installation in accordance with ASTM C1193 for solvent release sealants. Install sealant in accordance with manufacturer's instructions.

### 3.03 INSTALLATION - GENERAL

- A. Install mirrors in accordance with GANA recommendations.
- B. Set mirrors plumb and level, free of optical distortion.
- C. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.

### 3.04 CLEANING

- A. Remove wet glazing materials from finish surfaces.
- B. Remove labels after work is complete.
- C. Clean mirrors and adjacent surfaces.

### 3.05 PROTECTION

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste.

END OF SECTION

## SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Metal stud wall framing.
- C. Metal channel ceiling framing.
- D. Shaft wall system.
- E. Acoustic insulation.
- F. Gypsum sheathing.
- G. Cementitious backing board.
- H. Gypsum wallboard.
- I. Joint treatment and accessories.
- J. Textured finish system.
- K. Water-resistive barrier over exterior wall sheathing.

#### 1.02 REFERENCE STANDARDS

- A. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement. (replaced SG-971)
- B. ANSI A108.11 - American National Standard for Interior Installation of Cementitious Backer Units; 2012.1.
- C. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2012.1.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2011.
- E. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2002 (Reapproved 2007).
- F. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2011a.
- G. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- H. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011.
- I. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2011.
- J. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2011.

- K. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2007.
- L. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2010a.
- M. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2008.
- N. ASTM C1278/C1278M - Standard Specification for Fiber-Reinforced Gypsum Panel; 2007a (Reapproved 2011).
- O. ASTM C1280 - Standard Specification for Application of Gypsum Sheathing; 2012.
- P. ASTM C1325 - Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cement Substrate Sheets; 2008b.
- Q. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2011.
- R. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2012.
- S. ASTM E72 - Standard Test Methods of Conducting Strength Tests of Panels for Building Construction; 2010.
- T. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2012.
- U. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- V. ASTM E413 - Classification for Rating Sound Insulation; 2010.
- W. GA-216 - Application and Finishing of Gypsum Board; Gypsum Association; 2010.
- X. GA-600 - Fire Resistance Design Manual; Gypsum Association; 2009.
- Y. ICC (IBC) - International Building Code; 2012.
- Z. ICC-ES AC308 - Acceptance Criteria for Water-Resistive Barriers; ICC Evaluation Service, Inc.; 2011.
- AA. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.
- C. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- D. Test Reports: For all stud framing products that do not comply with ASTM C645 or C 754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.

### 1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing gypsum board application and finishing, with minimum five years of documented experience.

- B. Copies of Documents at Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

## PART 2 PRODUCTS

### 2.01 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
- B. Interior Partitions: Provide completed assemblies with the following characteristics:
1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- C. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:
1. Air Pressure Within Shaft: Sustained loads of 5 lbf/sq ft with maximum mid-span deflection of  $L/240$ .
  2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- D. Fire Rated Assemblies: Provide completed assemblies complying with applicable code.

### 2.02 METAL FRAMING MATERIALS

- A. Manufacturers - Metal Framing, Connectors, and Accessories:
1. Clarkwestern Dietrich Building Systems LLC: [www.clarkdietrich.com](http://www.clarkdietrich.com).
  2. Dietrich Metal Framing: [www.dietrichindustries.com](http://www.dietrichindustries.com).
  3. Marino Mare: [www.marinoware.com](http://www.marinoware.com).
  4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of  $L/240$  at 5 psf.
1. Exception: The minimum metal thickness and section properties requirements of ASTM C 645 are waived provided steel of 40 ksi minimum yield strength is used, the metal is continuously dimpled, the effective thickness is at least twice the base metal thickness, and maximum stud heights are determined by testing in accordance with ASTM E 72 using assemblies specified by ASTM C 754.
  2. Studs: "C" shaped with flat or formed webs with knurled faces.
  3. Runners: U shaped, sized to match studs.
  4. Ceiling Channels: C shaped.
- C. Exterior Non-Loadbearing Studs and Furring for Application of Gypsum Board: As specified in Section 09 2216.
- D. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
- E. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
- F. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI North American Specification for the Design of Cold-Formed Steel Structural Members.
  2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot dipped galvanized coating.
  3. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems indicated on drawings.
  4. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 12 feet.

## 2.03 BOARD MATERIALS

### A. Manufacturers - Gypsum-Based Board:

1. American Gypsum: [www.americangypsum.com](http://www.americangypsum.com).
2. American Gypsum: [www.americangypsum.com](http://www.americangypsum.com).
3. CertainTeed Corporation: [www.certainteed.com](http://www.certainteed.com).
4. Georgia-Pacific Gypsum: [www.gpgypsum.com](http://www.gpgypsum.com).
5. Lafarge North America Inc: [www.lafargenorthamerica.com](http://www.lafargenorthamerica.com).
6. National Gypsum Company: [www.nationalgypsum.com](http://www.nationalgypsum.com).
7. PABCO Gypsum: [www.pabcogypsum.com](http://www.pabcogypsum.com).
8. Temple-Inland Inc: [www.templeinland.com](http://www.templeinland.com).
9. USG Corporation: [www.usg.com](http://www.usg.com).

### B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.

1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
  - a. Mold-resistant board is required at all locations.
3. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
4. Thickness:
  - a. Vertical Surfaces: 5/8 inch.
  - b. Ceilings: 5/8 inch.
5. Mold-Resistant Paper-Faced Products:
  - a. American Gypsum; M-Bloc.
  - b. CertainTeed Corporation; ProRoc Brand Moisture & Mold Resistant Gypsum Board.
  - c. Lafarge North America Inc; Mold Defense Drywall.
  - d. Lafarge North America Inc; Protecta AR 100 Type X with Mold Defense.
  - e. National Gypsum Company; Gold Bond Brand XP Gypsum Board.
  - f. National Gypsum Company; Gold Bond Hi-Abuse Brand XP Wallboard.
  - g. Pacific Coast Building Products, Inc; PABCO Mold Curb Gypsum Wallboard.
  - h. Temple-Inland Inc; ComfortGuard Mold Resistant Gypsum Board.
  - i. USG Corporation; Sheetrock Brand Mold Tough Gypsum Panels.
  - j. USG Corporation; Sheetrock Brand Mold Tough Gypsum Panels AR.

### C. Backing Board For Wet Areas: One of the following products:

1. Application: Surfaces behind tile in wet areas including tub and shower surrounds and shower ceilings.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
  - a. Thickness: 1/2 inch.
  - b. Products:
    - 1) Custom Building Products; Wonderboard.
    - 2) National Gypsum Company; PermaBase Brand Cement Board.
    - 3) National Gypsum Company; PermaBase Flex Brand Cement Board.
    - 4) USG Corporation; Durock Brand Cement Board.

### D. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.

1. Application: Exterior sheathing, unless otherwise indicated.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. Unlaced Sheathing: Water-resistant exterior fiber-reinforced gypsum sheathing panels as defined in ASTM C1278/C1278M, and exceeding the relevant requirements of ASTM C1177/C1177M.
4. Core Type: Regular and Type X, as indicated.
5. Type X Thickness: 5/8 inch.

6. Regular Board Thickness: 5/8 inch.
  7. Edges: Square, for vertical application.
- E. Exterior Soffit Board: Exterior gypsum soffit board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Ceilings and soffits in protected exterior areas, unless otherwise indicated.
  2. Types: Regular, in locations indicated.
  3. Regular Type Thickness: 1/2 inch.
  4. Edges: Tapered.
- F. Shaftwall and Coreboard: Type X; 1 inch thick by 24 inches wide, beveled long edges, ends square cut.
1. Paper Faced Type: Gypsum shaftliner board or gypsum coreboard as defined ASTM C 1396/C 1396M; water-resistant faces.
  2. Mold Resistance: Score of 10, when tested in accordance with ASTM D 3273.
  3. Products:
    - a. Georgia-Pacific Gypsum LLC; DensGlass Ultra Shaftliner (mold-resistant).
    - b. National Gypsum Company; Gold Bond Brand 1" Fire-Shield Shaftliner XP (mold-resistant).
    - c. USG Corporation; Sheetrock Gypsum Liner Panels--Enhanced (mold-resistant).

#### 2.04 ACCESSORIES

- A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced.
- B. Acoustic Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board.
- C. Water-Resistive Barrier: No. 15 asphalt felt.
- D. Water-Resistive Barrier: No. 15 asphalt felt.
- E. Joint Materials: ASTM C475 and as recommended by gypsum board manufacturer for project conditions.
1. Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
  2. Ready-mixed vinyl-based joint compound.
- F. High Build Drywall Surfer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.
- G. Textured Finish Materials: Latex-based compound; plain.
- H. Screws for Attachment to Steel Members Less Than 0.03 inch In Thickness, to Wood Members, and to Gypsum Board: ASTM C1002; self-piercing tapping type; cadmium-plated for exterior locations.
- I. Screws for Attachment to Steel Members From 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws for application of gypsum board to loadbearing steel studs.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

#### 3.02 SHAFT WALL INSTALLATION

- A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions. 1. Install studs at spacing required to meet performance requirements.
- B. Shaft Wall Liner: Cut panels to accurate dimension and install sequentially between special friction studs.

### 3.03 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
- C. Studs: Space studs as permitted by standard.
  - 1. Extend partition framing to structure where indicated and to ceiling in other locations.
  - 2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
  - 3. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturers instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
- D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
- E. Furring for Fire Ratings: Install as required for fire resistance ratings indicated and to GA-600 requirements.
- F. Blocking: Install wood blocking for support of:
  - 1. Framed openings.
  - 2. Wall mounted cabinets.
  - 3. Plumbing fixtures.
  - 4. Toilet partitions.
  - 5. Toilet accessories.
  - 6. Wall mounted door hardware.

### 3.04 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
  - 1. Place one bead continuously on substrate before installation of perimeter framing members.
  - 2. Place continuous bead at perimeter of each layer of gypsum board.
  - 3. In non-fire-rated construction, seal around all penetrations by conduit, pipe, ducts, and rough-in boxes.

### 3.05 BOARD INSTALLATION

- A. Comply with ASTM C 840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing. 1. Exception: Tapered edges to receive joint treatment at right angles to framing.
- C. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- D. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
  - 1. Paper-Faced Sheathing: Immediately after installation, protect from weather by application of water-resistive barrier.
- E. Exterior Soffit Board: Install perpendicular to framing, with staggered end joints over framing members or other solid backing.



- F. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.
- G. Installation on Metal Framing: Use screws for attachment of all gypsum board except face layer of non-rated double-layer assemblies, which may be installed by means of adhesive lamination.

### 3.06 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials and as indicated.

### 3.07 JOINT TREATMENT

- A. Paper Faced Gypsum Board: Use paper joint tape, bedded with ready-mixed vinyl-based joint compound and finished with ready-mixed vinyl-based joint compound.
- B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
  - 1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
  - 2. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
  - 3. Level 3: Walls to receive textured wall finish.
  - 4. Level 2: In utility areas, behind cabinetry, and on backing board to receive file finish.
  - 5. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
  - 6. Level 0: Temporary partitions and surfaces indicated to be finished in later stage of project.
- C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
  - 1. Feather coats of joint compound so that camber is maximum 1/32 inch.
  - 2. Taping, filling, and sanding is not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.
  - 3. Taping, filling and sanding is not required at base layer of double layer applications.
- D. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.
- E. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

### 3.08 TEXTURE FINISH

- A. Apply finish texture coating by means of trowel in accordance with manufacturer's instructions and to match finish of adjacent existing finishes.

### 3.09 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

## SECTION 09 22 36 - METAL LATH

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Metal lath for Portland cement and gypsum plaster.
- B. Furring for metal lath.
- C. Metal ceiling framing.

#### 1.02 REFERENCE STANDARDS

- A. ASTM C 841 - Standard Specification for Installation of Interior Lathing and Furring; 2003 (Reapproved 2008).
- B. ASTM C 847 - Standard Specification for Metal Lath; 2010.
- C. ASTM C 933 - Standard Specification for Welded Wire Lath; 2009.
- D. ASTM C 1002 - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2007.
- E. ASTM C 1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster; 2008.
- F. GA-600 - Fire Resistance Design Manual; Gypsum Association; 2009.
- G. NAAMM ML/SFA 920 - Guide Specifications For Metal Lathing and Furring; The National Association of Architectural Metal Manufacturers; 1991.

#### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on furring and lathing components, structural characteristics, material limitations, and finish.

#### 1.04 QUALITY ASSURANCE

- A. Maintain one copy of each installation standard referenced in PART 3 on site throughout the duration of lathing and plastering work.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum Five years experience.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Metal Lath:
  - 1. Alabama Metal Industries Corporation: [www.amico-online.com](http://www.amico-online.com).
  - 2. Cemco: [www.cemcosteel.com](http://www.cemcosteel.com).
  - 3. Clark Western Building Systems: [www.clarkwestern.com](http://www.clarkwestern.com).
  - 4. Dietrich Metal Framing: [www.dietrichindustries.com](http://www.dietrichindustries.com).
  - 5. Substitutions: See Section 01 6000 - Product Requirements.

#### 2.02 FRAMING AND LATH ASSEMBLIES

- A. Provide completed assemblies with the following characteristics:
  - 1. Maximum Deflection of Vertical Assemblies: 1:360 under lateral point load of 100 lbs.

2. Maximum Deflection of Horizontal Assemblies: 1:240 deflection under dead loads and wind uplift.

### 2.03 FRAMING MATERIALS

- A. Furring Channels: Formed steel, minimum 0.020 inch thick, 3/8 inch deep x 7/8 inch high, splicing permitted; galvanized.
- B. Main Ceiling Channels: Formed steel, asphalt coated, minimum 0.05 inch thick, 3/4 inch deep x 1-1/2 inch high, single piece, no splicing; galvanized.
- C. Hangers: Steel wire, of size and type to suit application, to support ceiling components in place to deflection limits as indicated.
- D. Lateral Bracing: Formed steel, minimum 0.060 inch thick, size and length as required; galvanized.

### 2.04 LATH

- A. Diamond Mesh Metal Lath: ASTM C 847, galvanized; self-furring.
  1. Weight: To suit application, comply with deflection criteria, and as specified in ASTM C 841 for framing spacing.
  2. Weight: 2.5 lb/sq yd.
- B. Flat Rib Metal Lath: ASTM C 847, galvanized; 1/8 inch thick.
  1. Weight: To suit application, comply with deflection criteria, and as specified in ASTM C 841 for framing spacing.
  2. Weight: 1.8 lb/sq yd.
- C. Ribbed Metal Lath: ASTM C 847, galvanized; 3/8 inch thick.
  1. Weight: To suit application, comply with deflection criteria, and as specified in ASTM C 841 for framing spacing.
  2. Weight: 3.4 lb/sq yd.
- D. Corner Mesh: Formed sheet steel, minimum 0.018 inch thick, perforated flanges shaped to permit complete embedding in plaster, minimum 2 inch size; same finish as lath.
- E. Strip Mesh: Expanded metal lath, same weight as lath, 2 inch wide x 24 inch long; same finish as lath.

### 2.05 ACCESSORIES

- A. Anchorage: Tie wire, nails, and other metal supports, of type and size to suit application; to rigidly secure materials in place, galvanized.
- B. Fasteners: ASTM C 1002 self-piercing tapping screws.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that substrates are ready to receive work and conditions are suitable for application.
- C. For exterior plaster and stucco on stud walls, verify that water-resistive barrier has been installed over sheathing substrate completely and correctly.
- D. Do not begin until unacceptable conditions have been corrected.
- E. If substrate preparation is the responsibility of another installer, notify Bermello, Ajamil & Partners of unsatisfactory preparation before proceeding.

### 3.02 INSTALLATION - GENERAL

- A. Install interior lath and furring in accordance with ASTM C 841.

### 3.03 CEILING AND SOFFIT FRAMING

- A. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.
- B. Install furring independent of walls, columns, and above-ceiling work.
- C. Securely anchor hangers to structural members or embed in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.
- D. Space main carrying channels at maximum 72 inch on center, and not more than 6 inches from wall surfaces. Lap splice securely.
- E. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.
- F. Place furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.
- G. Reinforce openings in suspension system that interrupt main carrying channels or furring channels with lateral channel bracing. Extend bracing minimum 24 inches past each opening.
- H. Laterally brace suspension system.

### 3.04 ACCESS PANELS

- A. Install access panels and rigidly secure in place.
- B. Install frames plumb and level in opening. Secure rigidly in place.
- C. Position to provide convenient access to concealed work requiring access.

### 3.05 LATH INSTALLATION

- A. Apply metal lath taut, with long dimension perpendicular to supports.
- B. Lap ends minimum 1 inch. Secure end laps with tie wire where they occur between supports.
- C. Continuously reinforce internal angles with corner mesh, except where the metal lath returns 3 inches from corner to form the angle reinforcement; fasten at perimeter edges only.
- D. Place corner bead at external wall corners; fasten at outer edges of lath only.
- E. Place base screeds at termination of plaster areas; secure rigidly in place.
- F. Place 4 inch wide strips of metal lath centered over junctions of dissimilar backing materials. Secure rigidly in place.
- G. Place lath vertically above each top corner and each side of door frames to 6 inches above ceiling line.
- H. Place casing beads at terminations of plaster finish. Butt and align ends. Secure rigidly in place.
- I. Place additional strip mesh diagonally at corners of lathed openings. Secure rigidly in place.

### 3.06 TOLERANCES

- A. Maximum Variation from True Lines and Levels: 1/8 inch in 10 feet.

END OF SECTION

## SECTION 09 24 13 - PORTLAND CEMENT PLASTERING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Portland cement plaster for installation over metal lath, masonry, concrete, and solid surfaces.

#### 1.02 REFERENCE STANDARDS

- A. ASTM C91/C91M - Standard Specification for Masonry Cement; 2012.
- B. ASTM C150/C150M - Standard Specification for Portland Cement; 2012.
- C. ASTM C206 - Standard Specification for Finishing Hydrated Lime; 2003 (Reapproved 2009).
- D. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2006 (Reapproved 2011).
- E. ASTM C926 - Standard Specification for Application of Portland Cement-Based Plaster; 2012a.
- F. ASTM C932 - Standard Specification for Surface-Applied Bonding Compounds for Exterior Plastering; 2006.
- G. ICC (IBC) - International Building Code; 2012.
- H. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.
- I. PCA EB049 - Portland Cement Plaster/Stucco Manual; Portland Cement Association; 2003.
- J. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

#### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittals procedures.
- B. Product Data: Provide data on plaster materials, characteristics and limitations of products specified.

#### 1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum Five years of experience.
- B. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

#### 1.05 FIELD CONDITIONS

- A. Do not apply plaster when substrate or ambient air temperature is under 50 degrees F or over 80 degrees F.

### PART 2 PRODUCTS

#### 2.01 PLASTER MATERIALS

- A. Portland Cement, Aggregates, and Other Materials: In accordance with ASTM C926.
- B. Premixed Base Coat: ASTM 6150, type: II; manufactured by United States Gypsum Co.; IPA Systems, Inc.; Florida Stucco Corp or approved equivalent.
- C. Premixed Finish Coat: ASTM C190; type: II; color: Grey; manufactured by United States Gypsum Co.; IPA Systems, Inc.; Florida Stucco Corp or approved equivalent.

## 2.02 METAL LATH

- A. Metal Lath and Accessories: As specified in Section 09 22 36.23. Use metal lath as plaster base at exterior soffit overhang.
- B. Beads, Screeds, and Joint Accessories: As specified in Section 09 2236.23.

## 2.03 PLASTER MIXES

- A. Over Metal Lath: Three-coat application mixed and proportioned in accordance with manufacturer's instructions.
- B. Premixed Plaster Materials: Mix in accordance with manufacturer's instructions.
- C. Mix only as much plaster as can be used prior to initial set.
- D. Mix materials dry, to uniform color and consistency, before adding water.
- E. Protect mixtures from freezing, frost, contamination, and excessive evaporation.
- F. Do not retemper mixes after initial set has occurred.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify the suitability of existing conditions before starting work.
- B. Masonry: Verify joints are cut flush and surface is ready to receive work of this section. Verify no bituminous or water repellent coatings exist on masonry surface.
- C. Concrete: Verify surfaces are flat, honeycomb are filled flush, and surfaces are ready to receive work of this section. Verify no bituminous, water repellent, or form release agents exist on concrete surface that are detrimental to plaster bond.
- D. Metal Lath and Accessories: Verify lath is flat, secured to substrate, and joint and surface perimeter accessories are in place.

### 3.02 PREPARATION

- A. Dampen masonry surfaces to reduce excessive suction.
- B. Clean concrete surfaces of foreign matter. Clean surfaces using acid solutions, solvents, or detergents. Wash surfaces with clean water.
- C. Roughen smooth concrete surfaces and apply bonding agent in accordance with manufacturer's instructions.

### 3.03 PLASTERING

- A. Apply premixed plaster in accordance with manufacturer's instructions.
- B. Apply plaster in accordance with ASTM C926.
- C. Moist cure base coats.
- D. Apply second coat immediately following initial set of first coat.
- E. After curing, dampen previous coat prior to applying finish coat.
- F. Avoid excessive working of surface. Delay troweling as long as possible to avoid drawing excess fines to surface.
- G. Moist cure finish coat for minimum period of 48 hours.

### 3.04 TOLERANCES

- A. Maximum Variation from True Flatness: 1/8 inch in 10 feet.

END OF SECTION

## SECTION 09 30 13 – CERAMIC TILING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Cementitious backer board as tile substrate.
- D. Coated glass mat backer board as tile substrate.
- E. Stone thresholds.
- F. Ceramic accessories.
- G. Ceramic trim.

#### 1.02 REFERENCE STANDARDS

- A. ANSI A108 Series/A118 Series/A136.1 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2012.1.
- B. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2012.1.
- C. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex Portland Cement Mortar; 2012.1.
- D. ANSI A108.1c - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Bed with Dry-Set or Latex Portland Cement Mortar; 2012.1.
- E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive; 2012.1.
- F. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar; 2012.1.
- G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy; 2012.1.
- H. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 2012.1.
- I. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 2012.1.
- J. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 2012.1.
- K. ANSI A108.11 - American National Standard for Interior Installation of Cementitious Backer Units; 2012.1.
- L. ANSI A108.12 - American National Standard for Installation of Ceramic Tile with EGP (Exterior glue plywood) Latex-Portland Cement Mortar; 2012.1.
- M. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2012.1.

- N. ANSI A118.1 - American National Standard Specifications for Dry-Set Portland Cement Mortar; 2012.1.
- O. ANSI A118.4 - American National Standard Specifications for Latex-Portland Cement Mortar; 2012.1.
- P. ANSI A118.7 - American National Standard Specifications for Polymer Modified Cement Grouts for Tile Installation; 2012.1.
- Q. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2012.1.
- R. ANSI A136.1 - American National Standard for Organic Adhesives for Installation of Ceramic Tile; 2012.1.
- S. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2012.
- T. ASTM C847 - Standard Specification for Metal Lath; 2012.
- U. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2011.
- V. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2012.

#### 1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Maintenance Data: Include recommended cleaning methods, cleaning materials, stain removal methods, and polishes and waxes.
- F. Maintenance Materials: Furnish the following for Broward County, Port Everglades's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Extra Tile: 10 square feet of each size, color, and surface finish combination.

#### 1.05 QUALITY ASSURANCE

- A. Maintain one copy of The Tile Council of North America Handbook and ANSI A108 Series/A118 Series on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum 5 years of documented experience.
- C. Installer Qualifications: Company specializing in performing tile installation, with minimum of 5 years of documented experience.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.



## 1.07 FIELD CONDITIONS

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature of 50 degrees F during installation of mortar materials.

## PART 2 PRODUCTS

### 2.01 TILE

- A. Manufacturers: All products by the same manufacturer.
  - 1. American Olean: [www.americanolean.com](http://www.americanolean.com).
  - 2. Dal-Tile Corporation: [www.daltile.com](http://www.daltile.com).
  - 3. Summitville Tiles, Inc: [www.summitville.com](http://www.summitville.com).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Ceramic Mosaic Tile: ANSI A137.1, and as follows:
  - 1. Moisture Absorption: 0 to 0.5 percent.
  - 2. Size and Shape: 2 inch square.
  - 3. Edges: Cushioned.
  - 4. Surface Finish: Unglazed.
  - 5. Colors: To be selected by Bermello, Ajamil & Partners from manufacturer's standard range.
- C. Glazed Wall Tile: ANSI A137.1, and as follows:
  - 1. Moisture Absorption: 3.0 to 7.0 percent.
  - 2. Size and Shape: 4-1/4 inch square.
  - 3. Edges: Cushioned.
  - 4. Surface Finish: High gloss.
  - 5. Colors: To be selected by Bermello, Ajamil & Partners from manufacturer's standard range.

### 2.02 TRIM AND ACCESSORIES

- A. Ceramic Accessories: Glazed finish, same color and finish as adjacent field tile; same manufacturer as tile.
- B. Ceramic Trim: Matching bullnose, double bullnose, cove base, and cove ceramic shapes in sizes coordinated with field tile.
  - 1. Applications: Use in the following locations:
    - a. Open Edges: Bullnose.
    - b. Inside Corners: Jointed.
    - c. Floor to Wall Joints: Cove base.
  - 2. Manufacturer: Same as for tile.
- C. Thresholds: Marble, white or gray, honed finish; 2 inches wide by full width of wall or frame opening; 1/2 inch thick; beveled one long edge with radiused corners on top side; without holes, cracks, or open seams.
  - 1. Applications: Provide at the following locations:
    - a. At doorways where tile terminates.
    - b. At open edges of floor tile where adjacent finish is a different height.

### 2.03 SETTING MATERIALS

### 2.04 ADHESIVE MATERIALS

- A. Manufacturers:
  - 1. Bonsai American, Inc: [www.prospec.com](http://www.prospec.com)
  - 2. Bostik Inc: [www.bostik-us.com](http://www.bostik-us.com).
  - 3. Mapei Corporation: [www.mapei.com](http://www.mapei.com).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.

- B. Organic Adhesive: ANSI A136.1, thinset bond type; use Type I in areas subject to prolonged moisture exposure.

## 2.05 MORTAR MATERIALS

### A. Manufacturers:

1. Bonsai American, Inc: [www.prospec.com](http://www.prospec.com)
2. Bostik Inc: [www.bostik-us.com](http://www.bostik-us.com).
3. Custom Building Products: [www.custombuildingproducts.com](http://www.custombuildingproducts.com).
4. Substitutions: See Section 01 6000 - Product Requirements.

- B. Mortar Bed Materials: Portland cement, sand, latex additive, and water.

### C. Mortar Bond Coat Materials:

1. Dry-Set Portland Cement type: ANSI A118.1.
2. Latex-Portland Cement type: ANSI A118.4.

## 2.06 GROUTS

### A. Manufacturers:

1. Bonsai American, Inc: [www.prospec.com](http://www.prospec.com)
2. Bostik Inc: [www.bostik-us.com](http://www.bostik-us.com).
3. Custom Building Products: [www.custombuildingproducts.com](http://www.custombuildingproducts.com).
4. Substitutions: See Section 01 6000 - Product Requirements.

- B. Grout: Polymer modified cement grout, sanded or unsanded, as specified in ANSI A118.7.

## 2.07 THICK-BED MATERIALS

## 2.08 THIN-SET ACCESSORY MATERIALS

- A. Metal Lath: ASTM C 847, Flat diamond mesh, of weight to suit application, galvanized finish.
- B. Cementitious Backer Board: ANSI A118.9; High density, cementitious, glass fiber reinforced, 1/2 inch thick; 2 inch wide coated glass fiber tape for joints and corners.
- C. Coated Glass Mat Backer Board: ASTM C1178/C1178M, with coated inorganic fiberglass mat on both surfaces and integral acrylic coating vapor retarder.
- D. Mesh Tape: 2-inch wide self-adhesive fiberglass mesh tape.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.
- D. Verify that concrete sub-floor surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by tile manufacturer and setting materials manufacturer.
- E. Verify that required floor-mounted utilities are in correct location.

### 3.02 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.

- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.
- E. Install cementitious backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of dry-set mortar to a feather edge.
- F. Install tile backer board in strict accordance with manufacturer's instructions, using corrosion-resistant bugle head drywall screws. Bed fiberglass self-adhesive tape at all joints and corners with material used to set tiles.
- G. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

### 3.03 INSTALLATION - GENERAL

- A. Install tile and thresholds and grout in accordance with applicable requirements of ANSI A108.1 through A108.13, manufacturer's instructions, and The Tile Council of North America Handbook recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Form internal angles square and external angles bullnosed.
- F. Install ceramic accessories rigidly in prepared openings.
- G. Install thresholds where indicated.
- H. Sound tile after setting. Replace hollow sounding units.
- I. Keep expansion joints free of adhesive or grout. Apply sealant to joints.
- J. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- K. Grout tile joints. Use standard grout unless otherwise indicated.
- L. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar lanes.

### 3.04 INSTALLATION - FLOORS - MORTAR BED METHODS

- A. Over interior concrete substrates, install in accordance with The Tile Council of North America Handbook Method F112, bonded, unless otherwise indicated.
- B. Mortar Bed Thickness: 5/8 inch, unless otherwise indicated.

### 3.05 INSTALLATION - WALL TILE

- A. Over cementitious backer units install in accordance with The Tile Council of North America Handbook Method W223, organic adhesive.
- B. Over coated glass mat backer board on studs, install in accordance with The Tile Council of North America Handbook Method W245.
- C. Over interior concrete and masonry install in accordance with The Tile Council of North America Handbook Method W202, thin-set with dry-set or latex-portland cement bond coat.

- D. Over metal studs without backer install in accordance with The Tile Council of North America Handbook Method W241, mortar bed, with membrane where indicated.

#### 3.06 CLEANING

- A. Clean tile and grout surfaces.

#### 3.07 PROTECTION

- A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

## SECTION 09 65 13 - RESILIENT FLOORING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Resilient tile flooring.
- B. Resilient base.
- C. Installation accessories.

#### 1.02 REFERENCE STANDARDS

- A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
- B. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2004 (Reapproved 2010)e1.
- C. ASTM F1861 - Standard Specification for Resilient Wall Base; 2008.

#### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Selection Samples: Submit manufacturer's complete set of color samples for Bermello, Ajamil & Partners's initial selection.
- D. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of sub-floor is acceptable.
- E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- F. Maintenance Materials: Furnish the following for Broward County, Port Everglades's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Protect roll materials from damage by storing on end.

#### 1.05 FIELD CONDITIONS

- A. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- B. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

### PART 2 PRODUCTS

#### 2.01 TILE FLOORING

- A. Vinyl Composition Tile: Homogeneous, with color extending throughout thickness, and:
  - 1. Minimum Requirements: Comply with ASTM F1066, of Class corresponding to type specified.
  - 2. Size: 12 x 12 inch.
  - 3. Thickness: 0.125 inch.
  - 4. Pattern: Marbleized.

5. Manufacturers:
  - a. Armstrong World Industries, Inc: [www.armstrong.com](http://www.armstrong.com).
  - b. Mannington Mills, Inc: [www.mannington.com](http://www.mannington.com).
  - c. Tarkett Inc: [www.tarkett.com](http://www.tarkett.com).
  - d. Substitutions: See Section 01 6000 - Product Requirements.

## 2.02 RESILIENT BASE

- A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove, and as follows:
  1. Height: 4 inch.
  2. Thickness: 0.125 inch thick.
  3. Finish: Satin.
  4. Length: Roll.
  5. Color: Color as selected from manufacturer's standards.
  6. Accessories: Premolded external corners and end stops.
  7. Manufacturers:
    - a. Burke Flooring: [www.burkemercer.com](http://www.burkemercer.com).
    - b. Johnsonite, Inc: [www.johnsonite.com](http://www.johnsonite.com).
    - c. Roppe Corp: [www.roppe.com](http://www.roppe.com).
    - d. Substitutions: See Section 01 6000 - Product Requirements.

## 2.03 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seaming Materials: Waterproof; types recommended by flooring manufacturer.
- C. Moldings, Transition and Edge Strips: Same material as flooring.
- D. Filler for Coved Base: Plastic.
- E. Sealer and Wax: Types recommended by flooring manufacturer.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
- C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.
  1. Test in accordance with ASTM F710.
  2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
- D. Verify that required floor-mounted utilities are in correct location.

### 3.02 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.
- C. Prohibit traffic until filler is cured.

- D. Clean substrate.
- E. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

### 3.03 INSTALLATION

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install in accordance with manufacturer's instructions.
- C. Spread only enough adhesive to permit installation of materials before initial set.
- D. Fit joints tightly.
- E. Set flooring in place, press with heavy roller to attain full adhesion.
- F. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- G. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
  - 1. Resilient Strips: Attach to substrate using adhesive.
- H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

### 3.04 TILE FLOORING

- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless manufacturer's instructions say otherwise.
- B. Lay flooring with joints and seams at 45 degrees to building lines to produce symmetrical tile pattern.

### 3.05 RESILIENT BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.
- C. Install base on solid backing. Bond tightly to wall and floor surfaces.
- D. Scribe and fit to door frames and other interruptions.

### 3.06 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's instructions.

### 3.07 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

## SECTION 09 68 13 – TILE CARPETING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Carpet, stretched-in, with cushion underlay and direct-glued.
- B. Accessories.

#### 1.02 REFERENCE STANDARDS

- A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2006 (Reapproved 2011).
- B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
- C. CRI (CIS) - Carpet Installation Standard; Carpet and Rug Institute; 2009.
- D. CRI (GLP) - Green Label Plus Carpet Testing Program - Approved Products; Carpet and Rug Institute; Current Edition.

#### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- C. Manufacturer's Installation Instructions: Indicate special procedures.
- D. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
- F. Maintenance Materials: Furnish the following for Broward County, Port Everglades's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional requirements.

#### 1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing carpet with minimum three years experience.

#### 1.05 FIELD CONDITIONS

- A. Store materials in area of installation for minimum period of 24 hours prior to installation.
- B. Maintain minimum 70 degrees F ambient temperature 24 hours prior to, during and 24 hours after installation.
- C. Ventilate installation area during installation and for 72 hours after installation.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Carpet:
  - 1. Interface, Inc: [www.interfaceinc.com](http://www.interfaceinc.com).
  - 2. J & J Industries, Inc: [www.jjindustries.com](http://www.jjindustries.com).
  - 3. Milliken & Company: [www.milliken.com](http://www.milliken.com).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.



## 2.02 CARPET

- A. Carpet: Loop, nylon, conforming to the following criteria:
  - 1. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
  - 2. VOC Content: Provide CRI Green Label Plus certified product; in lieu of labeling, independent test report showing compliance is acceptable.
  - 3. Color: As selected from Standard Palette.
  - 4. Pattern: As selected from Standard Palette.
  - 5. Roll Width: 12 ft.
  - 6. Gage: 1/10 inch Minimum
  - 7. Stitches: 10 per inch Minimum
  - 8. Pile Weight: 28 oz/sq yd.
  - 9. Primary Backing:
    - a. Material: Polypropylene.

## 2.03 ACCESSORIES

- A. Sub-Floor Filler: Type recommended by carpet manufacturer.
- B. Tackless Strip: Carpet gripper, of type recommended by carpet manufacturer to suit application, with attachment devices.
- C. Adhesives - General: Compatible with materials being adhered; maximum VOC content as specified in Section 01 6116.
- D. Seam Adhesive: Recommended by manufacturer.
- E. Contact Adhesive: Compatible with carpet material; releasable type.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive carpet.
- B. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesives to sub floor surfaces.
- C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for flooring installation by testing for moisture and pH.
  - 1. Test in accordance with ASTM F710.
  - 2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.
- D. Verify that required floor-mounted utilities are in correct location.

### 3.02 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.
- C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
- D. Clean substrate.

### 3.03 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of sub-floor conditions.

- B. Install carpet and cushion in accordance with manufacturer's instructions and CRI Carpet Installation Standard.
- C. Verify carpet match before cutting to ensure minimal variation between dye lots.
- D. Lay out carpet and locate seams in accordance with shop drawings:
  - 1. Locate seams in area of least traffic, out of areas of pivoting traffic, and parallel to main traffic.
  - 2. Do not locate seams perpendicular through door openings.
  - 3. Align run of pile in same direction as anticipated traffic and in same direction on adjacent pieces.
  - 4. Locate change of color or pattern between rooms under door centerline.
  - 5. Provide monolithic color, pattern, and texture match within any one area.
- E. Install carpet tight and flat on subfloor, well fastened at edges, with a uniform appearance.

#### 3.04 STRETCHED-IN CARPET

- A. Install tackless strips with pins facing the wall around entire perimeter, except across door openings. Use edge strip where carpet terminates at other floor coverings.
- B. Space tackless strips slightly less than carpet thickness away from vertical surfaces, but not more than 3/8 inch.
- C. Install cushion in maximum size pieces using spot adhesive to adhere to sub-floor.
- D. Lay out cushion so that seams will be perpendicular to, or offset from, minimum 6 inches from carpet seams.
- E. Butt cushion edges together and tape seams.
- F. Trim cushion tight to edge of tackless strip and around projections and contours.
- G. Double cut carpet seams, with accurate pattern match. Make cuts straight, true, and unfrayed. Apply seam adhesive to all cut edges immediately.
- H. Join seams by hand sewing. Form seams straight, not overlapped or peaked, and free of gaps.
- I. Following seaming, hook carpet onto tackless strip at one edge, power stretch, and hook firmly at other edges. Follow manufacturer's recommendations for method and amount of stretch.
- J. Trim carpet neatly at walls and around interruptions. Tuck edges into space between tackless strip and wall.

#### 3.05 DIRECT-GLUED CARPET

- A. Double cut carpet seams, with accurate pattern match. Make cuts straight, true, and unfrayed. Apply seam adhesive to cut edges of woven carpet immediately.
- B. Apply contact adhesive to floor uniformly at rate recommended by manufacturer. After sufficient open time, press carpet into adhesive.
- C. Apply seam adhesive to the base of the edge glued down. Lay adjoining piece with seam straight, not overlapped or peaked, and free of gaps.
- D. Roll with appropriate roller for complete contact of adhesive to carpet backing.
- E. Trim carpet neatly at walls and around interruptions.

#### 3.06 CLEANING

- A. Remove excess adhesive from floor and wall surfaces without damage.
- B. Clean and vacuum carpet surfaces.

END OF SECTION

## SECTION 09 91 23 - INTERIOR AND EXTERIOR PAINTING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints, stains, varnishes, and other coatings.
- C. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
- D. Do Not Paint or Finish the Following Items:
  - 1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
  - 2. Items indicated to receive other finishes.
  - 3. Items indicated to remain unfinished.
  - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
  - 5. Floors, unless specifically so indicated.
  - 6. Glass.

#### 1.02 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. GreenSeal GS-11 - Paints; 1993.

#### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on all finishing products, including VOC content.
- C. Samples: Submit three paper chip samples, 8-1/2 x 11 inch in size illustrating range of colors and textures available for each surface finishing product scheduled.
- D. Certification: By manufacturer that all paints and coatings comply with VOC limits specified.
- E. Certification: By manufacturer that all paints and coatings do not contain any of the prohibited chemicals specified; GreenSeal GS-11 certification is not required but if provided shall constitute acceptable certification.
- F. Manufacturer's Instructions: Indicate special surface preparation procedures.
- G. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

#### 1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years experience.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

#### 1.06 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- D. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Provide all paint and coating products used in any individual system from the same manufacturer; no exceptions.
- B. Provide all paint and coating products from the same manufacturer to the greatest extent possible.
- C. Paints:
  - 1. Duron, Inc: [www.duron.com](http://www.duron.com).
  - 2. Benjamin Moore & Co: [www.benjaminmoore.com](http://www.benjaminmoore.com).
  - 3. PPG Architectural Finishes, Inc: [www.ppgaf.com](http://www.ppgaf.com).
  - 4. Pratt & Lambert Paints: [www.prattandlambert.com](http://www.prattandlambert.com).
- D. Substitutions: See Section 01 6000 - Product Requirements.

#### 2.02 PAINTS AND COATINGS - GENERAL

- A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
  - 1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
  - 2. Supply each coating material in quantity required to complete entire project's work from a single production run.
  - 3. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.
- B. Primers: Where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.
- C. Volatile Organic Compound (VOC) Content:
  - 1. Provide coatings that comply with the most stringent requirements specified in the following:
    - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
    - b. Ozone Transport Commission (OTC) Model Rule, Architectural, Industrial, and Maintenance Coatings; [www.otcair.org](http://www.otcair.org); specifically:

- 1) Opaque, Flat: 50 g/L, maximum.
  - 2) Opaque, Nonflat: 150 g/L, maximum.
  - 3) Opaque, High Gloss: 250 g/L, maximum.
  - 4) Varnishes: 350 g/L, maximum.
2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- D. Chemical Content: The following compounds are prohibited:
1. Aromatic Compounds: In excess of 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
  2. Acrolein, acrylonitrile, antimony, benzene, butyl benzyl phthalate, cadmium, di (2-ethylhexyl) phthalate, di-n-butyl phthalate, di-n-octyl phthalate, 1,2-dichlorobenzene, diethyl phthalate, dimethyl phthalate, ethylbenzene, formaldehyde, hexavalent chromium, isophorone, lead, mercury, methyl ethyl ketone, methyl isobutyl ketone, methylene chloride, naphthalene, toluene (methylbenzene), 1,1,1-trichloroethane, vinyl chloride.

### 2.03 PAINT SYSTEMS - EXTERIOR

- A. Paint CE-OP-3L - Masonry/Concrete, Opaque, Latex, 3 Coat:
1. One coat of block filler.
  2. Semi-gloss: Two coats of latex enamel; .

### 2.04 PAINT SYSTEMS - INTERIOR

- A. Paint CI-OP-3L - Concrete/Masonry, Opaque, Latex, 3 Coat:
1. One coat of block filler.
  2. Semi-gloss: Two coats of latex enamel; .
- B. Paint GI-OP-3L - Gypsum Board/Plaster, Latex, 3 Coat:
1. One coat of alkyd primer sealer.
  2. Semi-gloss: Two coats of latex enamel; .

### 2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
1. Gypsum Wallboard: 12 percent.
  2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.

### 3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to coating application.

- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- F. Concrete and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- G. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.
- H. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

### 3.03 APPLICATION

- A. Apply products in accordance with manufacturer's instructions.
- B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- C. Apply each coat to uniform appearance.
- D. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.
- E. Sand wood and metal surfaces lightly between coats to achieve required finish.
- F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- G. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

### 3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection.

### 3.05 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

### 3.06 PROTECTION

- A. Protect finished coatings until completion of project.
- B. Touch-up damaged coatings after Substantial Completion.

END OF SECTION

## SECTION 10 14 16 – SIGNAGE

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Room and door signs.

#### 1.02 REFERENCE STANDARDS

- A. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2009.
- B. ATBCB ADAAG - Americans with Disabilities Act Accessibility Guidelines; 2002.

#### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
  - 1. When room numbers to appear on signs differ from those on the drawings, include the drawing room number on schedule.
  - 2. When content of signs is indicated to be determined later, request such information from Broward County, Port Everglades through Bermello, Ajamil & Partners at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
  - 3. Submit for approval by Broward County, Port Everglades through Bermello, Ajamil & Partners prior to fabrication.
- D. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.
- E. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
- F. Verification Samples: Submit samples showing colors specified.
- G. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

#### 1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store tape adhesive at normal room temperature.

#### 1.06 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Flat Signs:
  - 1. Best Sign Systems, Inc: [www.bestsigns.com](http://www.bestsigns.com).
  - 2. Mohawk Sign Systems, Inc: [www.mohawksign.com](http://www.mohawksign.com).
  - 3. Seton Identification Products: [www.seton.com/aec](http://www.seton.com/aec).

### 2.02 SIGNAGE APPLICATIONS

- A. Accessibility Compliance: All signs are required to comply with ADA Standards for Accessible Design and ANSI/ICC A 117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
  - 1. Sign Type: Flat signs with engraved panel media as specified.
  - 2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
  - 3. Character Height: 1 inch.
  - 4. Sign Height: 2 inches, unless otherwise indicated.
  - 5. Office Doors: Identify with room numbers to be determined later, not the numbers shown on the drawings.
  - 6. Service Rooms: Identify with room names and numbers to be determined later, not those shown on the drawings.
  - 7. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.

### 2.03 SIGN TYPES

- A. Flat Signs: Signage media without frame.
  - 1. Edges: Square.
  - 2. Corners: Square.
  - 3. Wall Mounting of One-Sided Signs: Concealed screws.
- B. Color and Font: Unless otherwise indicated:
  - 1. Character Font: Helvetica, Arial, or other sans serif font.
  - 2. Character Case: Upper case only.
  - 3. Background Color: Clear.
  - 4. Character Color: Contrasting color.

### 2.04 TACTILE SIGNAGE MEDIA

- A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
  - 1. Total Thickness: 1/16 inch.
- B. Injection Molded Panels: One-piece acrylic plastic, with raised letters and braille.
  - 1. Total Thickness: 1/8 inch.

### 2.05 NON-TACTILE SIGNAGE MEDIA

- A. Silk Screened Plastic Panels: Letters and graphics silk screened onto reverse side of plastic surface:
  - 1. Sign Color: Clear.
  - 2. Total Thickness: 1/8 inch.



## 2.06 ACCESSORIES

- A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.
- B. Tape Adhesive: Double sided tape, permanent adhesive.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

### 3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.
- C. Locate signs where indicated:
  - 1. Room and Door Signs: Locate on wall at latch side of door with centerline of sign at 60 inches above finished floor.
  - 2. If no location is indicated obtain Broward County, Port Everglades's instructions.
- D. Protect from damage until Substantial Completion; repair or replace damage items.

END OF SECTION

## SECTION 10 28 13 - TOILET ACCESSORIES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Accessories for toilet rooms and utility rooms.
- B. Grab bars.

#### 1.02 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2012.
- B. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip; 1999 (Reapproved 2009).
- C. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2010.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2011.
- E. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2010.
- F. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium; 2011e1.
- G. ASTM C1036 - Standard Specification for Flat Glass; 2011e1.
- H. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2008.
- I. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use; 2004 (Reapproved 2010).
- J. GSA CID A-A-3002 - Mirrors, Glass; U.S. General Services Administration; 1996.

#### 1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on accessories describing size, finish, details of function, attachment methods.
- C. Samples: Submit two samples of each accessory, illustrating color and finish.
- D. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Toilet Accessories:
  - 1. A & J Washroom Accessories Inc: [www.ajwashroom.com](http://www.ajwashroom.com).
  - 2. American Specialties, Inc: [www.americanspecialties.com](http://www.americanspecialties.com).
  - 3. Bradley Corporation: [www.bradleycorp.com](http://www.bradleycorp.com).
  - 4. Bobrick Washroom: [www.bobrick.com](http://www.bobrick.com).

- B. All items of each type to be made by the same manufacturer.

## 2.02 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
  - 1. Grind welded joints smooth.
  - 2. Fabricate units made of metal sheet of seamless sheets, with flat surfaces.
- B. Keys: Provide 10 keys for each accessory to Broward County, Port Everglades; master key all lockable accessories.
- C. Stainless Steel Sheet: ASTM A666, Type 304.
- D. Stainless Steel Tubing: ASTM A269, Type 304 or 316.
- E. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
- F. Mirror Glass: Float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
- G. Adhesive: Two component epoxy type, waterproof.
- H. Fasteners, Screws, and Bolts: Hot dip galvanized, tamper-proof, security type.
- I. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

## 2.03 FINISHES

- A. Stainless Steel: No. 4 satin brushed finish, unless otherwise noted.
- B. Chrome/Nickel Plating: ASTM B456, SC 2, satin finish, unless otherwise noted.
- C. Baked Enamel: Pretreat to clean condition, apply one coat primer and minimum two coats epoxy baked enamel.
- D. Galvanizing for Items Other than Sheet: Comply with ASTM A123/A123M; galvanize ferrous metal and fastening devices.
- E. Shop Primed Ferrous Metals: Pretreat and clean, spray apply one coat primer and bake.
- F. Back paint components where contact is made with building finishes to prevent electrolysis.

## 2.04 TOILET ROOM ACCESSORIES

- A. Toilet Paper Dispenser: Double roll, surface mounted bracket type, stainless steel, spindleless type for tension spring delivery designed to prevent theft of tissue roll.
  - 1. Attached Purse Shelf: 0.03 inch satin finished stainless steel, with rolled or formed edge at front.
- B. Combination Towel Dispenser/Waste Receptacle: Recessed with projecting waste receptacle, stainless steel; seamless wall flanges, continuous piano hinges, tumbler locks on upper and lower doors.
  - 1. Waste receptacle liner: Reusable, heavy-duty vinyl.
  - 2. Towel dispenser capacity: 400 C-fold.
  - 3. Waste receptacle capacity: 4 gallons.
- C. Soap Dispenser: Liquid soap dispenser, deck-mounted on vanity, with polyethylene container concealed below deck; piston and 4 inch spout of stainless steel with bright polished finish; chrome-plated deck escutcheon.
  - 1. Minimum Capacity: 16 ounces.
- D. Mirrors: Stainless steel framed, 6 mm thick float glass mirror.

1. Size: as indicated on drawings.
  2. Backing: Full-mirror sized, minimum 0.03 inch galvanized steel sheet and nonabsorptive filler material.
  3. Fixed Tilt Mirrors: Minimum 3 inches tilt from top to bottom.
- E. Seat Cover Dispenser: Stainless steel, surface-mounted, reloading by concealed opening at base, tumbler lock.
1. Minimum capacity: 250 seat covers, each side.
- F. Grab Bars: Stainless steel, nonslip grasping surface finish.
- G. Grab Bars: Stainless steel, 1-1/4 inches outside diameter, minimum 0.05 inch wall thickness, nonslip grasping surface finish, concealed flange mounting; 1-1/2 inches clearance between wall and inside of grab bar.
1. Length and configuration: As indicated on drawings.
- H. Combination Sanitary Napkin/Tampon Dispenser: Stainless steel, surface-mounted.
1. Door: Seamless 0.05 inch door with returned edges and tumbler lock.
  2. Cabinet: Fully welded, 0.03 inch thick sheet.
  3. Operation: 25 cent coin required to operate dispenser. Provide locked coin box, separately keyed.
  4. Identify dispensers slots without using brand names.
  5. Minimum capacity: 15 napkins and 20 tampons.
- I. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.
- J. Diaper Changing Station: Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.
1. Style: Horizontal.
  2. Mounting: Surface.
  3. Color: Gray.
  4. Minimum Rated Load: 250 lbs.
  5. Manufacturers:
    - a. American Specialties, Inc: [www.americanspecialties.com](http://www.americanspecialties.com).
    - b. Bradley Corporation: [www.bradleycorp.com](http://www.bradleycorp.com).
    - c. Foundations Worldwide, Inc: [www.brocar.com](http://www.brocar.com).
    - d. Diaper Deck & Company: [www.diaperdeck.com](http://www.diaperdeck.com).
    - e. Koala Kare Products: [www.koalabear.com](http://www.koalabear.com).
    - f. Safe-Strap Company, Inc: [www.diaperdepot.com](http://www.diaperdepot.com).

## 2.05 UTILITY ROOM ACCESSORIES

- A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
1. Drying rod: Stainless steel, 1/4 inch diameter.
  2. Hooks: 2, 0.06 inch stainless steel rag hooks at shelf front.
  3. Mop/broom holders: 3 spring-loaded rubber cam holders at shelf front.
  4. Length: 36 inches.
  5. Length: Manufacturer's standard length for number of holders/hooks.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify existing conditions before starting work.

- B. Verify exact location of accessories for installation.
- C. Verify that field measurements are as indicated on drawings.

3.02 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights and Locations: As required by accessibility regulations, as indicated on drawings, and as follows:

3.04 SCHEDULE

- A. Grab Bars 1: Satin stainless steel.

END OF SECTION

## SECTION 10 44 16 - FIRE PROTECTION SPECIALTIES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

#### 1.02 REFERENCE STANDARDS

- A. NFPA 10 - Standard for Portable Fire Extinguishers; 2010.
- B. UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc.; current edition.

#### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate cabinet physical dimensions.
- C. Product Data: Provide extinguisher operational features.
- D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

#### 1.04 FIELD CONDITIONS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Fire Extinguisher Cabinets and Accessories:
  - 1. JL Industries, Inc: [www.jlindustries.com](http://www.jlindustries.com).
  - 2. Larsen's Manufacturing Co: [www.larsensmfg.com](http://www.larsensmfg.com).
  - 3. Potter-Roemer: [www.potterroemer.com](http://www.potterroemer.com).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.

#### 2.02 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
  - 1. Provide extinguishers labeled by UL for the purpose specified and indicated.
- B. Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gage.
  - 1. Class: B:C.
  - 2. Size: 10 pound.
  - 3. Size and classification as scheduled.
  - 4. Finish: Baked polyester powder coat, red color.

#### 2.03 FIRE EXTINGUISHER CABINETS

- A. Metal: Formed aluminum; manufacturer's heavy gauge.
- B. Cabinet Configuration: Semi-recessed and surface type.

1. Provide Surface mounted cabinets on concrete and concrete block surfaces.
  2. Provide semi-recessed cabinets in stud framed partitions.
  3. Sized to accommodate accessories.
- C. Door: 0.036 inch thick, reinforced for flatness and rigidity; lock with full glass access. Hinge doors for 180 degree opening with two butt hinge. Provide nylon catch.
- D. Door Glazing: Glass, clear, 1/8 inch thick float. Set in resilient channel gasket glazing.
- E. Cabinet Mounting Hardware: Appropriate to cabinet. Pre-drill for anchors.
- F. Weld, fill, and grind components smooth.
- G. Finish of Cabinet Exterior Trim and Door: Red baked enamel.
- H. Finish of Cabinet Interior: White enamel.

#### 2.04 ACCESSORIES

- A. Cabinet Signage: Fire Extinguisher.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

#### 3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install cabinets plumb and level in wall openings, as required by code from finished floor to inside bottom of cabinet.
- C. Secure rigidly in place.
- D. Place extinguishers and accessories in cabinets.
- E. Position cabinet signage at top.

END OF SECTION

## SECTION 13 34 20 – PANZERBELT SYSTEM AND TURNOVER ANCHOR

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section includes crane power cable protection system consisting of:
- B. Panzerbelt - special reinforced rubber belt channel cover.
  - 1. Pre-formed interlocking stainless steel channel.
  - 2. Turnover Anchor.
- C. Related Sections:
  - 1. Section 03 10 00 - Concrete Forming and Accessories.
  - 2. Section 03 30 00 - Cast-In-Place Concrete.

#### 1.2 REFERENCES

- A. ASTM International:
  - 1. ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
  - 2. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
  - 3. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- B. American Welding Society:
  - 1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
  - 2. AWS D1.6 - Structural Welding Code – Stainless Steel.

#### 1.3 SYSTEM DESCRIPTION

- A. The channel cover shall be a high quality flexible rubber steel cord and nylon reinforced Panzerbelt for heavy loading.
  - 1. The channel cover shall be flexible styrene butadiene reinforced rubber belt able to resist stresses both across and along the channel. It must be able to support a load equivalent to 1,160 psi (800 N/cm<sup>2</sup>) across the channel slot without damage.  
The composition of the cover shall be:
    - a. 80% Styrene Butadiene Rubber (SBR).
    - b. 15% Steel Cord.
    - c. 5% Nylon Synthetic Fibers.
  - 2. The belt reinforcement shall consist of four layers of reinforcement as follows:
    - a. Warp – Two layers of RFL dipped nylon yarn.
    - b. Weft – Two layers of brass coated steel cords.
  - 3. The reinforcement shall render the belt inflexible only in the transverse direction with the exception of the hinged area. The belt shall remain sufficiently flexible lengthwise to allow the necessary lifting performance of the belt during reeling up and depositing of the cables.



4. The belt layers shall be constructed by a hot vulcanization process incorporating highly abrasion resistant rubber compounds on the external surfaces and high adhesion rubber compounds adjacent to the steel cord layers.
  5. The belt shall be fixed to the channel with AISI 304 stainless steel strips. The strips shall be located in a recess, molded into the belt and fixed with 0.20" (5mm) dia. stainless steel rivets at 3" (78 mm) intervals. The rivet head shall remain below the surface of the fixing strips in pre-drilled countersunk holes.
  6. The belt shall have a series of longitudinal grooves, molded in the upper edge adjacent to the fixing strips to act like hinge ensuring the belt will open and close efficiently and adequately return to a horizontal resting position after being lifted.
  7. Belt splices shall be supplied with each length of belt and shall be AISI 304 stainless steel and fastened with stainless steel rivets.
  8. The belt shall be furnished in 164 ft (50 m) long to allow for efficient handling and installation.
  9. The cover shall be openable to minimum 90° by way of a specially developed hinge area and fixed to the ground on one side by means of steel fixing strip and rivets ensuring that the cover always returns to horizontal resting position after being lifted.
- B. The stainless steel channel shall consist of pre-formed interlocking sections that will be embedded in concrete.
1. Channel sections shall be manufactured from 16-gauge (1.5 mm) AISI 304 stainless steel in appropriate section lengths, lengths, as determined by the manufacturer, to minimize cost and maximize ease of construction. Channel sections shall be self-anchoring and reinforced in the belt securing area.
  2. Channel sections shall incorporate an interlocking feature to provide a positive engagement from one channel section to the next thus ensuring no sharp edges that would interfere with or damage the cable during reeling operations.
  3. The channel shall be pre-drilled along the hinge area to assist in installation of the belt. The manufacturer shall supply a method of locating the pre-drilled holes during belt installation.
  4. Each channel section shall be electrically connected to the other along both sides with copper grounding strips.
  5. A pre-formed stainless steel cable stand shall be supplied to protect the cable from debris and to allow adequate drainage.
  6. The channel sections shall be supplied fully assembled and are to include a high density Styrofoam cable slot filler to maintain channel geometry during shipment and installation.
- C. Turnover anchor shall be of stainless steel construction. Type and size are indicated on the drawings.

#### 1.4 DESIGN REQUIREMENTS

- A. Breaking strength for dipped nylon yarn: 285 lbs/in (50 kN/m).
- B. Breaking strength for brass coated steel cord: 3,650 lbs/in (640 kN/m).
- C. Belt shall be capable of resisting an equivalent load of 1,160 psi (800 N/cm<sup>2</sup>) spanning over the channel width.

#### 1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate assembly dimensions, general layout, locations of splices, structural members, connections, attachments, general construction details, anchorages and method of anchorage, method of installation.
- C. Product Data: Submit data on profiles, component dimensions, fasteners, performance characteristics.
- D. Manufacturer's Installation procedure: Submit installation procedures for use by the installation contractor.

#### 1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with manufacturer's recommendations.

#### 1.7 QUALIFICATIONS

- A. Manufacturer: Cavotec
- B. The manufacturer shall demonstrate the long term performance of the product by way of proven installation references totaling minimum of 66,000 ft (20,000 m) of Panzerbelt at 15 different sites within the last 5 years.
- C. The Panzerbelt shall be designed for more than 250,000 cycles for open/close operations.

#### 1.8 PRE-INSTALLATION MEETINGS

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

#### 1.9 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish two year manufacturer warranty for Panzerbelt and turnover anchor installation.

### PART 2 PRODUCTS

#### 2.1 PANZERBELT AND TURNOVER ANCHOR

- A. Manufacturers:
  - 1. Cavotec

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify Panzerbelt and turnover anchor are the proper size and placed in the correct position.

### 3.2 INSTALLATION

- A. Installation and tolerances shall be in accordance with manufacturer's recommendations.
- B. The manufacturer shall provide a representative, directly employed by the manufacturer and personally familiar with the system, to provide training to the installation contractor prior to beginning of installation.
- C. The manufacturer's representative shall be made available, as required, during construction to ensure the system is installed according to the manufacturer's recommendation.

END OF SECTION

## SECTION 14 21 11 - ELECTRIC TRACTION PASSENGER ELEVATORS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Electric traction passenger elevators.

#### 1.02 REFERENCES

- A. ANSI/ASME A17.1/CAN/CSA B44 - Safety Code for Elevators and Escalators.
- B. ADAAG - Americans with Disabilities Act Accessibility Guidelines.
- C. ANSI/NFPA 70 - National Electrical Code.
- D. ANSI/NFPA 80 - Fire Doors and Windows.
- E. ANSI/UL 10B - Fire Tests of Door Assemblies.
- F. CAN/CSA C22.1 - Canadian Electrical Code.
- G. Model and Local Building Codes
- H. ISO 9001: 2000 - Quality Management Systems - Requirements.

#### 1.03 DESIGN REQUIREMENTS

- A. Arrange elevator components in control closet or machinery space so equipment can be removed for repairs or replaced with minimal disturbance to other equipment and components.
- B. Where permitted by code, provide all elevator equipment including controls, drives, transformers, and rescue features within the elevator hoistway.

#### 1.04 SUBMITTALS

- A. Comply with Section 01 3000 - Administrative Requirements.
- B. Product Data: Submit manufacturer/installer's product data, including:
  - 1. Descriptive brochures or detail drawings of car and hall fixtures, cab ceilings, and product features.
  - 2. Power Information: Horsepower, starting current, running current, machine and control heat release, and electrical requirements.
- C. Shop Drawings: Submit manufacturer/installer's shop drawings, including plans, elevations, sections, and details, indicating location of equipment, loads, dimensions, tolerances, materials, components, fabrication, fasteners, hardware, finish, options, accessories, and other information to render totally functional elevators.
- D. Samples: Submit manufacturer/installer's samples of standard colors and finishes of finish materials.
- E. Operation and Maintenance Manual: Submit manufacturer/installer's operation and maintenance manual; including operation, maintenance, adjustment, and cleaning instructions; trouble shooting guide; renewal parts catalogs; and electrical wiring diagrams.
- F. Warranty: Submit manufacturer/installer's standard warranty.

#### 1.05 QUALITY ASSURANCE

- A. Manufacturer/Installer's Qualifications: Specialize in manufacturing and installing elevator equipment, with a minimum of 10 years successful experience.
- B. Regulatory Requirements:

1. Elevator design, clearances, construction, workmanship, materials, and installation, unless specified otherwise, shall be in accordance with ANSI/ASME A17.1, handicap accessibility, Americans with Disabilities Act, and other codes having legal jurisdiction.
  2. ANSI/ASME A17.1 shall govern, except where codes having legal jurisdiction include more rigid requirements or conflict with ANSI/ASME A17.1.
  3. Elevator shall follow design and manufacturing procedures certified in accordance with ISO 9001:2000 to meet product and service requirements for quality assurance for new products.
  4. Where product is in variance to the published ANSI/ASME A17.1 model code, provide a 3rd party AECO certification demonstrating equivalent function, safety, and performance.
- C. Pre-installation Meeting:
1. Convene pre-installation meeting before start of installation of elevators.
  2. Require attendance of parties directly affecting work of this section, including Contractor, Architect, and elevator manufacturer/installer.
  3. Review examination, installation, field quality control, adjusting, cleaning, protection, and coordination with other work.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer/installer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer/installer.
- B. Storage: Store materials in clean, dry area indoors in accordance with manufacturer/installer's instructions.
- C. Handling: Protect materials during handling and installation to prevent damage.

#### 1.07 PROJECT CONDITIONS

- A. Temporary Electrical Power:
1. Owner will arrange for temporary 220 VAC, single-phase, 60 Hz., GFCI-protected electricity to be available for installation of elevator components.
  2. Comply with Section 01 5000 - Temporary Facilities and Controls.
- B. Installation of the Elevator:
1. General Contractor will provide permanent three-phase power prior to installation start.
  2. General Contractor will provide clear, rollable access to a 20' x 10' secure and dry storage area prior to delivery.
  3. General Contractor will provide a clean, dry, and complete hoistway along with temporary installation platform and all required OSHA-compliant barricades prior to delivery.
- C. Temporary Use of Elevator:
1. Owner will negotiate with manufacturer/installer for temporary use of elevator, if required.
  2. Temporary use of elevator shall be in accordance with terms and conditions of manufacturer/installer's temporary acceptance form.

#### 1.08 SCHEDULING

- A. Coordinate elevator work with work of other trades, for proper time and sequence to avoid construction delays.

#### 1.09 WARRANTY

- A. Manufacturer/installer shall guarantee materials and workmanship of equipment installed under these specifications and make good, defects not due to ordinary wear or to improper use, which

may develop within 1 year after completion of installation or acceptance thereof by beneficial use, whichever is earlier.

#### 1.10 MAINTENANCE SERVICE

- A. Elevator maintenance service shall be performed by elevator manufacturer/installer.
- B. Elevators shall receive regular maintenance on each unit for period of 12 months after completion of work specified herein or acceptance thereof by beneficial use, whichever is earlier.
- C. Trained employees shall make periodic examinations and perform work including necessary adjusting, greasing, oiling, and replacing parts to keep elevators in operation, except parts that require replacement because of accidents, vandalism, misuse, or negligence by parties other than manufacturer/installer.
- D. Manufacturer/installer shall perform all Work, except emergency minor adjustment call-back service, during regular working hours. Manufacturer/installer shall provide emergency minor adjustment call-back service, 24 hours 7 days a week.
- E. Should Owner request that examinations, cleaning, lubrication, adjustments, repairs, replacements, or emergency minor adjustment call-back service, unless specified herein, be performed on other than manufacturer/installer's regular working hours of regular working days, manufacturer/installer shall absorb straight-time labor charges and Owner will compensate manufacturer/installer for overtime premium, travel time, and expense at normal billing rates.
- F. Elevator Control System:
  - 1. Include built-in remote diagnostic module to relay constant status of elevators and control system to a 24-hour, 7-days-a-week, central-monitoring facility.
  - 2. Remote Monitoring Device: Transmit information on current status of elevators, including malfunctions, system errors, and shutdown.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURER/INSTALLER

- A. Kone Elevator Company
- B. Elevator shall be installed by elevator manufacturer.

#### 2.02 ELEVATOR SYSTEM AND COMPONENTS

- A. Provide Kone Elevator Company EcoSpace Elevators
- B. Elevator Equipment Summary:
  - Terminal 4: Elevator #1 & 2
  - 1. Application: Machine-Room-Less
  - 2. Counterweight Location: Side
  - 3. Machine Location: Top of the hoistway mounted on car and counterweight guide rails
  - 4. Control Space Location: Remote Room
  - 5. Service: General Purpose Passenger
  - 6. Quantity of Units: 2
  - 7. Capacity: 3500 lbs
  - 8. Speed: 150 fpm
  - 9. Travel: See Drawings
  - 10. Landings: 2
  - 11. Front Openings: 1

12. Rear Openings:1
  13. Operation:Microprocessor Single Car Automatic Operation
  14. Guide Rails:15 lb. per foot
  15. Door type:Center Opening
  16. Hoistway Entrances3'-6" wide x 7'-0" high doors
  17. Power Supply:480 Volts
- C. Performance
1. Car Speed: -10% to +5% of contract speed under any loading condition or direction of travel.
  2. Car Capacity: Safely lower, stop and hold up to 125% of rated load per code.
- D. Ride Quality:
1. Vertical Vibration (maximum): 25 mg
  2. Horizontal Vibration (maximum): 15 mg
  3. Vertical Jerk (maximum): 2 ft/sec<sup>3</sup>
  4. Acceleration (maximum): 1.6 ft/sec<sup>2</sup>
  5. In Car Noise: 53-60 dB(A)
  6. Stopping Accuracy: ±5mm
  7. Starts per hour (maximum): 180
- E. Elevator Operation
1. Simplex Collective Operation: Using a microprocessor based controller, operation shall be automatic by means of the car and hall buttons. When all calls have been answered, the car shall park at the last landing served.
  2. Group Automatic Operation with Demand-Based Dispatching: Provide reprogrammable group automatic system that assigns cars to hall calls based on a dispatching algorithm designed to minimize passenger waiting time.
- F. Operating Features - Standard
1. Door Light Curtain Protection
  2. Static AC Drive
  3. Phase Monitor Relay
  4. Cab Overload with Indicator
  5. Load-weighing
  6. Central Alarm
  7. Remote Monitoring
  8. Firefighter's Operation
  9. Automatic Evacuation
    - a. When the main line power is lost for longer than 5 seconds the emergency battery power supply provides power automatically to the elevator controller. If the car is at a floor when the power fails, it remains at that floor, opens its doors, and shuts down. If the car is between floors, it is raised or lowered to the first available landing, opens its doors, and shuts down.
  10. Independent Service
- G. Operating Features - Optional
1. Hoistway Access Operation at top floor(s).
- 2.03 EQUIPMENT: CONTROL COMPONENTS AND CONTROL SPACE
- A. Controller: Provide microprocessor based control system to perform all of the functions of safe elevator operation, as well as perform car and group operational control.

1. All high voltage (110v or above) contact points inside the inspection and test panel shall be protected from accidental contact in a situation where the access panels are open.
  2. The controller shall be distributed throughout the elevator system located in the overhead, cab and inspection and test panel. The inverter will be mounted in the overhead adjacent to the hoist machine and an inspection and test panel will be located in the door jamb at the top floor or one floor below the top floor.
  3. Provide multi-bus control architecture to reduce cabling, material and waste.
- B. Drive: Provide a Variable Voltage Variable Frequency AC Closed Loop drive system. Provide stable start without high peak current, quickly reaching a low energy consumption level.
- C. Inspection and Test Panel: Integrated control equipment, main inspection and test panel in door frame at top level served or at one floor below the top level served.

#### 2.04 EQUIPMENT: HOISTWAY COMPONENTS

- A. Machine:
1. Gearless asynchronous AC motor with integral drive sheave, service and emergency brakes.
  2. Design machine to enable direct power transfer, thereby avoiding loss of power.
  3. Design machine to be compact, lightweight and durable to optimize material usage and save space.
  4. Mount to structural support channels on top of guide rail system as applicable in hoistway overhead.
- B. Governor:
1. Tension type over-speed governor with remote manual reset.
  2. Mount to structural support channels as applicable in hoistway overhead.
- C. Buffers, Car and Counterweight: Compression spring type buffers to meet code.
- D. Hoistway Operating Devices:
1. Emergency Stop switch in the pit.
  2. Terminal stopping switches.
  3. Emergency stop switch on the machine.
- E. Positioning System: System consisting of proximity sensors and door zone vanes.
- F. Guide Rails and Attachments: Provide Tee-section steel rails with brackets and fasteners. Side counterweight arrangements shall have a dual purpose bracket that combines both counterweight guide rails, and one of the car guide rails to building fastening.
- G. Suspension System: Non circular Elastomeric coated suspension media with high tensile grade steel cords.
- H. Governor rope: Steel wire rope with 6 mm diameter.

#### 2.05 EQUIPMENT: HOISTWAY ENTRANCES

- A. Hoistway Doors and Frames:
1. UL rated with required fire rating.
  2. Doors: Rigid flush panel construction with reinforcement ribs.
  3. Frames: Securely fasten at corners to form unit frame. Frames shall be bolted.
- B. Finish:
1. Exposed Areas of Corridor Frames: #4 stainless steel on all floors.
  2. Doors: #4 stainless steel on all floors.
- C. Sills: Aluminum on all floors.



- D. Entrance Markings and Jamb Plates: Provide standard entrance jamb tactile markings on both jambs, at all floors. Plate Mounting: Refer to manufacturer drawings.

#### 2.06 EQUIPMENT: CAR COMPONENTS

- A. Car Frame and Safety: Provide car frame with adequate bracing to support the platform and car enclosure. The safety shall be integral to the car frame and shall be flexible guide clamp type.
- B. Platform: Provide platform of steel construction with plywood subfloor and aluminum threshold.
- C. Car Guides: Provide sliding guide shoes mounted to top and bottom of both car and counterweight frame. Arrange each guide shoe assembly to maintain constant contact on the rail surfaces. Provide retainers in areas with Seismic design requirements.
- D. Provide central guiding system to reduce mechanical friction and energy consumption.
- E. Steel Cab:
1. Fire rating: Provide Class B fire rating for cab, or Class A fire rating where required by local Code.
  2. Design cab to comply with LEED Indoor Environmental Quality requirements through use of Low-Emitting Materials on walls, ceiling and subflooring.
  3. Car wall finish: The cab walls shall be steel, #4 stainless steel finish selected from manufacturer's standard selections.
  4. Base and frieze: Aluminum.
  5. Car front finish: Brushed stainless steel.
  6. Car door finish: Brushed stainless steel.
  7. Ceiling: Canopy ceiling, finished in #4 stainless steel with compact fluorescent lighting. Provide lighting consisting of four compact fluorescent energy saving lights located in two semi-oval lateral cutouts located on the center-sides of the cab ceiling, Lexan lens cover.
  8. Handrail: 1 3/8" round and curved brushed aluminum. Locate on rear wall.
  9. Flooring: VCT
  10. Ventilation: Provide one-speed fan in canopy.
  11. Emergency Car Lighting: Provide an emergency power unit employing a 12 volt sealed rechargeable battery and static circuits to illuminate the elevator car and provide current to the alarm bell in the event of building power failure.
  12. Emergency Siren: Provide siren mounted on top of the car that is activated when the Alarm button in the car operating panel is engaged.
  13. Emergency Exit Switch: Provide an electrical contact to open the safety circuit when the emergency car top exit is opened. When the exit door is opened, the top exit switch shall signal the control and the car will be unable to move.
  14. Emergency Exit Lock: Provide an emergency exit lock where required by local code.
  15. Emergency Exit Guard: Provide emergency exit guard on top of car when required for hoistway wall to platform clearance exceeds 12" or for multiple cars in hoistway.

#### 2.07 DOOR OPERATOR AND REOPENING DEVICES

- A. Door Operator: Provide a closed loop VVVF high performance door operator with frequency controlled drive for fast and reliable operation to open and close the car and hoistway doors simultaneously.
- B. In case of interruption or failure of electric power, the doors can be readily opened by hand from within the car, in accordance with applicable code. Provide emergency devices and keys for opening doors from the landing as required by local code.

- C. Doors shall open automatically when the car has arrived at or is leveling at the respective landings. Doors shall close after a predetermined time interval or immediately upon pressing of a car button. Provide door open button in the car operating panel. Momentary pressing of this button shall reopen the doors and reset the time interval.
- D. Provide door hangers and tracks for each car and hoistway door. Contour tracks to match the hanger sheaves. Design hangers for power operation with provisions for vertical and lateral adjustment. Hanger sheaves shall have polyurethane tires and pre-lubricated sealed for life bearings.
- E. Electronic Door Safety Device: Equip car doors with concealed transmitter and receiver infrared beam devices to detect presence of object in process of passing through hoistway entrance and car doorway (light curtain device).
  - 1. Use multi-beam scanning without moving parts to detect obstructions in door opening.
  - 2. Detector Device: Prevent doors from closing, or if they have already started closing, cause doors to reopen and remain open while object is within detection zone.
  - 3. Horizontal Beams: Minimum of 33 infra red beams to fill doorway from ground level to a height of 6 feet.

#### 2.08 EQUIPMENT: SIGNAL DEVICES AND FIXTURES

- A. Car Operating Panel: Provide a car operating panel with all push buttons, key switches and message indicators for elevator operation.
  - 1. Full height car operating panel shall be surface-mounted on front return.
  - 2. Comply with handicap requirements.
  - 3. Push Buttons: Mechanical, illuminating using long-lasting LEDs for each floor served.
  - 4. Emergency Buttons: Provide in accordance with code. Emergency alarm button, door open and door close buttons.
- B. Features of the Car Operating Panel Shall Include:
  - 1. Audible chime to signal that the car is either stopping at or passing a floor served by the elevator.
  - 2. Raised markings and Braille provided to the left hand side of each push button.
  - 3. Car Lantern: Provide LED illuminated car lantern with direction arrows to comply with local code when hall lanterns are not provided.
  - 4. Door open and close push buttons.
  - 5. Firefighter's hat and Phase 2 Key-switch
  - 6. Inspection key-switch.
  - 7. Key-switch for optional Independent Service Operation
  - 8. Illuminated alarm button with raised marking.
  - 9. Elevator Data Plate marked with elevator capacity and car number.
  - 10. Help Button: Activation of help button will initiate two-way communication between car and a location inside the building, switching over to alternate location if call is unanswered, where personnel are available to take the appropriate action. Visual indicators are provided for call initiation and call acknowledgement.
- C. Hall Fixtures: Provide hall fixtures with necessary push buttons and key switches for elevator operation.
  - 1. Push buttons: Metallic tactile push buttons, up button and down button at intermediate floors, single button at each terminal floor.
  - 2. Height: Comply with handicap requirements.
  - 3. Illumination: Illuminating using long-lasting low power LEDs.
- D. Hall Lanterns and Position Indicators.

1. LED illuminated direction arrows with audible and visible call acknowledgement.
- E. Hoistway access switches: Provide key-switch at top and/or bottom floor in entrance jamb as required by local code.
- F. Firefighter's Phase 1 Service: Key switch in brushed stainless steel cover plate.
- G. Fixture Cover Plates: For push buttons, hall lanterns and position indicators, resistant white back-printed glass, no screws required for mounting. Provide stainless steel cover plates for Firefighters Phase I switch and hoistway access switches, with tamper resistant screws in same finish.
- H. Mounting: Mount hall fixtures in entrance frames.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Examine hoistways, hoistway openings, and pits before starting elevator installation.
- B. Verify hoistway, pit, overhead, and openings are of correct size, within tolerances, and are ready for work of this section.
- C. Verify walls are plumb where openings occur and ready for entrance sill installation. Traditional sill angle or concrete sill support shall not be required.
- D. Verify hoistway is clear and plumb, with variations not to exceed -0 to +1 inch at any point. Verify projections greater than 4" must be beveled not less than 75 degrees from horizontal. No negative tolerance is permitted for minimum hoistway dimensions.
- E. Verify minimum 2-hour fire-resistance rating of hatch walls.
- F. Notify Architect in writing of dimensional discrepancies or other conditions detrimental to proper installation or performance of elevators.
- G. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to manufacturer/installer.

### 3.02 INSTALLATION

- A. Install elevators in accordance with manufacturer/installer's instructions and ANSI/ASME A17.1.
- B. Set entrances in vertical alignment with car openings, and aligned with plumb hoistway lines.

### 3.03 FIELD QUALITY CONTROL

- A. Perform tests of elevator as required by ANSI/ASME A17.1 and governing codes.

### 3.04 ADJUSTING

- A. Adjust elevators for proper operation in accordance with manufacturer/installer's instructions.
- B. Adjust elevators for smooth acceleration and deceleration of car so not to cause passenger discomfort.
- C. Adjust doors to prevent opening of doors at landing on corridor side, unless car is at rest at that landing, or is in leveling zone and stopping at that landing.
- D. Adjust automatic floor leveling feature at each floor to within 1/4 inch of landing.
- E. Repair minor damages to finish in accordance with manufacturer/installer's instructions and as approved by Architect.
- F. Remove and replace damaged components that cannot be successfully repaired as determined by Architect.

3.05 CLEANING

- A. Clean elevators promptly after installation in accordance with manufacturer/installer's instructions.
- B. Do not use harsh cleaning materials or methods that could damage finish.

3.06 PROTECTION

- A. Protect installed elevators from damage during construction in accordance with the negotiated temporary use agreement between Owner and manufacturer's installer.

END OF SECTION

## SECTION 21 00 00 – FIRE SUPPRESSION SYSTEM

### PART 1 - GENERAL

#### 1.1 SCOPE AND REQUIREMENTS

- A. This specification serves as the basis of design for a Fire Suppression System (FSS) that includes but is not limited to clean agent storage cylinders, delivery piping, associated piping components, controls, electrical wiring, conduit, smoke detection, warning alarms, and signage. The clean agent shall be 3M™ Novec™ 1230 Fire Protection Fluid (no substitutes). The 3M™ Novec™ 1230 fluid is a fluorinated ketone with chemical structure of  $CF_3CF_2COCF(CF_3)_2$ .
- B. The FSS will flood the protected room with clean agent after mandatory sensors have been alarmed and delay time is given. Once the FSS gives the signal is given to disperse the clean agent, the clean agent (95% of the dictated mass) will be dispersed in 10 seconds to flood the protected rooms with an adequate concentration to extinguish the fire.
- C. The FSS shall include all components and controls necessary to deliver the clean agent into the protected rooms which include the Switchgear Room, the Station Battery Room, and the IT room all located on the second floor of the Switchgear Building.

#### 1.2 NOMENCLATURE

- A. AHJ Authority having Jurisdiction
- FSS Fire Suppression System
- FSSC Fire Suppression System Contractor
- FPE Florida PE specializing in fire protection
- CA Clean Agent (3M™ Novec™ 1230 Fire Protection Fluid)
- PSD Photoelectric Smoke Detector
- DPDT Double Pole Double Throw
- SPDT Single Pole Double Throw

#### 1.3 CODES AND COMPLIANCE

- A. The composition, design, installation, testing and maintenance of the integrated FSS shall be in accordance with the following applicable codes, standards and regulatory bodies with year edition as specified by the Authority Having Jurisdiction (AHJ):

1. NFPA 1: Uniform Fire Code
2. NFPA 70: National Electrical Code (NEC)
3. NFPA 72: National Fire Alarm Code
4. NFPA 75: Protection of Electronic Computer/Data Process Equipment
5. NFPA 76: Fire Protection for Telecommunications Systems
6. NFPA 90A: Standard for Air Conditioning and Ventilation Systems
7. NFPA 92A: Recommended Practice for Smoke Control Systems
8. NFPA 100: Life Safety Code
9. NFPA 2001: Clean Agent Fire Extinguishing Systems
10. FAC 69A-3: Florida Administrative Code (FAC) – The State Fire Protection Code
11. FAC 69A-47: FAC- The Uniform Fire Safety Standard for Elevators
12. FBC: Florida Building Code
13. UL 864, 9<sup>th</sup> edition: Control Units and Accessories for Fire Alarm Systems
14. UL 2166: Halocarbon Clean Agent Extinguishing System Units
15. UL 268: Standard for Smoke Detectors for Open Areas
16. UL 268A: Standard for Smoke Detectors for Duct Application
17. ANSI B1.20.1: Standard for Pipe Threads, General Purpose
18. ISO-14520 Gaseous Fire Extinguishing Systems
19. Requirements of the Local Authority Having Jurisdiction
20. Manufacturer’s Design, Installation, Operation & Maintenance Manual

- B. The complete system shall have the applicable following listings and approvals:
1. Underwriters Laboratories, Inc.
  2. Factory Mutual Global

#### 1.4 DESIGN REQUIREMENTS

- A. General
1. System shall include both automatic and manual operation with control panel, fire detectors, alarm devices, manual discharge stations, abort stations, clean agent storage cylinders, delivery piping, wiring, conduit, and other devices specified herein and recommended by FSS manufacturer for a complete working system.
  2. System shall conform to requirements of applicable codes, standards, and authorities including those listed in section 1.3 and Owner’s insurance underwriter.
- B. FPE shall provide the following hydraulic calculations to be included in submittal: Based on the unbalanced piping principle as defined in NFPA No. 12A., and include:
1. Agent quantity for each nozzle.
  2. Nozzle type and size.
  3. Nozzle pressure.
  4. Number of agent storage cylinders, cylinder fill weight, and density.
  5. Total NOVEC 1230 agent weight.
  6. Pipe schedule including sizes, length, volume, and percent of agent in pipe after discharge.
  7. Discharge time.
  8. Pressure at beginning of pipe network.
  9. Pressure at beginning and end of each pipe section.
  10. Flow rate, density, and pressure drop per pipe section.

- C. Pipe Supports: Design and fabrication shall conform to the requirements of ASME B31.1. Pipe hangers shall be factory plastic coated steel rods and mounting hardware shall be stainless steel.
  
- D. Discharge Nozzles:
  - 1. Provide sufficient nozzles to assure a uniform agent concentration throughout protected area.
  - 2. Space discharge nozzles as required by applicable codes and manufacturer's criteria.
  - 3. Consider additional nozzles based on area conditions and manufacturer's recommendations.
  
- E. Fire Detectors:
  - 1. Thermal and photoelectric type as per FPE recommendations.
  - 2. Base spacing and installation on guidelines in NFPA 72 recommended practices for ceiling construction and airflow, and on manufacturer's recommendations.
  
- F. Locate manual discharge and abort stations at all exit doors of the protected area.
  
- G. Locate alarm devices within the protected area and above each exit door outside the protected area.
  
- H. FSS Control Panel:
  - 1. Locate to provide control, supervision, annunciation, and power for the operation of the protected area zone and detection circuits.
  - 2. Provide rechargeable battery supply to automatically operate each protected area system including detectors, control panel, manual stations, alarm sounding devices, and auxiliary equipment in the event of a loss of primary power.
  - 3. Provide a common general alarm circuit for common area signaling.
  - 4. Provide form "C" SPDT dry contacts for general alarm and trouble.
  - 5. Provide a single switch that will silence active signals without affecting subsequent signals.
  - 6. Provide diagnostic indicators to indicate, at a minimum, ac power loss, dc power fault, auxiliary power loss, system common ground fault, and trouble in the common general alarm circuit.
  - 7. Control Circuitry: Provide each protected area with the following supervised circuits:
    - a. Detection: Utilizing cross-zoned or counting zone.
    - b. Individually Fused and Silenceable Audible Circuits:
      - 1) Three required.
      - 2) Individual diagnostic fault indicators.
      - 3) Minimum of 24V dc, at 350 mA available power.
      - 4) Program to operate on alarm, predischage, and discharge.
    - c. Manual Release: Programmable with the following options:
      - 1) Override time delay and abort circuit. Discharge will be immediate.
      - 2) Override abort circuit but not the time delay. Discharge occurs at the end of the time delay.
      - 3) Not override time delay or abort circuits.
    - d. Time Delay:
      - 1) Field programmable in 1-second intervals from 0 to 60 seconds.
      - 2) Have the ability, through the abort circuit, of being recycled and held until the abort switch is released.
      - 3) Control panel-mounted digital countdown timer.

- 4) Illuminated digital display when the system time delay is active and counting down.
  - e. Agent Release:
    - 1) Parallel wired initiators or solenoids, fully supervised.
    - 2) Wired in a Class A configuration such that a trouble signal will occur if there is a break in the wiring.
    - 3) System shall function properly if a fire condition occurs with this abnormal condition.
  - f. Abort:
    - 1) Dedicated and supervised.
    - 2) Actuation shall recycle the time delay to its original setting, and begin counting after the abort station (momentary) pushbutton is released.
  - g. Container Low-Pressure: Dedicated and supervised.
  - h. Diagnostic Fault Indicators: Detection, alarm audible, predischage audible, discharge audible, manual release, and abort circuits; discharge circuit wiring; discharge device; relay connection; and low pressure.
  - i. Area Abort Switch:
    - 1) Switch to disable the clean agent discharge circuit.
    - 2) Switch shall not interfere with the detection or audible circuits.
    - 3) Operation of this switch shall cause a distinctive trouble indication for the area involved.
  - j. Protected Area Control Panel:
    - 1) Minimum of six DPDT and two SPDT auxiliary relays rated at 10 amps at 120V ac/3V dc resistive.
    - 2) Programmable relays for operation in alarm, predischage, discharge, or trouble modes.
    - 3) Programming of relays without the need to relocate wiring.
    - 4) Means to individually operate relays without the need to put the control panel into alarm condition.
    - 5) Means to prevent each relay from operating in event of system testing.
  - k. Capability to transmit a trouble indication from each area.
- I. Control System:
1. Actuation of a fire detector in the protected area shall initiate the following control functions:
    - a. Light the corresponding suppression zone light on control panel.
    - b. Activate alarm.
    - c. De-energize HVAC fans and close motorized duct dampers to seal protected area.
    - d. Transmit a signal (close a normally-open alarm contact) to the building fire alarm system.
  2. Actuation of a second fire detector in the protected area shall initiate the following control functions:
    - a. Light the corresponding suppression zone light on control panel.
    - b. Activate strobe/horn combination signaling predischage of clean agent.
    - c. Allow shut down control of electrical equipment in the protected area.
    - d. Start preset agent discharge time delay. (30 seconds or as recommended by FSS manufacturer.
    - e. Transmit a signal (close a normally-open alarm contact) to the building fire alarm system.



3. If predischarge is not aborted, and time delay expires, the FSS shall discharge clean agent and strobe lights shall be activated outside the protected area.
  4. Actuation of manual discharge stations shall immediately discharge clean agent into the protected area and initiate the following control functions:
    - a. Light suppression zone light on control panel stating “clean agent discharged”.
    - b. Activate visual and audible alarm devices.
    - c. Transmit a signal (close a normally-open alarm contact) to the building fire alarm system.
  5. Trouble conditions caused by fire detector, valve actuator circuit wiring, loss of agent storage container pressure, manual action of “abort” push button or “clean agent discharge” push button shall initiate the following control functions:
    - a. Light the corresponding suppression zone light on control panel.
    - b. Light system trouble light.
    - c. Sound system trouble alarm horn.
    - d. Transmit a signal (close a normally-open trouble contact) to the building fire alarm system.
  6. Trouble conditions caused by open bell wiring, open battery circuit wiring, silenced alarm sounding devices, or loss of primary power shall initiate the following control functions:
    - a. Light system trouble light.
    - b. Sound system trouble alarm horn.
    - c. Transmit a signal (close a normally-open trouble contact) to the building fire alarm system.
- J. General contractor shall insure coordination between the building fire alarm system, HVAC system, electrical system, and fire suppression system contractors.

## 1.5 PERFORMANCE REQUIREMENTS

- A. General: Design a FSS to detect a fire and suppress the fire by total flooding of clean agent.
- B. Clean Agent shall be delivered to the protected room at the following volume of clean agent to volume of room air %(v/v) extinguishing concentration:
  1. \*4.7% (v/v) for Class A (surface type fires) hazards.
  2. \*5.9% (v/v) for Class B (Flammable Liquids) hazards.
  3. \*4.2% (v/v) for Class C (Energized Electrical Equipment) hazards.

\*Note this concentration can be increased by Fire Protection Engineer but cannot exceed 10% (v/v) for that is the maximum allowable concentration for room that could contain human occupants; this concentration is based on protected room temperature of 70 degrees F.

## 1.6 FIRE SUPPRESSION SYSTEM COMPONENTS

1. Provide photoelectric and thermal smoke detectors as required to be mounted at locations shown on FPE drawings, as per FSS manufacturer recommendations.
2. The addressable, distributed-intelligence control unit and fire alarm/suppression system shall perform fire alarm, supervisory, and trouble event initiation; occupant notification;

- event annunciation; local control functions; fire suppression system release, and off premises transmission.
3. The system's distributed intelligence shall extend to the automatic initiating devices on the signaling line circuit. Each automatic initiating device shall have a microprocessor capable of independently determining whether or not a fire signature at its monitored location is of sufficient magnitude to warrant the issuance of an alarm signal to the control unit.
  4. The Novec 1230 extinguishing agent shall be stored in modular steel alloy containers compliant with DOT Specification 4BW-500. The storage containers shall be equipped with safety rupture disks and each container shall have a pressure gauge to provide visual supervision of the container pressure and a factory install low pressure supervisory switch.
  5. Discharge nozzles shall be installed within the manufacturer's guidelines to distribute the Novec 1230 agent throughout the protected space. The approved nozzle range (radius) shall be between 5 and 50 feet for each nozzle, per FPE drawings. Nozzle spacing shall be in accordance with UL listing and FM approval guidelines. Nozzles shall have the ability to be installed in either upright or pendent positions depending on system design.
  6. Piping shall be adequately supported and anchored at all directional changes and nozzle locations. All piping shall be reamed after cutting, and all oil and chips shall be removed. Pipe threads shall be coated with Teflon tape or an appropriate joint compound applied to the male threads only.
  7. The control system shall include battery standby power (supplied by the FSS manufacturer) to support a minimum 24 hours in stand-by mode and 15 minutes in alarm.
  8. The manual release station (MRS) shall include push buttons for "immediate clean agent discharge" and "abort (stop) clean agent discharge" and shall be located at each exit door for easy access from individuals prior to exiting from the protected hazard area.
  9. Electrically actuated fire alarms, both audible and visible shall be provided and installed. All alarm devices shall be UL listed and/or FM approved. A horn and strobe device shall be mounted on the wall directly adjacent to the exit door of each protected area.

#### 1.7 SYSTEM DESIGN CRITERIA

- A. The fire suppression system (FSS) shall be manufactured by one firm listed in section 1.8 A. This firm shall be full-responsible for the design, provision, and installation of all components required, testing, and approval of the FSS.
- B. The FSS system shall be supplied and installed by a Fire Suppression System Contractor (FSS). The Fire Suppression System Contractor shall be trained by the manufacturer to design, install, test and maintain the Novec 1230 Clean Agent (FSS) shall be able to produce certificates stating such on request.
- C. All materials and equipment shall be new and unused.
- D. A total flooding, clean agent fire suppression system, filled with Novec 1230, shall be installed to meet a minimum design concentration of 4-6% by volume in all designated spaces to be protected.
- E. The clean extinguishing agent shall be electrically non-conductive and of sufficient purity to prevent deposition of residue after discharge from a gaseous fire-extinguishing system.

- F. The FSS shall include at least one cylinder that has the fluid capacity to provide a single discharge to the room it is dedicated to serve. Each room shall have its own unique dedicated storage tank cylinder. The agent cylinders shall be filled with Novec1230 fluid, and super pressurized with dry nitrogen to a working pressure of 360 PSIG at 70 degrees Fahrenheit or as recommended by Fire Suppression System manufacturer.

#### 1.8 COMPANY QUALIFICATIONS TO MANUFACTURE AND INSTALL FSS

A. Acceptable FSS Manufacturers

1. Amerex
2. Ansul Incorporated
3. Fenwal Protection Systems
4. Firetrace International
5. Janus Fire Systems
6. Siemens
7. Or Approved Qualified Equal

B. Additional qualifications of acceptable manufacturers:

1. The manufacturer/supplier of the system hardware and components shall be a licensed firm that has a minimum of fifteen (15) years' experience in the design and manufacture of FSS of similar type.
2. The manufacturer/supplier of the systems shall be ISO 9001 and ISO 14001 requested for a minimum period of five (5) years for the design, production and distribution of fire detection, fire alarm and fire suppression systems.
3. The name of the manufacturer/supplier and manufacturer part numbers shall appear on all major components.
4. All devices, components and equipment shall be the products of the same manufacturer/supplier.
5. The system manufacturer/supplier shall have the ability to provide multiple suppression system arrangements to accommodate the performance criteria required by the project.
6. All devices, components and equipment shall be listed by the standardizing agencies (UL and FM).

C. Qualifications of the Fire Suppression System Contractor (FSSC)

1. The system shall be supplied and installed by a factory authorized distributor. The FSSC shall be trained by the FSS hardware manufacturer to calculate/design, install, test and maintain the FSS and shall be able to produce a certificate of training issued by the FSS manufacturer to the Owner, the architect/engineer, and all authorities having jurisdiction before commencing installation.
2. The FSSC shall employ a person who can show proficiency at least equal to a NICET level IV certification in special hazards design.
3. The FSSC shall confirm in writing that he stocks a full complement of spare parts and offers 24-hour emergency service for all equipment being furnished.
4. The FSSC shall show proof of emergency service available on a twenty-four (24) hour, seven (7) day-a-week basis upon request.

5. The installing FSS Contractor shall submit paperwork showing a minimum \$2,000,000.00 liability and completed operations insurance policy. These limits shall supersede limits required in the other sections of the specifications.

#### 1.9 WARRANTY

- A. The FSS manufacturer shall warrant the FSS from the date of shipment from the factory as follows: Complete Engineered System products for thirty-six (36) months; Control Unit for sixty (60) months; and the Application specific-control devices for twenty-four (24) months.

#### 1.10 SUBMITTALS

- A. The FSCC shall submit the following design information and drawings for approval prior to commencing work on the project:
  1. Data sheets, catalog cuts, and technical information describing system components and devices to be installed.
  2. Calculations for standby battery power.
  3. Wiring diagrams including elementary, electrical termination, and interconnection diagrams.
  4. One-line conduit diagrams showing equipment locations, conduit locations, wire size, number of conductors, equipment mounting and other construction details.
  5. Isometric piping diagrams showing location of agent storage containers, pipe sizes, pipe lengths, and fittings. Key to required piping and nozzle calculations, and cross reference all junctions with calculations.
  6. Complete details on support of agent storage containers.
  7. Installation plan and riser (layout) drawings detailing the quantity, location, and marking of all system components, including, but not limited to agent storage tanks, nozzles, pipe routing (including pipe sizes, material and lengths) control panels, smoke detectors, manual pull stations, abort stations, audible and visual alarms.
  8. Electrical layout drawings showing location of all devices and point-to-point wiring schematics and description of the methods used for detector mounting. Conduit routings shall be shown with number of conductors, type of wire, and wire sizes indication for each conduit segment.
  9. Complete sequence of operation detailing alarm devices, remote signaling, time delay, and agent discharge for each room.
  10. Information outlining the operation and maintenance procedures required of the FSS Owner.
  11. Point-to-point wiring diagram showing the termination points for all field-wiring circuits to the internal controls. All internal wiring and communications cabling shall be shown.
  12. A primary-power calculation that details the power requirements for the Control Unit and all field devices such as smoke detectors, notification appliances and releasing solenoids. Include the required capacity of the main AC power-line feed from the commercial power and light company.
  13. A secondary power calculation that shows the quiescent and alarm power requirements for the Control Unit and all field devices. Include the periods of time for which the quiescent and alarm power requirements shall be supported in order to determine the necessary standby battery capacity.

14. The FSS Contractor shall submit a calculation justifying the capacity of batteries selected.
- B. Informational Submittals:
1. Experience qualification listing of firm(s) proposed to design and install the FSS.
  2. Design Calculations:
    - a. Hydraulic flow from a UL listed computer program, including the FSS manufacturer's name and UL listing for verification.
    - b. Include individual pipe lengths and fittings to be used.
    - c. Verify that the design concentration of NOVEC 1230 is reached within specified time.
  3. Certifications: FSS Manufacturer's certificate(s) of proper installation.
  4. Test Plan: Submit as specified in Article Field Quality Control, at least 30 days prior to beginning functional testing.
  5. Operation and Maintenance (O & M) Data: FSS Contractor shall submit O & M manual from FSS manufacturer.
- C. The architect will review all submittals for conformance to the drawings and specifications. The FSS contractor shall be required to resubmit any materials, with appropriate modifications, that are found to be in non-conformance with the requirements of the drawings and these specifications after review by the architect. Approval of the submittals by the architect shall not relieve the FSS Contractor of their responsibility to meet the requirements of the drawings and specifications.
- D. Flow Calculation Reports: The FSS Contractor shall provide the following information in the flow calculation report.
1. Customer information and project data.
  2. Enclosure information. At a minimum, enclosure information shall include minimum and adjusted design concentrations, minimum and maximum enclosure temperatures, minimum agent required and volume of enclosures, including non-permeable volume if applicable.
  3. Agent information. At a minimum, agent information shall include cylinder size and part number, quantity of cylinders, main and/or reserve cylinders, pipe take off direction and the floor loading for agent cylinder.
  4. Pipe network information. At a minimum, pipe network information shall include pipe type, pipe diameter, pipe length, change in direction or elevation, pipe equivalent length and any added accessory equivalent length. In addition, the following nozzle information shall be provided; number of nozzles and identification of enclosure location, flow rate of associated nozzle, nozzle nominal size, and nozzle type and nozzle orifice area.
- E. Pipes and pipe fittings. A detailed list of pipes and pipe fittings used in the design of the pipe network.
- F. OPTIONAL: Three-Way Ball Valve Information. A calculation shall be completed for each directional valve in the piping network. Modeling of the Three-Way Ball Valve shall be shown in the "90-deg" and "through" position.
- G. Commissioning Equipment List: The FSS Contractor shall provide a commissioning equipment list for each installed system. The equipment list shall identify all installed equipment and configurations. The FSS Contractor shall submit the following:

1. Four (4) sets of installation drawings for each installed system and one (1) set of calculation reports, owner's manuals and product data sheets.
2. A description of system functionality and a detailed matrix of all the initiating points, control modules, and field circuits that identifies the labeling of all components and shows the relationships and activation sequences among the various initiating points and the control modules and/or field circuits.
3. The FSS Contractor shall submit a commissioning check sheet for each installed ASD detector. The check sheet shall list all installed equipment, configurations and measured ambient conditions.
4. The FSS Contractor shall submit a test plan that describes how the system shall be tested. This shall include a step-by-step description of all tests and shall indicate type and location of test apparatus to be used. Tests shall not be scheduled or conducted until the engineer of record approves the test plan. At a minimum, the tests to be conducted shall be per the relevant referenced codes and any additional supplemental tests required by the AHJ. Tests shall not be scheduled or conducted until the engineer of record approves the test plan.
5. Upon completion of installation and commissioning acceptance, two (2) sets of "As-Built" installation drawings and One (1) set of the calculation report for each installed system.

H. Test Plan

1. The distributor shall submit a test plan that describes how the system equipment and room integrity shall be tested. This shall include a step-by-step description of all tests and shall indicate type and location of test apparatus to be used. At a minimum, the tests to be conducted shall be per NFPA 2001 and any additional supplemental tests required by the AHJ. Tests shall not be scheduled nor conducted until the engineer of record approves the test plan.

I. Installation Drawings

1. Four (4) sets of installation drawings for each installed clean agent FSS and one (1) set of the calculation report, owner's manual and product data sheets shall be submitted to the end-user/owner.
2. Upon completion of installation and commissioning acceptance, two (2) sets of "As-Built" installation drawings and One (1) set of the calculation report for each installed FSS shall be given to the owner/end-user for use and reference.

J. Documentation: The FSS Contractor shall submit two (2) copies the following after complete installation:

1. Engineered System Design, Installation, Operation and Maintenance Manual.
2. Installation, Operation and Maintenance Manual.

## PART 2 - FIRE SUPPRESSION SYSTEM REQUIREMENTS

### 2.1 GENERAL

- A. The clean agent FSS shall consist of 3M Novec 1230 clean agent storage container(s), actuation hardware and discharge nozzle(s) attached to a piping network along with controls.

## 2.2 SYSTEM PERFORMANCE

- A. System Discharge
  - 1. The discharge time required to achieve 100% clean agent concentration in the protected room required for fire extinguishment shall not exceed 10 seconds.
- B. Duration of Protection
  - 1. 85% of the minimum clean agent design concentration in the protected room required for fire extinguishment shall be maintained for 10-minutes or the period of time to allow effective emergency action by trained personnel. A level 1 certification in room integrity testing, provided by a recognized manufacturer of room integrity testing equipment, is required.
- C. Minimum System Design Limits
  - 1. Nozzles
    - a. Nozzles shall be listed and approved for a maximum ceiling height of 16 feet (4.88 m) and a minimum ceiling height of 1 foot (0.31 m).
    - b. Nozzle area coverage for both 360- and 180-degree nozzles shall be a maximum of 35 ft. x 35 ft. square.
    - c. System Nozzles shall be listed and approved to accommodate a maximum clean agent arrival time of 2.0 seconds and a maximum dispersion time of 6 seconds.
    - d. System Nozzles shall be listed and approved for a minimum of 60 PSIG (4.16 bar gauge) nozzle pressure.

## 2.3 PIPE AND FITTINGS

- A. Distribution piping, and fittings, shall be installed in accordance with NFPA 2001, approved piping standards and the engineered FSS manufacturer's requirements.
- B. Piping shall be black or galvanized steel, schedule 40, and meet requirements of ASTM A53 grade A or ASTM106.
- C. Piping, fittings, and nozzles shall have a melting point greater than 1600 degrees Fahrenheit. Aluminum components shall not be used.
- D. Fittings shall be malleable iron, 300 lb. class, per ASTM A197.

## 2.4 ACTUATION HARDWARE

- A. The clean agent cylinders shall be actuated in accordance with the applicable design manual.
- B. The FSS panel shall be UL Listed per UL 864, 9th Edition with the interfacing electric actuators.

## 2.5 NOZZLES

- A. Total flooding clean agent extinguishing system nozzles shall be made of stainless steel.

- B. Each nozzle shall be located in the space per the manufacturer's guidelines. Nozzles shall have either a 180- or a 360-degree discharge pattern.
- C. Each nozzle discharge pattern shall be available in sizes ranging from 3/8-in NPT to 2-in NPT.
- D. Within each nozzle size and style, the manufacturer shall offer multiple different orifice areas (minimum of 20).
- E. Nozzles shall be UL Listed and FM Approved for use with the manufacturer's clean agent extinguishing system employing Novec 1230 fluid.

## 2.6 CLEAN AGENT STORAGE CONTAINER ASSEMBLIES

- A. Novec 1230 fluid shall be stored in containers manufactured and marked in accordance with US Department of Transportation (DOT) specification 4BW-500 or 4BA-500. The agent storage containers shall be super pressurized with dry nitrogen to 360 PSIG (or as recommended by FSS Manufacturer) at 70 degrees F (24.8 bar gauge at 21 degrees C.) The FSS manufacturer shall be able to provide US DOT documentation that the registration number marked on the clean agent storage container corresponds to a manufacturing location at a US address.
- B. Novec 1230 fluid containers shall be equipped with a pressure gauge to display internal pressures. The gauge shall be an integral part of the equipment and shall be color-coded for fast referencing of pressure readings.
- C. A low-pressure switch shall be provided as standard equipment on the Novec 1230 fluid containers. A decrease in pressure will cause the normally open contacts to close, indicating a trouble condition at the control panel. The low-pressure switch shall be field removable/replaceable while the container is still fully charged.
- D. Novec 1230 fluid containers with empty weights in excess of 105-lbm shall be equipped with an integral liquid level indicator (LLI). The LLI will allow the agent container to remain connected and secured in place while measuring the agent mass.
- E. High-strength alloy steel, equipped with the following:
  - 1. Integral lifting ring.
  - 2. Automatic, remotely operated discharge valve assembly.
  - 3. 0 to 600 psi pressure gauge.
  - 4. Electrically supervised valve actuator.
  - 5. Filling valve to allow recharging in place.
  - 6. Supervisory pressure switch to sense loss of agent from the container.
  - 7. Liquid level indicating device, UL listed.
- F. Pressure Relief: On overpressure condition of greater than 810 psi.

## 2.7 OPTIONAL EQUIPMENT

- A. When protecting multiple hazard areas from a single supply of Novec 1230 fluid, Three-Way Directional Ball Valves shall be used.



1. The Three-Way Directional Ball Valves shall be UL Listed or FM Approved for use with Novec 1230 fluid and Control Unit Engineered Suppression Systems.
2. The Three-Way Directional Ball Valves shall be installed and located in the FSS piping network per the manufacturer's guidelines and design manual.

## 2.8 ELECTRICAL WORK

- A. All electrical enclosures, raceways, and conduits shall be provided and installed in accordance with applicable codes and intended use, and shall contain only those electrical circuits associated with the FSS or FA control system. No circuit or circuits that are unrelated to the FSS or FA shall be routed through the enclosures, raceways, and conduits dedicated to the FSS or FA system.
- B. Splicing of circuits shall be kept to a minimum, and is only permitted in an electrical box suitable for the purpose. Appropriate hardware shall be used to make the wire splices. Wires that are spliced together shall have the same color insulation.
- C. White colored wire shall be used exclusively for the identification of the neutral conductor of an alternating-current circuit. Green colored wire shall be used exclusively for the identification of the earth-ground conductor of an AC or DC circuit. Appropriate color-coding shall be utilized for all other field wiring.
- D. All electrical circuits shall be numerically tagged with suitable markings at each terminal point. All circuits shall correspond with the installation drawings.
- E. All electrical work shall follow division 26 specifications.

## 2.9 SYSTEM CONFIGURATION

- A. Activation of the extinguishing system shall be via crossed-zoned smoke detection in the following optional combinations:
  1. Photoelectric and Thermal smoke detectors.
- B. Detection system layout shall be in accordance with NFPA72 and it shall require the activation of at least one detector from each of the two crossed-zoned detector groupings to trigger the countdown to automatic release of the clean agent.

## 2.10 FSS CONTROL PANEL

- A. General
  1. Panel shall contain required system operation lights, reset and silence switches, circuits, relays, a standby battery power and either an enclosed or adjacently-mounted battery charger, and all other devices necessary to provide a complete automatic control system.
  2. The control unit shall consist of a printed-circuit board (PCB), an integral display/control assembly, and terminations for all field circuits, a primary power supply and an enclosure with removable door and viewing window.
- B. Cabinet:

1. UL listed and FM approved as an alarm-releasing control unit.
  2. NEMA 250, Type 1.
  3. Surface-mounted, Type 316 stainless steel.
  4. Door: Hinged, key lockable.
  5. Finish: Manufacturer's standard color.
- C. Standby Battery:
1. Minimum Capacity: 6 Ah.
  2. Sized to operate the system for a minimum of 24 hours in supervisory condition and 15 minutes in alarm control condition immediately after the time in supervisory condition.
  3. Sealed, gelled electrolyte type, designed for FSS or FA service.
  4. Supervised to provide a trouble signal on low voltage, open, or shorted cell.
- D. Battery Charger:
1. Automatic, solid state, capable of charging batteries from 75 to 100 percent of full charge within 24 hours.
  2. Voltmeter or other means to display battery condition.
  3. Enclosure: Manufacturer's standard.
- E. The PCB shall contain the main-system microprocessor, the real-time clock, the history buffers, the watchdog timer, one USB device port, and two RS-232 serial ports. It shall also provide terminations for the following field circuits:
1. One (1) signaling line circuit (SLC)
  2. Two (2) notification appliance circuits (NACs)
  3. Two (2) combination NAC/releasing circuits (Combos)
  4. Two (2) releasing circuits
  5. Three (3) programmable relays
  6. One (1) trouble relay
  7. One (1) RS-485 communications circuit
  8. Battery charging circuit
  9. AC input power connections
- F. The SLC shall serve as the hardware and software interface between the intelligent initiating and control devices and the Control Unit. The SLC shall be capable of communicating with up to 255 automatic detectors, monitor modules, and control devices, in any combination, without restrictions on the numbers of each type of field device.
- G. The two releasing circuits shall be capable of actuating electro-explosive initiators, control heads, or solenoid valves. The releasing circuits shall be capable of actuating Factory Mutual System classified valves (Groups A,B,D,E,G)
- H. The two notification-appliance circuits (NACs) shall be independently programmable and configurable for either Class-A or -B operation.
1. The input power to the NAC shall be filtered and regulated. The NAC shall be capable of delivering a current of up to 1.5 A @ 24 VDC to the notification appliances.
  2. It shall be possible to field-configure each Class-B, Style-Y NAC to activate notification appliances with any and all of the following parameters via a personal-computer-based configuration program:
    - a. Twenty-character location
    - b. Drill activation

- c. Silenceable/non-silenceable operation
  - d. Walk-test activation
  - e. Master-coded operation (60 bpm, 120 bpm, temporal per ANSI S3.41, continuous)
  - f. Cutoff delay (5, 10, 15 minutes)
  - g. Silence inhibit (1, 3, 5 minutes)
- 3. It shall be possible to override one master code with another depending on the state (i.e., pre-alarm, prerelease, release, or time-limit-cutout) of the particular fire suppression zone. It shall also be possible to shut off and re-activate a NAC as required by the approved system operating sequence. No supplemental equipment shall be required to perform this functionality.
  - 4. It shall not be necessary to use external synchronization modules to synchronize the audible and visual notification signals created by any NAC
  - 5. Terminals for connection of field conductors to the NACs shall be large enough to accommodate #12 AWG wiring.
  - 6. The basic power-supply / charger assembly shall consist of an AC to DC switching power unit. The power-supply / charger assembly shall be configurable to accept either 120 or 240 VAC input voltage, and shall provide 5.4 A at 24 VDC of filtered and regulated power to operate the system and charge the system's standby battery. The charger assembly shall be capable of charging batteries of capacities up to 70 AH. Two user-configurable auxiliary-power circuits shall be provided on the PCB to power peripheral devices. The auxiliary-power circuits shall be software programmable for either continuous or interruptible power output, and shall be rated for 1.0 A at 24 VDC. It shall not be necessary to set jumpers or dip switches on the PCB to make these outputs continuous or interruptible.
  - 7. The system shall have the ability to use an optional Intelligent Communications Module (ICM). The ICM shall be a device server that provides Internet access to the Control Unit via any standard Web browser such as Internet Explorer or Netscape Navigator. The ICM shall provide the following client services:
    - a. Dial-up control-unit monitoring and status reporting
    - b. Automatic event detection and reporting via e-mail
    - c. Web-browser-based
    - d. Emulated display for the control unit
    - e. Access to items in the control unit's List Menu

## 2.11 ANNUNCIATION

- A. The following modules shall be provided for remote-event annunciation and operator control as indicated on the bid documents.
  - 1. Textual-Type Remote Display Control Module (RDCM)
    - a. Model RDCM shall completely duplicate the display and operator-intervention capabilities of the main-control-unit display.
    - b. The RDCM shall communicate with the Control Unit via RS-485 communications, and the system shall be capable of supporting with up to 15 remote displays.
    - c. The remote displays shall operate on 24 VDC power provided by the Control Unit power supply, or by any remote power supply that is UL Listed or FM Approved for fire alarm applications. The remote-display modules shall supervise their input-power connections.

- d. The main Control Unit display or one RDCM shall be capable of being programmed as the master unit with immediate operator-intervention privileges upon the occurrence of any alarm or fault condition. The master unit shall have control for a minimum period of 30 seconds, and all other control points shall be locked out and notified of the locked-out condition if another operator attempts to intervene during the locked-out period imposed by the master control module.

B. Output Driver Modules

1. The Driver and Relay Annunciator Driver Module shall provide the Control Unit with up to 32 programmable outputs for remote LEDs, along with 6 system-level LEDs and 5 system-level functional switches.
2. The Driver and Relay Driver Module shall provide the Control Unit with up to 32 programmable outputs for remote relays.
3. The Driver and Relay Modules shall communicate with the Control Unit via the RS-485 communications circuit, with the most-remote module capable of being located up to 4,000 feet from the control unit. The modules shall be capable of being installed in various combinations as long as the maximum number of 16 for each module type is not exceeded.
4. Both modules shall be powered from the power supply, or from an external, regulated, and power-limited power supply Listed and Approved for use with fire-protective-signaling systems, depending upon the total load of the remote outputs.

## 2.12 DETECTORS

A. Base:

1. Interchangeable with photoelectric or thermal type detectors.
2. LED that illuminates steadily upon detector sensing a fire condition and with ability to power a remote annunciator that will duplicate LED indication.

B. Detection Devices, General:

1. Equip with a means of securing head to base in a manner that head may not be readily tampered with or removed.
2. UL listed and FM approved.

C. Photoelectric Detector

- a. The Photoelectric Detector, shall be a microprocessor-based smoke detector. The photoelectric detector shall be a light scattering type, low profile, intelligent detector that senses a broad range of smoldering and flaming-type fires. The sensing chamber shall permit a full 360° smoke entry.
- b. Each photoelectric detector shall be electronically addressable and fully field-programmable. It shall be possible to set an alert threshold anywhere from 0.2 to 3.4% per foot obscuration in 0.1%-per-foot increments, and to set an alarm threshold anywhere from 0.5 to 3.5% per foot obscuration in 0.1%-per-foot increments. Alarm thresholds shall be dynamically adjustable as a result of another alarm event anywhere in the system. Where permitted, each detector shall be programmable for alarm verification in periods of up to 180 seconds in 1-second increments. Each detector shall provide a real-time value of current, local obscuration level in percent-per-foot readout when requested by an operator at the control unit.

- c. It shall be possible to configure each photoelectric detector for non-latching operation to prevent inadvertent or spurious fire signatures from accidentally discharging a waterless extinguishing system. The control unit shall latch the alarm report, but the discharge sequence shall be interrupted if the fire signature at the detector drops below the detector's programmable alarm threshold
  - d. Detector calibration, address, alert and alarm thresholds, and drift-compensation algorithm shall be stored in each detector's non-volatile memory. Systems that store all detector parameters in the control unit (i.e., non-distributed-intelligence-to-the-device-level architecture) shall not be considered as equivalent.
  - e. A detector-housing, shall be available to allow a photoelectric detector to monitor for the presence of combustion products in an air duct. The detector housing shall be rated for air-duct velocities ranging from 500 to 4,000 feet per minute. It shall also be possible to mount the photoelectric detector in an air duct with velocities ranging up to 4,000 feet per minute.
  - f. Solid state circuitry pulsed infrared LED light source, and silicon photodiode receiving element.
  - g. Incorporate means to discriminate between valid fire signals and nonfire signal.
  - h. Include a fine stainless steel mesh cover to prevent foreign objects from entering sensing chamber.
  - i. Dew-proof and unaffected by air velocities up to 3,000 fpm.
2. Thermal Detector (shall only be included if FPE requests)
- a. The Thermal Detector, shall be a microprocessor-based heat detector. The thermal detector shall be a thermistor-type, low profile, intelligent detector that responds to a fixed temperature with minimal thermal lag. The sensing chamber shall permit a full 360° heat entry.
  - b. Each thermal detector shall be electronically addressable and fully field-programmable. It shall be possible to set both alert and alarm thresholds anywhere from 80°F to 155°F in 1°F increments. Each detector shall provide a real-time value of current, local temperature in °F readout when requested by an operator at the control unit.
  - c. It shall be possible to configure each thermal detector for non-latching operation to prevent inadvertent or spurious fire signatures from accidentally discharging the clean agent fire extinguishing system. The control unit shall latch the alarm report, but the discharge sequence shall be interrupted if the fire signature at the detector drops below the detector's programmable alarm threshold.
  - d. Detector calibration, address, and alert and alarm thresholds shall be stored in each detector's non-volatile memory. Systems that store all detector parameters in the control unit (i.e., non-distributed-intelligence-to-the-device-level architecture) shall not be considered as equivalent.

## 2.13 CONDUCTORS AND CONDUITS

- A. All conductors shall be enclosed in rigid or thin-walled, steel conduit.
- B. Any conduit or raceway exposed to dampness or other similar conditions shall be properly sealed and installed to prevent moisture entrapment. Provisions for draining and drying shall be employed as required.

- C. All wiring shall be of the proper size to conduct the circuit current, but shall not be smaller than #18 AWG unless permitted by the local electrical code. Wiring for the signaling line circuit shall be in accordance with the Control Unit Installation, Operation, and Maintenance Manual. Wire that has scrapes, nicks, gouges, or crushed insulation shall not be used. The manufacturer's minimum wire-bending radii shall be observed in all enclosures, raceways, and conduits. Aluminum wire shall not be used.
- D. All wiring shall be installed by qualified personnel conforming to the National Electrical Code, Article 525 and Article 760. Wiring installation shall meet all local, state, province and/or county codes.
- E. Power limited 24 VDC circuits shall be wired using factory assemblies consisting of 4-conductor 18 AWG CMP cables and non-power limited circuits shall be wired using factory assemblies consisting of 2-conductor 18 AWG NPLF cables. All cable assemblies shall have a keyed locking male connector on one end and a keyed locking female connector of the other end. The connector housing shall have a UL flammability rating of UL-94 VO and gold plated terminals.
- F. The complete electrical system installation and all auxiliary components shall be connected to earth ground in accordance with the National Electric Code.

#### 2.14 MANUAL DISCHARGE STATION

- A. Furnish to provide a means of manually discharging the fire suppression system in case of an emergency.
- B. Stainless steel, with keyed red release button.
- C. Cover shall include operating instructions and identify discharge station as a clean agent discharge component.
- D. Double-pole switch.
- E. UL listed and FM approved.

#### 2.15 DISCHARGE ABORT STATION

- A. "Dead man" type requiring constant pressure to transfer one set of normally open and one set of normally closed contacts on each contact block.
- B. Digital countdown timer to indicate time remaining until system discharge.
- C. Faceplate constructed of stainless steel, with abort button, operating instructions, and identification as a component of the NOVEC 1230 system.
- D. Rated 6 amps at 120V ac and 1 amp at 120 V dc, with ability to override shutdown of HVAC and control equipment.

2.16 ALARM BELL

- A. Vibrating type, approved for use with the control unit provided.
- B. Polarized for full supervision, and rated at 24V dc, drawing no more than 0.063 amps.
- C. Noise Level: 86 to 90 db at 10 feet.
- D. Finish: Baked red enamel.
- E. UL listed and FM approved.

2.17 STROBE LIGHT

- A. Rating: 24V dc with amperage draw of 0.033 amps.
- B. Lamp protected by a white translucent lens imprinted with the word NOVEC 1230 in red letters.
- C. Polarized, powered from the control panel.
- D. UL listed and FM approved.

PART 3 - EXECUTION

3.1 DETECTORS

- A. Install thermal and photoelectric detectors as dictated by Fire Protection engineering drawings.
- B. Do not install detectors closer than 3 feet from air supply diffusers and 1 foot from wall.
- C. Conform to NFPA No. 72E, latest edition.

3.2 AGENT STORAGE CONTAINERS

- A. Floor mount and securely support to wall with wall brackets.
- B. Attach mounting brackets and piping to the structure in a manner capable of withstanding the thrust developed during discharge without displacement.
- C. Connect the same size containers to a common manifold.

3.3 PIPING

- A. Install in accordance with Section NFPA Standards.
- B. Cap pipe ends immediately after installation. Maintain until nozzles are installed.

- C. Provide escutcheon plates at all pipe penetrations through walls, floors, and ceilings.
- D. Pipe Supports: Install in accordance with ASME B31.1.

### 3.4 ELECTRICAL

- A. Install in accordance with Division 26, Electrical.

### 3.5 SIGNS

- A. In addition to the following, provide as required to comply with NFPA 2001 and the recommendations of the NOVEC 1230 equipment manufacturer.
  - 1. Caution:
    - a. Provide on all entry doors to clean agent protected areas.
    - b. Wording: Alert personnel that room is protected by clean agent and all doors must be kept closed in event of fire.
    - c. Size: 10 inches by 14 inches by 1/16 inch, constructed of plastic, with black face and yellow letters.
  - 2. Manual Discharge:
    - a. Provide adjacent to each manual discharge station.
    - b. Identify the manual discharge station as the place where clean agent can be manually discharged.
    - c. Size: 4 inches by 4 inches by 1/16 inch, constructed of plastic, with red face and white letters.
  - 3. Flashing Light:
    - a. Provide adjacent to each strobe horn and light.
    - b. Explain the presence of the flashing lights.
    - c. Size: 7 inches by 4 inches by 1/16 inch, constructed of plastic, with red face and white letters.

### 3.6 FIRE SUPPRESSION SYSTEM INSTALLATION

- A. The FSS shall be supplied and installed by a factory-authorized, Fire Suppression System Contractor. The FSS Contractor shall be trained and certified by the awarded manufacturer of the FSS to design, install and maintain the fire suppression system. The FSS Contractor shall install the system in accordance with the manufacturer's design, installation, operation and maintenance manual.

### 3.7 ELECTRICAL SYSTEM INSTALLATION

- A. The FSS Contractor shall install the system in accordance with the appropriate Fire Suppression System installation, operation and maintenance manual.
- B. Locations of all electrical equipment, the Control Unit, and all system components are subject to the approval of the architect.



- C. All final-acceptance tests shall be performed in the presence of the architect and the authority having jurisdiction. The FSS Contractor shall record all equipment, tests and system configurations in a format approved by the FSS manufacturer and/or the local Authority Having Jurisdiction. A copy of the commissioning tests and results shall be provided to the architect, the authority having jurisdiction, and the end-user.

3.8 SEQUENCE OF OPERATION (FOR INFORMATION ONLY, ACTUAL SEQUENCE SHALL BE WRITTEN BY FIRE SUPPRESSION SYSTEM CONTRACTOR)

- A. First Alarm (Smoke Detection) : Actuation of one detector shall generate a first alarm, and the following shall occur:
  - 1. The first alarm indicator light shall be illuminated on the FSS control panel and a signal shall be sent to the Fire Alarm Control Panel denoting first alarm.
  - 2. A visual strobe light shall be illuminated and audio horn shall be energized in the protected area over the sign reading “First Alarm, Smoke Detected in the Protected Area, Prepare to Evacuate the Building.”
  - 3. A signal shall be sent to the HVAC control panel. HVAC control panel shall de-energize all fans and close all dampers per HVAC sequence of operation.
- B. Second Alarm (Countdown to Clean Agent Discharge): Actuation of second detector in same protected area shall generate a second alarm,
  - 1. The second alarm indicator light shall be illuminated on the FSS control panel and signal shall be sent to Fire Alarm Control Panel denoting second alarm.
  - 2. A visual strobe light shall be illuminated and audio horn shall be energized in the protected area over the sign reading “Evacuate the Room, Clean Agent Shall Be Discharged in 30 seconds, Press Abort Button to Prevent Clean Agent Discharge.”
  - 3. A 30-second (adjustable) time delay sequence shall be initiated and the Abort button for this room shall be enabled.
  - 4. If the HVAC fans are de-energized and dampers closed a signal shall be received from the HVAC control panel denoting HVAC system de-energized and sealed.
  - 5. After the 30-second time delay, the clean agent shall be discharged into the protected area containing (2) actuated detectors.
- C. Third Alarm (Clean Agent Discharged): After clean agent is dispersed into the protected area a visual strobe light shall be illuminated and audio horn shall be energized in the protected area over the sign reading, “Warning: Clean Agent Has Been Discharged in Protected Area.”

3.9 ROUTINE MAINTENANCE

- A. Routine maintenance on equipment shall be performed as recommended by the FSS manufacturer’s installation, operation and maintenance manual. At a minimum the routine maintenance will include the following by a certified Fire Suppression System Distributor:
  - 1. Visual check of pipe network and distribution nozzles per the operation and maintenance manual.
  - 2. Weight and pressure of the Engineered System cylinders per the operation and maintenance manual.
  - 3. Inspect all cylinders and equipment for damage per the operation and maintenance manual.

4. Pneumatic operation of the Three-Way Directional Ball Valve. Routine maintenance on the suppression system as a whole shall be performed as recommended by NFPA 2001, current edition.

### 3.10 PIPE LABELING

- A. Label with the legend NOVEC 1230 EXTINGUISHING AGENT in letters 1 inch high.
- B. Maximum Intervals:
  1. Exposed Piping: 12 feet.
  2. Concealed Piping: 20 feet.

### 3.11 FIELD QUALITY CONTROL

- A. General: System functional and performance testing shall be conducted by qualified, trained personnel in accordance with the manufacturer's recommended procedures and NFPA 2001.
- B. Test Plan:
  1. Prepare a plan of testing to include a step-by-step description of all tests to be performed and the type and location of test apparatus to be employed.
  2. Testing shall not be conducted until the Test Plan has been approved.
- C. Functional Tests:
  1. Perform under supervision of equipment manufacturer and with the Engineer present.
  2. All functional testing, including system and equipment interlocks, must be successfully completed at least 5 days prior to beginning performance testing.
  3. Check all containers and distribution piping for proper mounting and installation.
  4. Test all electrical wiring for proper connection, continuity, and resistance to ground.
  5. Verify that HVAC and FA connections to the area have properly installed dampers, and HVAC equipment will shut down upon a signal from the control panel.
  6. Test each detector in accordance with the manufacturer's recommended procedures, and record test values.
  7. Demonstrate that all system and equipment interlocks, such as door release devices, audible and visual devices, equipment shutdowns, and local and remote alarms function as designed.
  8. Test each control panel circuit by inducing a trouble condition into the system.
- D. Performance Test:
  1. Perform under actual or approved simulated operating conditions to demonstrate that the entire control system functions as designed and intended.
  2. Perform under supervision of equipment manufacturer.
  3. Demonstrate to the Owner's representative, and authorities having jurisdiction, operation of all components under simulated fire conditions.
  4. Test in accordance with NFPA 2001.
  5. Conduct using the Retro-Tec Corp. (or equal) door fan system, or equivalent, with integrated computer program.
  6. Room Pressurization;

- a. Conduct test, at room pressurization in each protected space, to determine the presence of openings that would affect the system concentration levels.
  - b. Seal all protected spaces against agent loss or leakage.
  - c. Conduct pressurization tests until protected space is shown to be successfully sealed.
7. Test the following circuits:
- a. Automatic actuation.
  - b. A.R.M.
  - c. Manual actuation.
  - d. HVAC and power shutdowns.
  - e. Audible and visual alarm devices.
  - f. Manual override of abort functions and agent container pressure supervision.
  - g. Supervision of all panel circuits, including ac power and battery power supplies.
  - h. Communication with FA control panel and HVAC control panel.
8. Upon acceptance by Owner, recharge system if required, and place the completed system into normal service.

### 3.12 TESTING AND DOCUMENTATION

#### A. System Inspection, Checkout and Testing

1. The final test and acceptance shall be conducted in the presence of the Owner's representative and a representative from the Authority Having Jurisdiction.
  - a. Tests shall demonstrate that the entire control system functions as intended. Automatic discharge, manual discharge, equipment shutdown, and alarm devices shall be tested.
  - b. All containers and distribution piping shall be checked for proper mounting and installation.
  - c. All electrical wiring shall be tested for proper connection, continuity and resistance to earth.
  - d. Final inspection shall be made to ensure that all required dampers, door bottom seals, weather-stripping, caulking and foam sealant have been installed and that the areas protected shall contain the NOVEC 1230 clean agent for 10 minutes or a time required (determined by AHJ) to allow emergency response to arrive on site.
  - e. A second follow up test shall be conducted in presence of owners. Repeat 6 months into the warranty period.
  - f. Test delivery piping to hold 40 psig for 10 minutes.
2. The final approval testing for the FSS shall follow NFPA 2001 Standard on Clean Agent Fire Extinguishing Systems and shall include but not be limited to the following:
  - (a) Functional Testing signals properly transmit to all site control panels and remote station control panels; Operate detection circuits to insure control panel is responding correctly;. Operate manual abort and manual agent release button and see if control panel receives signals correctly; operate all auto-actuating valves; operate each type of input device on stand-by (battery) power, verify receipt of trouble condition at site and remote control panels: test system operation under stand-by (battery) power.
  - (b) Total enclosure leakage testing using door fan measurement: record leakage flow measurements (cfm) at two negative pressures of -10 Pa(-0.001 psi) and -50 Pa (-0.007 psi) by depressurizing the enclosure; record leakage flow (cfm) measurements at two positive pressures of 10 Pa (0.001 psi) and 50 Pa (0.007 psi)

- (c) Determine if FSS system operation is satisfactory and enclosure integrity passes, thus insuring that a clean agent discharge into the protected area will last at the extinguishing concentration for a period of 10 minutes or as required to allow emergency responders to reach site.
- 3. If FSS does not operate correctly FSSC will make required changes or provide additional components to insure the system operates correctly.
- 4. If building integrity test fails, then FSSC will work with General Contractor conducting smoke tests or other tests to isolate leakage.
- 3. Training Requirements
  - a. Prior to final acceptance, the installing contractor shall provide operational training to each shift of the Owner's personnel. The training shall address emergency procedures, abort functions, and control panel operation, troubleshooting and safety requirements.
  - b. Including in the training of all building personnel: procedure during first alarm; procedure at second alarm; evacuation path from the protected room to the building exterior; procedure to stop the clean agent from discharging into the protected room by pressing the abort switch; procedure to initiate a pre-discharge second alarm mode by pressing the manual discharge agent switch.
  - c. Training of all building personnel to insure exit doors are closed upon leaving the protected room.
- 4. Operation and Maintenance
  - a. Prior to final acceptance, the installing contractor shall provide the FSS Owner's Manual to the Owner.
- 5. As-Built Drawings
  - a. Upon completion of each system, the installing contractor shall provide copies of the system "as-built" drawings to the system Owner.
- 6. System Inspections
  - a. The FSS installing contractor shall meet with the FSS Owner to discuss future inspection and tests (that shall be conducted annually) as per National and local code requirements of each system installed under this contract.
  - b. Clean agent quantity and pressure of storage containers shall be checked and a tag shall be placed on the storage container that states clean agent pressure, date, and name of individual conducting inspection.
  - c. Protected area shall be inspected to determine if new penetrations to the room or any other occurrence has breached enclosure integrity.

END OF SECTION 21 00 00

## SECTION 21 05 00 – COMMON WORK RESULTS FOR FIRE SUPPRESSION

### PART 1 - GENERAL

#### 1.1 SECTION REQUIREMENTS

- A. Submittals:
  - 1. Piping Materials and Installation Instructions
  - 2. Grout
  - 3. Fire Suppression Equipment
  - 4. Supports and Anchorages
  - 5. Mechanical Sleeve Seals
  - 6. Escutcheons
  - 7. Welding Certificates

#### 1.2 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operations according to AWS D1.1 “Structural Welding Code” Steel.
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications. Certify that each welder has passed AWS qualification tests for welding and processes involved and that the certification is current.

#### 1.3 DELIVERY

- A. Deliver pipes and tubes with factory-applied caps. Maintain caps through shipping, storage, and handling to prevent pipe end damage and to prevent dirt, debris, and moisture from entering pipe.

#### 1.4 COORDINATION

- A. Arrange for pipe spaces, chases, slots, openings in building structure during progress of construction to allow for fire suppression installations.
- B. Allow floor space for each clean agent storage tank and wall space for control panels, alarms, lights, and signage.
- C. Coordinate installation of required supporting devices and set sleeves in poured in place concrete and other structural components.

## PART 2 - PRODUCTS

### 2.1 WELDING MATERIALS

- A. Comply with AWS D 10.12 for welding materials.

### 2.2 SLEEVES

- A. Mechanical Sleeve Seals: Modular rubber sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- C. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- D. Coordinate requirements for access panel and doors for fire suppression items behind finished surfaces that require access.

### 2.3 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.
- C. One-Piece, Deep Pattern Type: deep drawn box-shaped brass with polished chrome-plated finish.
- D. One-Piece, Cast Brass Type: With set screw, chrome-plated (polished) finish.
- E. Split-Casting, Cast Brass Type: With concealed hinge and set screw, chrome-plated (polished) finish.
- F. One-Piece, Floor Plate Type: With cast iron floor plate.

### 2.4 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

### 2.5 VIBRATION ISOLATION AND SEISMIC CONTROL DEVICES

- A. Vibration Supports:

1. Pads: Arranged in single or multiple layers of oil- and water-resistant [neoprene] of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match supported equipment.
  2. [Restrained ]Mounts: Double-deflection type, with molded, oil-resistant fiberglass, rubber or neoprene isolator elements with factory-drilled, encapsulated top plate and baseplate. Provide isolator with minimum 0.5-inch static deflection.
- B. Seismic Restraints:
1. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
  2. Channel Support System: MFMA-4, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
  3. Postinstalled Anchors: Torque-controlled expansion anchors, seismic rated, zinc plated carbon steel for interior applications and stainless steel for exterior locations. Provide anchor bolts with strength four times the load imposed as tested according to ASTM E 488.

## PART 3 - EXECUTION

### 3.1 MOTOR INSTALLATION

- A. Anchor motor assembly to base, adjustable rails, or other support, arranged and sized according to manufacturer's written instructions.

### 3.2 GENERAL PIPING INSTALLATIONS

- A. Install piping free of sags and bends.
- B. Install fittings for changes in direction and branch connections.
- C. Install sleeves for pipes passing through concrete and masonry walls, gypsum board partitions, and concrete floor and roof slabs.
- D. Exterior Wall, Pipe Penetrations: Mechanical sleeve seals installed in steel or cast-iron pipes for wall sleeves.
- E. Install piping at right angles or parallel to building walls. No diagonal runs.
- F. Install piping above accessible ceiling to allow space for ceiling removal.
- G. Install piping to allow access to valves.
- H. Select system and components with pressure rating higher than system operating pressure.
- I. Install unions at final connection to each piece of equipment.

- J. Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals in water piping.
- K. Fire Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stop material.

### 3.3 GENERAL EQUIPMENT INSTALLATIONS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. 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.
- D. Install equipment to allow right of way for piping installed at required slope.

### 3.4 BASES, SUPPORTS, AND ANCHORAGES

- A. Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
  - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
  - 2. Install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base to connect concrete base to concrete floor.
  - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
  - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 5. Use [3000-psi (20.7-MPa)], 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete"
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.
- C. Mix and install grout for fire-suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors. Place grout, completely filling equipment bases.

### 3.5 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes to remove burrs.



- B. Remove scale, slag, dirt, and debris from inside and outside of pipes and fittings before assembly.
- C. Threaded Joints: Thread pipe according to SME B1.201.1 cut threads full and clean. Ream threaded pipe ends to remove burrs and restore original pipe ID.
- D. Apply tape or threaded compound to external pipe threads.
- E. Do not use pipe or pipe fittings that are damaged, corroded, or have cracked welds.
- F. Weld joints per AWS D10.12.

END OF SECTION 210500

## SECTION 21 10 00 – WATER-BASED FIRE-SUPPRESSION SYSTEMS

### PART 1 - GENERAL

#### 1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data for valves, sprinklers, specialties, and alarms.
  - 1. Submit sprinkler system drawings identified as "working plans" and calculations according to NFPA 13. Submit required number of sets to authorities having jurisdiction for review, comment, and approval. Include system hydraulic calculations.
  - 2. Submit test reports and certificates as described in NFPA 13.
- B. Design and Installation Approval: Acceptable to authorities having jurisdiction.
- C. Hydraulically design sprinkler systems according to NFPA 13.
- D. Comply with NFPA 13, NFPA 13R, NFPA 70, and all applicable codes.
- E. UL-listed and -labeled and FM-approved pipe and fittings.

#### 1.2 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.
- B. Dry-Pipe, double-action, sprinkler system: Automatic sprinklers are attached to piping. During normal conditions deluge valve is closed, thus, the fire protection piping serving the dry-pipe sprinklers is dry (free of water). Two events must occur before water will be discharged into the system. Products of combustion must be sensed by two of the area smoke detectors. Secondly, one of the fire sprinkler glass bulbs must be shattered. Then, water will enter the piping system and only flow through the sprinkler heads that have their bulbs broken.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Standard Piping System Component Working Pressure: Listed for at least 175 psig (1200 kPa).
- B. Fire-suppression sprinkler system design shall be approved by authorities having jurisdiction.
  - 1. Margin of Safety for Available Water Flow and Pressure: 20 percent, including losses through water-service piping, valves, and backflow preventers.
  - 2. Minimum Density for Automatic-Sprinkler Piping Design:
    - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq ft. area.
    - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq ft. area.
    - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq ft. area.
    - d. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq ft. area.

WATER-BASED FIRE-SUPPRESSION SYSTEMS

- e. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq ft. area.
- f. Special Occupancy Hazard: As determined by authorities having jurisdiction.
- 3. Total Combined Hose-Stream Demand Requirement: According to NFPA 13, unless otherwise indicated:
  - a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
  - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.
  - c. Extra-Hazard Occupancies: 500 gpm for 90 to 120 minutes.

#### 1.4 SUBMITTALS

- A. Product Data: For the following:
  - 1. Piping materials, including dielectric fittings and sprinkler specialty fittings.
  - 2. Pipe hangers and supports.
  - 3. Valves, including listed fire-protection valves, unlisted general-duty valves, and specialty valves and trim.
  - 4. Sprinklers, escutcheons, sleeves and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
  - 5. Alarm devices, including electrical data.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Fire-hydrant flow test report.
- D. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations.
- E. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include “Contractor’s Material and Test Certificate for Aboveground Piping” and “Contractor’s Material and Test Certificate for Underground Piping.”
- F. Welding certificates.
- G. Field quality-control test reports.
- H. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Installer’s responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
    - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

- C. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:
  - 1. NFPA 13, "Installation of Sprinkler Systems."
  - 2. NFPA 230, "Fire Protection of Storage."

#### 1.6 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

#### 1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

### PART 2 - PRODUCTS

#### 2.1 FIRE DEPARTMENT SIAMESE CONNECTION

- A. Brass, flush wall type, exterior fire department connection with brass escutcheon plate, without sill cock, and a minimum of two 65 mm (2 1/2 in.) connections threaded to match those on the local fire protection service, with polished brass caps and chains. Provide escutcheon with integral raised letters "Standpipe and Automatic Sprinkler". Provide connection with a swing check valve. Install an automatic ball drip between fire department connection and check valve to discharge over an indirect drain connection or to the outside. When additional alarm valve is installed, additional check valve is not required. Check valves must be installed in accordance with their vertical or horizontal listing.

#### 2.2 SPRINKLERS

- A. Quick response sprinklers shall be standard type except as noted. The maximum distance from the deflector to finished ceiling shall be 2 in. for pendent sprinklers. Pendent sprinklers in finished areas shall be provided with semi-recessed adjustable screwed escutcheons and installed within the center one-third of their adjustment. The sprinkler shall be installed in the flush position with the element exposed below the ceiling line. At the specified locations, provide the following type of sprinklers. All sprinklers except "institutional" type sprinklers shall be FM approved.

#### 2.3 TOOLS AND REPLACEMENT PARTS

- A. Sprinkler Cabinet:

1. Provide a minimum 5 percent spare sprinklers with escutcheons with a minimum of two of each type/or as required by NFPA-13, whichever is more demanding.
  2. Provide a minimum of two of each type sprinkler wrenches used.
  3. Install cabinets in each building where directed by the Resident Engineer.
  4. Spare sprinklers shall be kept in a cabinet where ambient temperatures do not exceed 100 Deg F.
- B. Sprinkler system water flow switch: one of each size provided.
- C. Sprinkler system valve tamper switch: one of each type provided.
- D. Sprinkler system pressure switch: one of each type provided.
- E. Provide two sprinkler plugs attached to multi-section extension poles 2400 mm (8 ft.) minimum.

#### 2.4 AIR COMPRESSOR

- A. Provide air compressor specifically approved for a dry sprinkler system with UL Listed FM Approved dry valves.
- B. Compressor shall maintain the required operating pressure on the dry system and be capable of full recovery within 30 minutes of an emergency.
- C. Provide a 120 volt electrical connection to a non-switched dedicated electrical connection and equip with an hourly run meter.
- D. A check valve or other positive backflow prevention device shall be installed in the air supply to each system to prevent airflow or waterflow from one system to another.
- E. Where the air compressor feeding the dry pipe system has less capacity than the discharge through a 1/8 in. orifice at 10 psig, no air maintenance device shall be required.
- F. A listed relief valve shall be provided between the compressor and controlling valve and shall be set to relieve at a pressure 10 psi in excess of the operating air pressure of the system.
- G. Automatic air supply to more than one dry pipe system shall be connected to enable individual maintenance of air pressure in each system.

#### 2.5 IDENTIFICATION SIGNS

- A. Provide for all new and existing sectional valves, riser control valves, system control valves, drain valves, test and drain connections and alarm devices with securely attached identification signs (enamel on metal) in accordance with NFPA 13.

#### 2.6 STANDPIPE HOSE VALVE CABINETS

- A. White glossy polyester coated 20 gage steel box, 20 gage tubular steel door and 18 gage frame with continuous steel hinge with brass pin, welded and ground smooth steel corner seams,

recess type, 600 x 600 x 250 mm (24 x 24 x 10 in.). Finish door and frame with white prime polyester coating.

## 2.7 HANGERS AND EARTHQUAKE BRACING

- A. In accordance with NFPA 13 and 14. Comply with seismic requirements as per 15050 for seismic zone locations.

## 2.8 WATERFLOW SWITCHES

- A. Integral, mechanical, non-coded, non-accumulative retard type, with two sets of SPDT auxiliary contacts and adjustable from 0 to 90 seconds. Set flow switches at an initial setting between 20 and 30 seconds adjustable.
- B. All conduit and wiring connected thereto shall be provided in Section 28 31 00, FIRE DETECTION AND ALARM.

## 2.9 VALVE SUPERVISORY SWITCHES

- A. Provide each indicating sprinkler, standpipe and fire pump control valve with adequate means for mounting a valve supervisory switch.
- B. Mount switch so as not to interfere with normal operation of the valve and adjust to operate within two revolutions toward the closed position of the valve control, or when the stem is moved no more than one fifth of the distance from its normal position.
- C. The mechanism shall be contained in a weatherproof die cast aluminum housing, which shall provide a 20 mm (3/4 in.) tapped conduit entrance and incorporate the necessary facilities for attachment to the valves.
- D. Switch housing to be finished in red baked enamel.
- E. Supervisory switches for ball and butterfly valves may be integral with the valve.
- F. All conduit and wiring connected thereto shall be provided in Section 28 31 00, FIRE DETECTION AND ALARM.

## 2.10 PRESSURE SWITCHES

- A. Provide with 15 mm (1/2 in.) NPT male pressure connection.
- B. Alarm switch shall be activated by any flow of water equal to or in excess of the discharge from one sprinkler.
- C. Supervisory switch shall be activated by either high or low air pressure condition.
- D. Furnish switch in a red baked enamel, weatherproof, oil resistant housing with tamper resistant screws.

2.11 WATER MOTOR GONG

- A. Provide water powered mechanical device providing an audible signal when there is a flow of water in the automatic sprinkler system.

2.12 WALL, FLOOR AND CEILING PLATES

- A. Exposed piping passing through walls, floors or ceilings shall be provided with chrome colored escutcheon plates.
- B. Comply with NFPA 101 Fire Barrier Penetration codes.

2.13 PRESSURE GAUGE

- A. Provide a 100 psi pressure gauge at each flow alarm switch location, at the top of each sprinkler or standpipe riser, at each main drain connection, and on the suction and discharge of the fire pump.

2.14 HANGERS

- A. Hangers shall be designed to support five times the weight of the water filled pipe plus 250 Lb (114Kg) at each point of piping support.
- B. These points of support shall be adequate to support the system.
- C. The spacing between hangers shall not exceed the value given for the type of pipe as indicated in NFPA 13 tables.
- D. Hanger components shall be ferrous.
- E. Detailed calculations shall be submitted, when required by the reviewing authority, showing stress developed in hangers, piping, fittings and safety factors allowed.

2.15 SPRINKLERS

- A. Automatic Sprinklers: With heat-responsive element complying with the following:
  - 1. UL 199, for applications except residential.
  - 2. UL 1626, for residential applications.
  - 3. UL 1767, for early-suppression, fast-response applications.
- B. Sprinkler Types and Categories: Nominal 1/2-inch (12.7-mm) orifice for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- C. Sprinkler types include the following:
  - 1. Upright, pendent, and sidewall sprinklers.
  - 2. Extended coverage sprinklers.

3. Quick-response sprinklers.
  4. Pendent and sidewall, dry-type sprinklers.
- D. Sprinkler Finishes: Chrome-plated and bronze.
- E. Sprinkler Escutcheons: Chrome-plated steel, one piece, semirecessed; with finish to match sprinklers.
- F. Sprinkler Guards: Wire-cage type, including fastening device.
- G. Sprinkler Cabinets: Finished steel cabinet and hinged cover, with space for minimum of six spare sprinklers plus sprinkler wrench, suitable for wall mounting. Include number of sprinklers required by NFPA 13 and one wrench for sprinklers. Include separate cabinet with sprinklers and wrench for each style sprinkler on Project.

## 2.16 PIPING SPECIALTIES AND ALARM DEVICES

- A. Fire Department Connection: UL 405, flush, wall type, with cast-brass body; NH-standard thread inlets matching local fire department threads.
1. Finish: Polished brass.
- B. Water-Motor-Operated Alarms: UL 753, mechanical-operation type with pelton-wheel operator with shaft length, bearings, and sleeve to suit wall construction and 10-inch- (250-mm-) diameter, cast-aluminum alarm gong with red-enamel factory finish. Include NPS 3/4 (DN 20) inlet and NPS 1 (DN 25) drain connections.
- C. Water-Flow Indicators: UL 346; electrical-supervision, vane-type water-flow detector; with 250-psig (1725-kPa) pressure rating; and designed for horizontal or vertical installation. Include two single-pole, double-throw, circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
- D. Pressure Switches: UL 753; electrical-supervision-type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts and design that operates on rising pressure and signals water flow.
- E. Valve Supervisory Switches: UL 753; electrical; single-pole, double throw; with normally closed contacts. Include design that signals controlled valve is in other than fully open position.
- F. Pressure Gages: UL 393, 3-1/2- to 4-1/2-inch- (90- to 115-mm-) diameter dial with dial range of 0 to 250 psig (0 to 1725 kPa).



## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Supervisory Switches: For each indicating each sprinkler zone, PIV (post indicator valve), control valve, provide a supervisory switch that is connected to the fire alarm system. Standpipe hose valves and test and drain valves shall not be provided with supervisory switches.
- B. Waterflow Switches: For each sprinkler zone and each standpipe riser , provide a waterflow switch. Install waterflow switch and adjacent valves in easily accessible locations.
- C. Sprinkler Zone: Each sprinkler zone shall coincide with each smoke zone and fire alarm zone.
- D. Piping connections:
  - 1. Sprinkler System Only: Start at flanged outlet within the building at exterior wall.
  - 2. Combined Standpipe and Sprinkler System: Start the sprinkler system work for each zone at valve connection to standpipe location at each zone.
- E. Drains, Test Pipes and Accessories:
  - 1. Provide a drain at base of risers, drain connection on valved sections, and drains at other locations for complete drainage of the system. Provide valve in drain lines and connect to the central drain riser. Discharge riser outside over splash block, indirectly over standpipe drain connected to storm sewer, or as indicated. The main drain shall be capable of full discharge test without allowing water to flow onto the floor.
  - 2. Provide test pipes in accordance with NFPA 13. Test pipes shall be valved and piped to discharge through proper orifice as specified above for drains.
- F. Provide a 100 psi pressure gage at each flow alarm switch location, at the top of each sprinkler or standpipe riser, at each main drain connection, and on the suction and discharge of the fire pump.
- G. Conceal all piping, except in pipe basements, stairwells and rooms without ceilings.
- H. Install new piping and sprinklers aligned with natural building and other sprinklers lines.
- I. Locate piping in stairways as near ceiling as possible to prevent tampering by unauthorized personnel. Provide a minimum headroom of 7 ft.-6 in. for all piping.
- J. Piping arrangement shall avoid contact with other piping and equipment and allow clear access to other equipment or devices requiring access or maintenance.
- K. Cutout disks, which are created by cutting holes in the walls of pipe for flow switches and non-threaded pipe connections, shall be affixed near to the pipe where the originated. They shall be displayed until final inspection and then removed.
- L. For each new or existing fire department connection, locate the symbolic sign given in NFPA 170 a distance of 8 to 10 ft. above each connection location. The sign shall be 18 x 18 in. with symbol at least 350 x 350 mm (14 x 14 in.).

- M. Firestopping for all holes through stairways, smoke barrier walls, and fire walls shall be sealed on a daily basis.
- N. Provide hydraulic design information signage as required by NFPA 13 and 14.
- O. Install access doors in ceilings of rooms where above ceiling access is required.

### 3.2 TEST

- A. Automatic Sprinkler System: NFPA 13 and 25.
- B. Standpipe and Hose System: NFPA 25.

### 3.3 INSTRUCTIONS

- A. Furnish the services of a competent instructor for not less than two four-hour periods for instructing personnel in the operation and maintenance of the fire pump and sprinkler system, on the dates requested by the Owner.

### 3.4 PIPE AND FITTING APPLICATION

- A. Use steel pipe with threaded, press-seal, roll-grooved, or cut-grooved joints; copper tube with wrought-copper fittings and brazed joints; or CPVC plastic pipe and fittings and metal-to-plastic transition fittings with solvent-cemented joints.
  - 1. For steel pipe joined by threaded fittings, use Schedule 40.
  - 2. For steel pipe joined by welding or roll-grooved pipe and fittings, use Schedule 10.
  - 3. For steel pipe NPS 2 (DN 50) and smaller, joined by press-seal fittings, use Schedule 5 pipe, fabricated with manufacturer's press-seal tools.
- B. Pipe between Fire Department Connections and Check Valves: Use galvanized-steel pipe with flanged or threaded joints.
- C. Install shutoff valve, [check valve,] [backflow preventer,] pressure gage, drain, and other accessories indicated at connection to water service piping.

### 3.5 PIPING INSTALLATION

- A. Install "Inspector's Test Connections" in sprinkler piping, complete with shutoff valve.
- B. Install sprinkler zone control valves, test assemblies, and drain headers adjacent to standpipes.
- C. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.
- D. Install alarm devices in piping systems and connect to fire-alarm system.
- E. Protect piping from earthquake damage as required by NFPA 13.

- F. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Install gages to permit removal, and install where they will not be subject to freezing.
- G. Install fire-protection service valves supervised-open, located to control sources of water supply except from fire department connections. Where there is more than one control valve, provide permanently marked identification signs indicating portion of system controlled by each valve.
- H. Install check valve in each water supply connection. Install backflow preventers in potable-water supply sources.
- I. Install alarm check valves for proper direction of flow, including bypass check valve and retard chamber drain line connection.

### 3.6 SPRINKLER APPLICATIONS

- A. Rooms without Ceilings: Upright sprinklers.
- B. Rooms with Suspended Ceilings: [Pendent sprinklers] [Recessed sprinklers] [Flush sprinklers] [Concealed sprinklers].
- C. Wall Mounting: Sidewall sprinklers.
- D. Sprinklers Subject to Freezing: Upright, pendent, or sidewall, dry sprinklers as indicated.
- E. Special Applications: Extended coverage or quick-response sprinklers as indicated.
- F. Sprinkler Finishes: Chrome plated in finished spaces, rough bronze in unfinished spaces, and dull chrome in residential spaces. Provide escutcheons in finished and residential spaces.
- G. Install sprinklers in suspended ceilings in center of long dimension of ceiling panels.

### 3.7 TESTING

- A. Flush, test, and inspect sprinkler piping systems according to NFPA 13.

END OF SECTION 211000

## SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

### PART 1 GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Applicable provisions of this Section apply to all sections of Division 22, Plumbing.

#### 1.2 CONTRACT DOCUMENTS

- A. Examine all drawings and specifications carefully before submitting a bid. Architectural drawings take precedence over mechanical or electrical drawings with reference to building construction. If discrepancies or conflicts occur between drawings, or between drawings and specifications, notify the Engineer in writing prior to bid date; however, the most stringent requirement shall govern.
- B. For purposes of clearness and legibility, drawings are essentially diagrammatic and, although size and location of equipment are drawn to scale wherever possible, Contractor shall make use of all data in all of the contract documents and shall verify this information at the building site.
- C. The drawings indicate required size and points of termination of pipes, conduits and ducts and suggest proper routes to conform to structure avoid obstructions and preserve clearances. However, it is not intended that drawings indicate all necessary offsets, and it shall be the responsibility of the Contractor to make the installation in such a manner as to conform to structure, avoid obstructions, preserve headroom and keep openings and passageways clear, without further instructions or cost to the Owner.
- D. Furnish, install and/or connect with appropriate services all items shown on any drawing without additional compensation.
- E. Consider the terms "provide" and "install" as synonymous with "furnish and install".

#### 1.3 CODE REQUIREMENTS

- A. Perform work in accordance with the following codes and any applicable statutes, ordinances, codes, and regulations of governmental authorities having jurisdiction.
  - 1. ASHRAE:
    - a. Standard 90.1 – Energy Standard for Buildings Except Low Rise Residential Buildings
  - 2. Occupational Safety and Health Regulations (OSHA)
  - 3. National Fire Protection Association (NFPA):
    - a. NFPA 1 – Uniform Fire Code
    - b. NFPA 54 – National Fuel Gas Code

- c. NFPA 70 – National Electrical Code
  - d. NFPA 101 – Life Safety Code
  - 4. Florida Building Code 2010 Edition:
    - a. Accessibility Code
    - b. Energy Conservation Code
    - c. Fuel Gas Code
    - d. Mechanical Code
    - e. Plumbing Code
  - 5. Florida Administrative Code
    - a. Chapter 61G15-34 Responsibility Rules of Professional Engineers Concerning the Design of Mechanical Systems
    - b. Chapter 69A-3 Fire Prevention – General Provisions
    - c. Chapter 69A-47 Uniform Fire Safety Standards for Elevators
    - d. Chapter 69A-53 Uniform Fire Safety Standards for Hospitals and Nursing Homes
    - e. Chapter 69A-60 The Florida Fire Prevention Code
  - 6. ADA Accessibility Guidelines for Buildings (ADAAG)
- B. Resolve, in writing, any code violation discovered in contract documents with the Engineer prior to bidding. After award of the contract, make any correction or addition necessary for compliance with applicable codes at no additional cost to Owner.
- C. The installer shall include in the work, without extra cost to the Owner, any labor, materials, services, apparatus and drawings required to comply with all applicable laws, ordinances, rules and regulations.

#### 1.4 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date bids are received. Specifications and standards are minimum requirements for all equipment, material and work. In instances where capacities, size or other feature of equipment, devices or materials exceed these minimums, meet listed or shown capacities.
- B. Whenever a reference is made to a standard, installation and materials shall comply with the latest published edition of the standard at the time project is bid unless otherwise specified herein.

#### 1.5 QUALITY ASSURANCE

- A. The intent of the Division 22 specifications and the accompanying drawings is to provide a complete, operable, and satisfactory plumbing system as shown, specified, and required by

applicable codes. Include all work specified in Division 22 and shown on the accompanying drawings.

- B. The drawings that accompany the Division 22 specifications are diagrammatic. They do not show every offset, bend, tee, or elbow which may be required to install work in the space provided and avoid conflicts. Follow the drawings as closely as is practical to do so and install additional bends, offsets and elbows where required by local conditions from measurements taken at the building, subject to approval, and without additional cost to the contract.
- C. Coordinate exact requirements governed by actual job conditions. Check all information and report any discrepancies before fabricating work. Report changes in time to avoid unnecessary work.
- D. Systems shall be built and installed to deliver their full rated capacity at the efficiency for which they were designed.
- E. The entire plumbing system shall operate at full capacity without objectionable noise or vibration.
- F. Materials and Equipment:
  - 1. Furnish new and unused materials and equipment. Work shall be of good quality, free of faults and defects.
  - 2. All equipment shall fit in the space provided.
  - 3. Each piece of equipment provided shall meet all detailed requirements of the drawings and specifications and shall be suitable for the installation shown.
  - 4. Where two or more units of the same class of equipment are provided, use products of the same manufacturer; component parts of the entire system need not be products of the same manufacturer.
  - 5. Manufacturer's model names and numbers used in these drawings and specifications are subject to change per manufacturer's action. Contractor shall therefore verify model names and numbers with manufacturer's representative before ordering any product or equipment.
- G. Workmanship:
  - 1. Install all materials in a neat and workmanlike manner.
  - 2. Follow manufacturer's directions. If they are in conflict with the contract documents, obtain clarification before starting work.
- H. Cutting and Patching:
  - 1. Cutting, patching and repairing for the proper installation and completion of the work specified in this division, including plastering, masonry work, concrete work, carpentry work, firestopping, and painting, shall be performed by skilled craftsmen of each respective trade in conformance with the appropriate division of work. Additional openings required in building construction shall be made by drilling or cutting.

2. Fill holes which are cut oversize so that a tight fit is obtained around the objects passing through.
3. Do not pierce beams or columns without permission of the Owner and then only as directed.
4. New or existing work that is cut or damaged shall be restored to its original condition. Where alterations disturb existing finishes, the surfaces shall be repaired, refinished and left in condition existing prior to commencement of work.

#### 1.6 SUBMITTALS

- A. Submittals: Product Data. Submit in accordance with project contract documents.
- B. If not specified in the project contract documents, then submit either a minimum of five hard copies in 3-ring binders or electronic PDFs, as required by the Engineer.
- C. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Engineer to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.
- D. Submit Product Data for review on all scheduled pieces of equipment, equipment requiring electrical connections or connections by other trades, and as required by the contract documents. Include manufacturer's detailed shop drawings, specifications, and data sheets. Data sheets shall include capacities, RPM, BHP, pressure drop, design and operating pressures, temperatures and similar data. Manufacturer's abbreviations or codes are not acceptable.

#### 1.7 PERMITS, FEES, AND INSPECTIONS

- A. Obtain and pay for all permits, fees, tap fees, connection charges, demand charges, systems charges, impact fees and inspections.
- B. Deliver all certificates of inspection issued by authorities having jurisdiction to the Engineer.

#### 1.8 WARRANTY

- A. Warranty work and equipment for one year from the date of final acceptance of the project. During the warranty period provide labor and materials to make good any faults or imperfections that may arise due to defects or omissions in materials or workmanship.

### PART 2 PRODUCTS

#### 2.1 SLEEVES

- A. Mechanical Sleeve Seals: Modular rubber sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

- C. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- D. PVC Pipe: ASTM D 1785, Schedule 40.

## 2.2 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

## 2.3 MOTORS

- A. Motor Characteristics:
  - 1. Frequency Rating: 60 Hz.
  - 2. Voltage Rating: NEMA standard voltage for circuit voltage to which motor is connected.
  - 3. Service Factor: 1.15.
  - 4. Duty: Continuous duty at ambient temperature of 105 deg F (40 deg C) and at altitude of 3300 feet (1005 m) above sea level.
  - 5. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
  - 6. Enclosure: Unless otherwise indicated, open dripproof.
  - 7. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

## 2.4 HANGERS AND SUPPORTS

- A. Hanger and Pipe Attachments: Factory fabricated with galvanized coatings; nonmetallic coated for hangers in direct contact with copper tubing.
- B. Powder-Actuated Fasteners: Threaded-steel stud, with pull-out and shear capacities appropriate for supported loads and building materials where used.
- C. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, with pull-out and shear capacities appropriate for supported loads and building materials where used.

## 2.5 VIBRATION ISOLATION CONTROL DEVICES

- A. Vibration Supports:
  - 1. Elastomeric Isolation Pads: Arranged in single or multiple layers of oil- and water-resistant, of sufficient stiffness for uniform loading over pad area, molded with a non-slip pattern and galvanized-steel baseplates, and factory cut to sizes that match supported equipment.



- a. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc., Super W; or comparable product by one of the following:
    1. Kinetics Noise Control, Inc.
    2. Vibration Mountings & Controls, Inc.
  2. Elastomeric Isolation Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements with factory-drilled, encapsulated top plate and baseplate. Provide isolator with minimum 0.5-inch (13-mm) static deflection.
    - a. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc., Type ND; or comparable product by one of the following:
      1. Kinetics Noise Control, Inc.
      2. Vibration Mountings & Controls, Inc.
  3. Open-Spring Isolators: Freestanding, laterally stable, open-spring isolators. Provide isolator with minimum 1-inch (25-mm) static deflection.
    - a. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc., Type SLFH; or comparable product by one of the following:
      1. Kinetics Noise Control, Inc.
      2. Vibration Mountings & Controls, Inc.
  4. Housed-Spring Isolators: Freestanding, laterally stable, open-spring isolators in two-part telescoping housing. Provide isolator with minimum 1-inch (25-mm) static deflection.
    - a. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc., Type C; or comparable product by one of the following:
      1. Kinetics Noise Control, Inc.
      2. Vibration Mountings & Controls, Inc.
- B. Vibration Hangers:
1. Elastomeric Hangers: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements bonded to steel housings with threaded connections for hanger rods. Provide isolator with minimum 0.5-inch (13-mm) static deflection.
    - a. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc., HD; or comparable product by one of the following:
      1. Kinetics Noise Control, Inc.
      2. Vibration Mountings & Controls, Inc.
  2. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression. Provide isolator with minimum 1-inch (25-mm) static deflection.
    - a. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc., HS-B; or comparable product by one of the following:
      1. Kinetics Noise Control, Inc.

2. Vibration Mountings & Controls, Inc.

2.6 PRESSURE GAGES AND TEST PLUGS

- A. Pressure Gages: Direct-mounting, indicating-dial type complying with ASME B40.100. Dry metal case, minimum 2-1/2-inch (63-mm) diameter with red pointer on white face, and plastic window. Minimum accuracy 3 percent of middle half of range. Range two times operating pressure.
- B. Test Plug: Corrosion-resistant brass or stainless-steel body with two self-sealing rubber core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping. Minimum pressure and temperature rating 500 psig at 200 deg F (3450 kPa at 93 deg C).

PART 3 EXECUTION

3.1 INSTALLATIONS

- A. Install materials and equipment in a professional manner. The Engineer may direct replacement of items which, in his opinion, do not present a professional appearance. Replace or reinstall items at the expense of the Contractor.
- B. Obstructions
  - 1. The drawings indicate certain information pertaining to surface and subsurface obstructions which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
  - 2. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided. Verify locations given.
  - 3. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.
  - 4. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.
- C. Where "rated" walls, floor, roofs and ceilings are penetrated or cut to install equipment, materials, devices, etc. the Contractor shall provide and install all materials required to re-establish the rating of the wall, floor, roof or ceiling to the satisfaction of the authority having jurisdiction.
- D. Space Requirements: Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material which is not suitable in this respect.

- E. Select equipment to operate with minimum noise and vibration. If objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, rectify such conditions without cost to the Owner.
- F. Wiring Method: Install cables in raceways and cable trays except low voltage network cable above accessible ceilings. Conceal raceway and cables except in unfinished spaces.
  - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
  - 2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceways and Boxes for Electrical Systems."
- G. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

### 3.2 MOTOR INSTALLATION

- A. Anchor motor assembly to base, adjustable rails, or other support, arranged and sized according to manufacturer's written instructions.

### 3.3 GENERAL PIPING INSTALLATIONS

- A. Install piping free of sags and bends.
- B. Install fittings for changes in direction and branch connections.
- C. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- D. Exterior Wall, Pipe Penetrations: Mechanical sleeve seals installed in steel or cast-iron pipes for wall sleeves.
- E. Comply with requirements in Division 07 Section "Penetration Firestopping" for sealing pipe penetrations in fire-rated construction.
- F. Install unions at final connection to each piece of equipment.
- G. Install dielectric unions and flanges to connect piping materials of dissimilar metals in gas piping.
- H. Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals in water piping.

### 3.4 GENERAL EQUIPMENT INSTALLATIONS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components, unless otherwise indicated.

- C. 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.
- D. Install equipment to allow right of way for piping installed at required slope.

### 3.5 BASES, SUPPORTS, AND ANCHORAGES

- A. Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
  - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
  - 2. Install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base to connect concrete base to concrete floor.
  - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
  - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 5. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete"
- B. Mix and install grout for fire-suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors. Place grout, completely filling equipment bases.

### 3.6 HANGERS AND SUPPORTS

- A. Comply with MSS SP-69 and MSS SP-89. Install building attachments within concrete or to structural steel.
- B. Install hangers and supports to allow controlled thermal and seismic movement of piping systems.
- C. Install powder-actuated fasteners and mechanical-expansion anchors in concrete after concrete is cured. Do not use in lightweight concrete or in slabs less than 4 inches (100 mm) thick.
- D. Load Distribution: Install hangers and supports so piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- E. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
  - 1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30 (DN 15 to DN 750).
  - 2. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.

3. Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).
  4. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).
  5. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2 (DN 15 to DN 50).
- F. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500).
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500), if longer ends are required for riser clamps.

### 3.7 VIBRATION ISOLATION CONTROL DEVICE INSTALLATION

- A. Adjust vibration isolators to allow free movement of equipment limited by restraints.
- B. Install resilient bolt isolation washers and bushings on equipment anchor bolts.
- C. Install cables so they do not bend across sharp edges of adjacent equipment or building structure.

### 3.8 FIELD QUALITY CONTROL

- A. Tests:
  1. Include all tests specified and/or required under laws, rules and regulations of all departments having jurisdiction. Tests shall also be performed as indicated herein and other sections of the specifications.
  2. After all mechanical systems have been completed and put into operation, subject each system to an operating test under design conditions to insure proper sequence and operation throughout the range of operation. Make adjustments as required to insure proper functioning of all systems.
  3. All parts of the work and associated equipment shall be tested and adjusted to work properly and be left in perfect operating condition.
  4. Correct defects disclosed by these tests without any additional cost to the Owner. Repeat tests on repaired or replaced work.
  5. Maintain a log of all tests being conducted and have it available for review by the Engineer. Log to indicate date, type of tests, duration, and defects noted and when corrected.
  6. Special tests on individual systems are specified under individual sections.
  7. Mechanical Contractor shall provide personnel, tools and equipment and assist the Test and Balance Contractor in making any adjustments necessary to meet the test and balance requirements.

END OF SECTION 220500

## SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Bronze angle valves.
  - 2. Bronze ball valves.
  - 3. Iron, single-flange butterfly valves.
  - 4. Bronze swing check valves.
  - 5. Iron swing check valves.
  - 6. Iron, grooved-end swing check valves.
  - 7. Iron, center-guided check valves.
  - 8. Iron gate valves.
  - 9. Bronze globe valves.
  - 10. Iron globe valves.

#### 1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated.

## 1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
  - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 2. ASME B31.1 for power piping valves.
  - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads, flange faces, grooves, and weld ends.
  - 3. Set angle, gate, and globe valves closed to prevent rattling.
  - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
  - 5. Set butterfly valves closed or slightly open.
  - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
  - 1. Maintain valve end protection.
  - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
  - 1. Gear Actuator: For quarter-turn valves NPS 8 (DN 200) and larger.
  - 2. Handwheel: For valves other than quarter-turn types.



3. Handlever: For quarter-turn valves NPS 6 (DN 150) and smaller.

E. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

## 2.2 BRONZE ANGLE VALVES

A. Class 150, Bronze Angle Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Hammond Valve.
  - b. Milwaukee Valve Company.
  - c. NIBCO INC.
  - d. Or equal.
2. Description:
  - a. Standard: MSS SP-80, Type 2.
  - b. CWP Rating: 300 psig (2070 kPa).
  - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
  - d. Ends: Threaded.
  - e. Stem: Bronze.
  - f. Disc: PTFE or TFE.
  - g. Packing: Asbestos free.
  - h. Handwheel: Malleable iron.

## 2.3 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Conbraco Industries, Inc.; Apollo Valves.
- b. Milwaukee Valve Company.
- c. NIBCO INC.
- d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- e. Or equal.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.

2.4 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Milwaukee Valve Company.
  - b. NIBCO INC.
  - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - d. Or equal.
2. Description:
  - a. Standard: MSS SP-67, Type I.
  - b. CWP Rating: 200 psig (1380 kPa).
  - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
  - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
  - e. Seat: EPDM.
  - f. Stem: One- or two-piece stainless steel.
  - g. Disc: Aluminum bronze.

2.5 IRON, GROOVED-END BUTTERFLY VALVES

A. 175 CWP, Iron, Grooved-End Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Shurjoint Piping Products.

- b. Tyco Fire Products LP; Grinnell Mechanical Products.
- c. Victaulic Company.
- d. Or equal.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 175 psig (1200 kPa).
- c. Body Material: Coated, ductile iron.
- d. Stem: Two-piece stainless steel.
- e. Disc: Coated, ductile iron.
- f. Seal: EPDM.

B. 300 CWP, Iron, Grooved-End Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Mueller Steam Specialty; a division of SPX Corporation.
- b. NIBCO INC.
- c. Shurjoint Piping Products.
- d. Tyco Fire Products LP; Grinnell Mechanical Products.
- e. Victaulic Company.
- f. Or equal.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. NPS 8 (DN 200) and Smaller CWP Rating: 300 psig (2070 kPa).
- c. NPS 10 (DN 250) and Larger CWP Rating: 200 psig (1380 kPa).
- d. Body Material: Coated, ductile iron.
- e. Stem: Two-piece stainless steel.
- f. Disc: Coated, ductile iron.
- g. Seal: EPDM.

## 2.6 BRONZE SWING CHECK VALVES

A. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Milwaukee Valve Company.
- b. NIBCO INC.
- c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- d. Or equal.

2. Description:

- a. Standard: MSS SP-80, Type 4.

- b. CWP Rating: 300 psig (2070 kPa).
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: PTFE or TFE.

## 2.7 IRON SWING CHECK VALVES

### A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Milwaukee Valve Company.
  - b. NIBCO INC.
  - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - d. Or equal.
2. Description:
  - a. Standard: MSS SP-71, Type I.
  - b. CWP Rating: 200 psig (1380 kPa).
  - c. Body Design: Clear or full waterway.
  - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - e. Ends: Flanged.
  - f. Trim: Bronze.
  - g. Gasket: Asbestos free.

## 2.8 IRON, GROOVED-END SWING CHECK VALVES

### A. 300 CWP, Iron, Grooved-End Swing Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Shurjoint Piping Products.
  - b. Tyco Fire Products LP; Grinnell Mechanical Products.
  - c. Victaulic Company.
  - d. Or equal.
2. Description:
  - a. CWP Rating: 300 psig (2070 kPa).
  - b. Body Material: ASTM A 536, ductile iron.
  - c. Seal: EPDM.
  - d. Disc: Spring-operated, ductile iron or stainless steel.

## 2.9 IRON, CENTER-GUIDED CHECK VALVES

### A. Class 125, Iron, Globe, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Milwaukee Valve Company.
  - b. Mueller Steam Specialty; a division of SPX Corporation.
  - c. NIBCO INC.
  - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - e. Or equal.
2. Description:
  - a. Standard: MSS SP-125.
  - b. CWP Rating: 200 psig (1380 kPa).
  - c. Body Material: ASTM A 126, gray iron.
  - d. Style: Globe, spring loaded.
  - e. Ends: Flanged.
  - f. Seat: Bronze.

## 2.10 IRON GATE VALVES

### A. Class 125, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Milwaukee Valve Company.
  - b. NIBCO INC.
  - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - d. Or equal.
2. Description:
  - a. Standard: MSS SP-70, Type I.
  - b. CWP Rating: 200 psig (1380 kPa).
  - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - d. Ends: Flanged.
  - e. Trim: Bronze.
  - f. Disc: Solid wedge.
  - g. Packing and Gasket: Asbestos free.

## 2.11 BRONZE GLOBE VALVES

### A. Class 150, Bronze Globe Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Milwaukee Valve Company.
  - b. NIBCO INC.
  - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - d. Or equal.
  
2. Description:
  - a. Standard: MSS SP-80, Type 2.
  - b. CWP Rating: 300 psig (2070 kPa).
  - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
  - d. Ends: Threaded.
  - e. Stem: Bronze.
  - f. Disc: PTFE or TFE.
  - g. Packing: Asbestos free.
  - h. Handwheel: Malleable iron.

## 2.12 IRON GLOBE VALVES

### A. Class 125, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Milwaukee Valve Company.
  - b. NIBCO INC.
  - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - d. Or equal.
  
2. Description:
  - a. Standard: MSS SP-85, Type I.
  - b. CWP Rating: 200 psig (1380 kPa).
  - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - d. Ends: Flanged.
  - e. Trim: Bronze.
  - f. Packing and Gasket: Asbestos free.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine valve interior for cleanliness free of foreign matter and for signs of corrosion.
- B. Remove special packing material to allow proper functioning of valve.

- C. Operate valves in fully-open and fully-dead position and examine guides and seats.
- D. Examine valve threads and mating piping for form and cleanliness.
- E. Examine mating flange faces for condition that might cause leakage. Verify gasket is proper size, material, suitable for usage and free from defects.

### 3.2 INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install check valves for proper direction of flow and as follows:
  - 1. Swing Check Valves: In horizontal position with hinge pin level.
  - 2. Center-Guided Check Valves: In horizontal or vertical position, between flanges.

### 3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

### 3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
  - 1. Shutoff Service: Ball or butterfly valves.
  - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
  - 3. Throttling Service: Globe or angle valves.
  - 4. Pump-Discharge Check Valves:
    - a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with nonmetallic disc.
    - b. NPS 2-1/2 (DN 65) and Larger for Domestic Water: Center-guided, metal-seat check valves.
    - c. NPS 2-1/2 (DN 65) and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.
7. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.

### 3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

#### A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 150, nonmetallic disc.
3. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
4. Bronze Swing Check Valves: Class 150, nonmetallic disc.
5. Bronze Globe Valves: Class 150, nonmetallic disc.

#### B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, aluminum-bronze disc.
3. Iron, Grooved-End Butterfly Valves: 175 CWP.
4. Iron, Grooved-End Swing Check Valves: 300 CWP.
5. Iron, Center-Guided Check Valves: Class 125, globe, metal seat.
6. Iron Globe Valves: Class 125.

### 3.6 SANITARY-WASTE AND STORM-DRAINAGE VALVE SCHEDULE

#### A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 150, nonmetallic disc.
3. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
4. Bronze Swing Check Valves: Class 150, nonmetallic disc.
5. Bronze Globe Valves: Class 150, nonmetallic disc.

#### B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
2. Iron Swing Check Valves with Closure Control: Class 125, lever and weight.
3. Iron Gate Valves: Class 125, OS&Y.



### 3.7 COMPRESS AIR VALVE SCHEDULE

- A. Pipe NPS 2 (DN50) and smaller:
  - 1. Bronze and brass valves: May be provided with solder-joint ends instead of threaded ends.
  - 2. Ball valve: Two-piece regular port, brass or bronze.
  - 3. Bronze swing check valves: Class 150, bronze disc.
  
- B. Pipe NPS 2 ½ (DN65) and larger:
  - 1. Iron valves may be provided with threaded or flanged ends.
  - 2. Iron swing check valves: Class 250 metal seats.
  - 3. Iron gate valves. Class 250 NPS.

END OF SECTION 220523

## SECTION 22 07 00 – PLUMBING INSULATION

### PART 1 - GENERAL

#### 1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data.
- B. Quality Assurance: Labeled with maximum flame-spread index of 25 and maximum smoke-developed index of 50 according to ASTM E 84.

### PART 2 - PRODUCTS

#### 2.1 INSULATION MATERIALS

- A. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- B. 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. The most common jacket for equipment applications is ASJ.
- C. Mineral-Fiber, Preformed Pipe Insulation: Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ.
- D. Mineral-Fiber, Pipe and Tank Insulation: Complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB; and having factory-applied FSK jacket. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less.
- E. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
- F. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- G. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
- H. Factory-Applied Jackets: When factory-applied jackets are indicated, comply with the following:
  - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  - 2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
- I. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

- J. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

## PART 3 - EXECUTION

### 3.1 PIPE INSULATION INSTALLATION

- A. Comply with requirements of the Midwest Insulation Contractors Association's "National Commercial & Industrial Insulation Standards" for insulation installation on pipes and equipment.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall, Partition, and Floor Penetrations: Install insulation continuously through penetrations. Seal penetrations. Comply with requirements in Division 07 Section "Penetration Firestopping."
- D. Flexible Elastomeric Insulation Installation:
  - 1. Seal longitudinal seams and end joints with adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
  - 2. Insulation Installation on Pipe Fittings and Elbows: Install mitered sections of pipe insulation. Secure insulation materials and seal seams with adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- E. Mineral-Fiber Insulation Installation:
  - 1. Insulation Installation on Straight Pipes and Tubes: Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  - 2. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
  - 3. For insulation with factory-applied jackets on below ambient surfaces, 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.
- F. Interior Piping System Applications: Insulate the following piping systems:
  - 1. Domestic hot water.
  - 2. Recirculated domestic hot water.
  - 3. Roof drain bodies and horizontal rainwater leaders of storm water piping.
  - 4. Exposed water supplies and sanitary drains of fixtures for people with disabilities.

- G. Do not apply insulation to the following systems, materials, and equipment:
1. Flexible connectors.
  2. Sanitary drainage and vent piping.
  3. Drainage piping located in crawlspaces unless otherwise indicated.
  4. Chrome-plated pipes and fittings, except for plumbing fixtures for people with disabilities.
  5. Piping specialties, including air chambers, unions, strainers, check valves, plug valves, and flow regulators.

### 3.2 EQUIPMENT INSULATION SCHEDULE

- A. Domestic hot-water storage tank insulation shall be the following:

1. Mineral-Fiber Pipe and Tank: 1 inch thick.

### 3.3 INDOOR PIPING INSULATION SCHEDULE

- A. Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawlspaces.
2. Underground piping.

- B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
2. NPS 1-1/2 and Larger: Insulation shall be one of the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

- C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be the following:
  - a. Manufactured Protective Shielding Pipe Covers.

END OF SECTION 220700

## SECTION 22 11 16 - DOMESTIC WATER PIPING

### PART 1 - GENERAL

#### 1.1 SECTION REQUIREMENTS

- A. Comply with NSF 14 for plastic, potable domestic water piping and components.
- B. Comply with NSF 61 for potable domestic water piping and components.

### PART 2 - PRODUCTS

#### 2.1 PIPE AND FITTINGS

- A. Hard Copper Tubing: ASTM B 88, Types L and M (ASTM B 88M, Types B and C), water tube, drawn temper with wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  - 1. Copper Unions: Cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
  - 2. Joining Materials: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder.
- B. Soft Copper Tubing: ASTM B 88, Types K and L (ASTM B 88M, Types A and B), water tube, annealed temper with copper pressure fittings, cast-copper-alloy or wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  - 1. Joining Materials: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder.
- C. PVC Pipe: ASTM D 1785, Schedule 40.
  - 1. PVC Fittings: ASTM D 2466, Schedule 40, socket type.
- D. Special-Duty Valves:
  - 1. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
  - 2. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.
- E. Transition Fittings: Manufactured piping coupling or specified piping system fitting. Same size as pipes to be joined and pressure rating at least equal to pipes to be joined.
- F. Flexible Connectors: Stainless-steel, corrugated-metal tubing with wire-braid covering. Working-pressure rating a minimum of 200 psig (1380 kPa).

## 2.2 PIPING JOINING MATERIALS

- A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

## 2.3 SPECIALTY VALVES

- A. Comply with requirements in Division 22 Section “General-Duty Valves for Plumbing Piping” for general-duty metal valves.
- B. Comply with requirements in Division 22 Section “Domestic Water Piping Specialties” for balancing valves, drain valves, backflow preventers, and vacuum breakers.

## 2.4 TRANSITION FITTINGS

- A. General Requirements:
  - 1. Same size as pipes to be joined.
  - 2. Pressure rating at least equal to pipes to be joined.
  - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Plastic-to-Metal Transition Fittings:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Charlotte Pipe and Foundry Company.
    - b. Harvel Plastics, Inc.
    - c. Spears Manufacturing Company.
  - 2. Description: CPVC or PVC one-piece fitting with manufacturer’s Schedule 80 equivalent dimensions; one end with threaded brass insert and one solvent-cement-socket or threaded end.
- D. Plastic-to-Metal Transition Unions:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Colonial Engineering, Inc.
    - b. NIBCO INC.
    - c. Spears Manufacturing Company.
  - 2. Description: CPVC or PVC four-part union. Include brass or stainless-steel threaded end, solvent-cement-joint or threaded plastic end, rubber O-ring, and union nut.

## 2.5 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
  
- B. Dielectric Unions:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Capitol Manufacturing Company.
    - b. Central Plastics Company.
    - c. EPCO Sales, Inc.
    - d. Hart Industries International, Inc.
    - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    - f. Zurn Plumbing Products Group; Wilkins Water Control Products.
  - 2. Description:
    - a. Pressure Rating: 150 psig at 180 degrees F.
    - b. End Connections: Solder-joint copper alloy and threaded ferrous.
  
- C. Dielectric Flanges:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Capitol Manufacturing Company.
    - b. Central Plastics Company.
    - c. EPCO Sales, Inc.
    - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - 2. Description:
    - a. Factory-fabricated, bolted, companion-flange assembly.
    - b. Pressure Rating: 150 psig.
    - c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
  
- D. Dielectric-Flange Kits:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Central Plastics Company.
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Description:
    - a. Nonconducting materials for field assembly of companion flanges.
    - b. Pressure Rating: 150 psig.
    - c. Gasket: Neoprene or phenolic.
    - d. Bolt Sleeves: Phenolic or polyethylene.
    - e. Washers: Phenolic with steel backing washers.
  
- E. Dielectric Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Calpico, Inc.
  - b. Lochinvar Corporation.
2. Description:
  - a. Galvanized-steel coupling.
  - b. Pressure Rating: 300 psig at 225 degrees F.
  - c. End Connections: Female threaded.
  - d. Lining: Inert and noncorrosive, thermoplastic.

F. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Perfection Corporation; a subsidiary of American Meter Company.
  - b. Precision Plumbing Products, Inc.
  - c. Victaulic Company.
2. Description:
  - a. Electroplated steel nipple complying with ASTM F 1545.
  - b. Pressure Rating: 300 psig at 225 degrees F.
  - c. End Connections: Male threaded or grooved.
  - d. Lining: Inert and noncorrosive, propylene.

## 2.6 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One Piece, Cast Brass: Polished, chrome-plated finish with set screws.
- C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. One Piece, Stamped Steel: Chrome-plated finish with set screw.
- E. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and set screw.
- F. Split Plate, Stamped Steel: Chrome-plated finish with concealed hinge, set screw.
- G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- H. Split-Casting Floor Plates: Cast brass with concealed hinge.

## 2.7 SLEEVES

- A. Galvanized-Steel-Sheet Sleeves: 0.0239 inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.



- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Drawings plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Comply with requirements in Division 22 Section "Common Work Results for Plumbing" for basic piping installation requirements.
- C. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Comply with requirements in Division 22 Section "Common Work Results for Plumbing" for wall penetration systems.
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Common Work Results for Plumbing" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- E. Install shut off valve immediately upstream of dielectric fittings.
- F. Install domestic water piping without pitch for horizontal piping and plumb for vertical piping.
- G. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- H. Comply with requirements in Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.
  - 1. Soldered Joints: Comply with procedures in ASTM B 828 unless otherwise indicated.
- I. Comply with requirements in Division 22 Section "Common Work Results for Plumbing" for pipe hanger and support devices.
- J. Support vertical piping at each floor.
- K. Install flexible connectors in suction and discharge piping connections to each domestic water pump.
- L. Install piping parallel or at 90 degree angles from building walls.
- M. Install piping above ceilings to allow space for ceiling panel removal and coordinate with other services in space.
- N. Install piping to allow service and maintenance.

- O. Install pipe fittings at pressure rating higher than system
- P. Install fittings for each change of direction.
- Q. Install unions at final connection to each piece of equipment it is serving.

### 3.2 INSPECTING AND CLEANING

- A. Inspect and test piping systems as follows:
  - 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
  - 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
- B. Clean and disinfect potable domestic water piping by filling system with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.

### 3.3 PIPING SCHEDULE

- A. Underground, Service Entrance Piping: Soft copper tubing.
- B. Aboveground Distribution Piping: Type L hard copper tubing.

### 3.4 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  - 1. Shutoff Duty: Use bronze ball or gate valves for piping NPS 2 (DN 50) and smaller. Use cast-iron butterfly or gate valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
  - 2. Throttling Duty: Use bronze ball or globe valves for piping NPS 2 (DN 50) and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
  - 3. Hot-Water-Piping, Balancing Duty: [**Calibrated**] [**Memory-stop**] balancing valves.
  - 4. Drain Duty: Hose-end drain valves.
- B. Install gate valves close to main on each branch and riser serving two or more plumbing fixtures or equipment connections and where indicated.
- C. Install gate or ball valves on inlet to each plumbing equipment item, on each supply to each plumbing fixture not having stops on supplies, and elsewhere as indicated.
- D. Install drain valve at base of each riser, at low points of horizontal runs, and where required to drain water distribution piping system.

- E. Install swing check valve on discharge side of each pump and elsewhere as indicated.
- F. Install ball valves in each hot-water circulating loop and discharge side of each pump.

END OF SECTION 221116

## SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Temperature-actuated, water mixing valves.
  - 2. Strainers for domestic water piping.
  - 3. Hose bibbs.
  - 4. Wall hydrants.
  - 5. Water-hammer arresters.
  - 6. Air vents.
  - 7. Trap-seal primer device.
  - 8. Flexible connectors.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product.

#### 1.4 MINIMUM

- A. Minimum working pressure for domestic water piping specialties: 180 psig.

### PART 2 - PRODUCTS

#### 2.1 BALANCING VALVES

- A. Memory-Stop Balancing Valves:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Inc.; T1710 or comparable product by one of the following:
    - a. Conbraco Industries, Inc.
    - b. Milwaukee Valve Company.
  - 2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.

3. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
4. Size: NPS 2 (DN 50) or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass.
8. Seats and Seals: Replaceable.
9. End Connections: Threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

## 2.2 TEMPERATURE-ACTUATED, WATER MIXING VALVES

### A. Water-Temperature Limiting Devices:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Watts; LFMMV or comparable product by one of the following:
  - a. Leonard Valve Company.
  - b. Powers; a division of Watts Water Technologies, Inc. (LFLM490)
  - c. Symmons Industries, Inc.
  - d. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig (860 kPa).
4. Type: Thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: 120 deg F (49 deg C).
9. Tempered-Water Design Flow Rate: 0.5 gpm (0.032 L/s).
10. Valve Finish: Rough bronze.

### B. Individual-Fixture, Water Tempering Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Watts; LFMMV or comparable product by one of the following:
  - a. Lawler Manufacturing Company, Inc.
  - b. Leonard Valve Company.
  - c. Powers; a division of Watts Water Technologies, Inc. (LFLM495)
  - d. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1069 & 1070, thermostatically controlled, water tempering valve.
3. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.

8. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
9. Tempered-Water Setting: 105 deg F (41 deg C).
10. Minimum Tempered-Water Design Flow Rate: 0.5 gpm (0.03 L/s).

## 2.3 STRAINERS FOR DOMESTIC WATER PIPING

### A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 (DN 65) and larger.
3. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
  - a. Strainers NPS 2 (DN 50) and Smaller: 0.020 inch (0.51 mm) .
  - b. Strainers NPS 2-1/2 to NPS 4 (DN 65 to DN 100): 0.045 inch (1.14 mm) .
  - c. Strainers NPS 5 (DN 125) and Larger: 0.10 inch (2.54 mm) .
6. Drain: Factory-installed, hose-end drain valve.

## 2.4 HOSE BIBBS

### A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig (860 kPa).
7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Rough bronze.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

## 2.5 WALL HYDRANTS

### A. Moderate-Climate Wall Hydrants:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Woodford; B65 or comparable product by one of the following:
  - a. Josam Company.
  - b. Zurn
  - c. MIFAB, Inc.
  - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - e. Watts Drainage Products.
2. Standard: ASME A112.21.3M for concealed -outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig (860 kPa).
4. Operation: Loose key.
5. Inlet: NPS 3/4 or NPS 1 (DN 20 or DN 25).
6. Outlet:
  - a. Concealed, with integral vacuum breaker or nonremovable hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
  - b. Garden-hose thread complying with ASME B1.20.7.
7. Box: Deep, flush mounted with cover.
8. Box and Cover Finish: Polished nickel bronze.
9. Operating Keys(s): One with each wall hydrant.

## 2.6 WATER-HAMMER ARRESTERS

### A. Water-Hammer Arresters:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn; 1250XL or comparable product by one of the following:
  - a. AMTROL, Inc.
  - b. Josam Company.
  - c. MIFAB, Inc.
  - d. Precision Plumbing Products, Inc.
  - e. Sioux Chief Manufacturing Company, Inc.
  - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - g. Watts Drainage Products.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston, lead-free.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

## 2.7 AIR VENTS

### A. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig (1035-kPa) minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 (DN 10) minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

## 2.8 TRAP-SEAL PRIMER DEVICE

### A. Supply-Type, Trap-Seal Primer Device:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Precision Plumbing Products; P1-500 or comparable product by one of the following:
  - a. MIFAB, Inc.
  - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - c. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig (860 kPa) minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.
8. Provide adjusting screw to adjust between high and low pressures.

## 2.9 FLEXIBLE CONNECTORS

### A. Basis-of-Design Product: Subject to compliance with requirements, provide Metraflex; BBS (Bronze) or SST/MLP (Steel) or comparable product by one of the following:

1. Flex-Hose Co., Inc.
2. Flexicraft Industries.

### B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig (1380 kPa).
2. End Connections NPS 2 (DN 50) and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged copper alloy.

### C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.



1. Working-Pressure Rating: Minimum 200 psig (1380 kPa).
2. End Connections NPS 2 (DN 50) and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.

## 2.10 VACUUM BREAKERS

### A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ames Co.
  - b. Conbraco Industries, Inc.
  - c. FEBCO; SPX Valves & Controls.
  - d. Rain Bird Corporation.
  - e. Toro Company (The); Irrigation Div.
  - f. Watts Industries, Inc.; Water Products Div.
  - g. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1001.
3. Size: NPS ½ to NPS 3 (DN 8 to DN 80), as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Chrome plated.

### B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Conbraco Industries, Inc.
  - b. MIFAB, Inc.
  - c. Watts Industries, Inc.; Water Products Div.
  - d. Woodford Manufacturing Company.
  - e. Zurn Plumbing Products Group; Light Commercial Operation.
  - f. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

### C. Pressure Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ames Co.
  - b. Conbraco Industries, Inc.
  - c. FEBCO; SPX Valves & Controls.
  - d. Toro Company (The); Irrigation Div.
  - e. Watts Industries, Inc.; Water Products Div.
  - f. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Accessories:

- a. Valves: Ball type, on inlet and outlet.

## 2.11 DRAIN VALUES

- A. Ball-Valve-Type, Hose-End Drain Valves:
  - 1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
  - 2. Pressure Rating: 400 psig minimum CWP.
  - 3. Size: NPS  $\frac{3}{4}$  (DN 20).
  - 4. Body: Copper alloy.
  - 5. Ball: Chrome plated brass.
  - 6. Seats and Seals: Replaceable.
  - 7. Handle: Vinyl-covered steel.
  - 8. Inlet: Threaded or solder joint.
  - 9. Outlet: Thraeded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.
  
- B. Gate-Valve-Type, Hose-End Drain Valves:
  - 1. Standard: MSS SP-80 for gate valves.
  - 2. Pressure Rating: Class 125.
  - 3. Size: NPS  $\frac{3}{4}$  (DN 20).
  - 4. Body: ASTM B 62 bronze.
  - 5. Inlet: NPS  $\frac{3}{4}$  (DN 20).
  - 6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.
  
- C. Stop-and-Waste Drain Valves:
  - 1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
  - 2. Pressure Rating: 200 psig minimum CWP or Class 125.
  - 3. Size: NPS  $\frac{3}{4}$  (DN 20).
  - 4. Body: Copper alloy or ASTM B 62 bronze.
  - 5. Drain: NPS  $\frac{1}{8}$  (DN 6) side outlet with cap.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
  
- B. Install water-control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.
  
- C. Install balancing valves in locations where they can easily be adjusted.
  
- D. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
  - 1. Install cabinet-type units recessed in or surface mounted on wall as specified.

- E. Install Y-pattern strainers for water on supply side of each control valve water pressure-reducing valve solenoid valve and pump.
- F. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch (38-by-89-mm) fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."
- G. Install water-hammer arresters in water piping according to PDI-WH 201.
- H. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.
- I. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

### 3.2 CONNECTIONS

- A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

### 3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  - 1. Primary, thermostatic, water mixing valves.
  - 2. Manifold, thermostatic, water mixing-valve assemblies.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Test each pressure vacuum breaker reduced-pressure-principle backflow preventer and double-check, backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Set field-adjustable flow set points of balancing valves.
- B. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 221119

## SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

### PART 1 - GENERAL

#### 1.1 SECTION REQUIREMENTS

- A. Minimum Pressure Requirement for Soil, Waste, and Vent: 10-foot head of water (30 kPa).
- B. Comply with NSF 14, "Plastic Piping Components and Related Materials," for plastic piping components.

### PART 2 - PRODUCTS

#### 2.1 PIPES AND FITTINGS

- A. Copper Drainage Tube and Fittings: ASTM B 306, Type DWV drawn temper with wrought copper, Type DWV drainage fittings.
- B. Hub-and-Spigot Cast-Iron Soil Pipe and Fittings: ASTM A 74, Service class; ASTM C 564 rubber gaskets.
- C. Hubless Cast-Iron Soil Pipe and Fittings: ASTM A 888 or CISPI 301, with ASTM C 1277 shielded couplings.
- D. PVC Plastic, DWV Pipe and Fittings: ASTM D 2665, Schedule 40, plain ends with PVC socket-type, DWV pipe fittings.

### PART 3 - EXECUTION

#### 3.1 PIPING INSTALLATION

- A. Comply with requirements in Division 22 Section "Common Work Results for Plumbing" for basic piping installation requirements.
- B. 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."
- C. Install wall penetration system at each pipe penetration through foundation wall. Make installation watertight. Comply with requirements in Division 22 Section "Common Work Results for Plumbing" for wall penetration systems.
  - 1. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

- D. 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.
- E. 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.
- F. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
  - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
  - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
  - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- G. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- H. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- I. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- J. Comply with requirements in Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.
- K. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure unless otherwise indicated.
- L. Comply with requirements in Division 22 Section "Common Work Results for Plumbing" for pipe hanger and support devices.

END OF SECTION 221316

SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Exposed Metal Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company; Josam Div.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Watts Drainage Products Inc.
  - e. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless-steel plug with seal.

- B. Metal Floor Cleanouts:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn; Z1400-K or a comparable product by one of the following:
  - a. Josam Company; Josam Div.
  - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - c. Watts Drainage Products Inc.
2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Inside calk.

8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Medium Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn; Z1446 or a comparable product by one of the following:
  - a. Josam Company; Josam Div.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.; d of Smith Industries, Inc.
  - d. Watts Drainage Products Inc (CO-460-RD).
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, drilled-and-threaded brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

## 2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Watts; FD-100-A or a comparable product by one of the following:
  - a. Josam Company; Josam Div.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Zurn Plumbing Products Group; Specification Drainage Operation (Z415B).
2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Outlet: Bottom.
9. Top or Strainer Material: Nickel bronze.
10. Top Shape: Round; except square in tile floors.
11. Dimensions of Top or Strainer: 6-inch (152-mm).
12. Top Loading Classification: Medium Duty.
13. Funnel: Provide where indicated on plans.



14. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
15. Trap Material: Cast iron.
16. Trap Pattern: Deep-seal P-trap.
17. Trap Features: Cleanout and trap-seal primer valve drain connection.

## 2.3 ROOF FLASHING ASSEMBLIES

### A. Roof Flashing Assemblies:

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:
  - a. Acorn Engineering Company; Elmdor/Stoneman Div.
  - b. Thaler Metal Industries Ltd.

### B. Description: Manufactured assembly made of 6.0-lb/sq. ft. 0.0938-inch- thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

1. Open-Top Vent Cap: Without cap.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- B. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor unless otherwise indicated.
  1. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
  2. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- C. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- D. Install air-gap fittings on indirect-waste piping discharge into sanitary drainage system.
- E. Install grease removal devices on floor. Install trap, vent, and flow-control fitting according to authorities having jurisdiction. Install control panel adjacent to unit, unless otherwise indicated.

END OF SECTION 221319

## SECTION 22 14 29 - SUMP PUMPS

### PART 1 - GENERAL

#### 1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data. Include performance curves, furnished specialties, motor horsepower, and electrical characteristics.
- B. Comply with UL 778 for motor-operated water pumps.

### PART 2 - PRODUCTS

#### 2.1 SUMP PUMP PACKAGE

- A. Submersible Sump Pumps: Factory assembled and tested, centrifugal submersible sump pump. Provide duplex pumps, with sump pump kit that includes controls, float level switches, oil detection sensor that de-energizes pump upon oil detection.
  - 1. Acceptable manufacturer shall be Zoeller or equal.
  - 2. Pump housing shall be cast-iron with epoxy coating, aluminum with epoxy coating, bronze, plastic or stainless steel.
  - 3. Impeller: Brass, bronze or cast iron.
  - 4. Pump and Motor Shaft: Stainless steel.
  - 5. Motor: Hermetically sealed, capacitor-start type, with built-in overload protection; three-conductor waterproof power cable of length required, and with grounding plug and cable-sealing assembly. Motor shall be NEMA type 6P, sized to operate pump without overloading the motor at any point on the pump curve.
  - 6. Bearings: As required to hold shaft alignment, antifriction type for thrust, permanently lubricated.
  - 7. Provide perforated, suction strainer.
  - 8. Automatic control, level alarm, oil alarm. Control panel shall be provided in a NEMA-4X enclosure, with the following:
    - a. Power switch to energize/de-energize the automatic controls.
    - b. Hand/off/auto switches to manually override automatic controls.
    - c. Run lights to indicate when pumps are energized/de-energized.
    - d. Level status lights to indicate with water level in sump has reached low, high, and alarm levels.
    - e. Magnetic motor contractors.
    - f. Disconnect breaker for each pump.
    - g. Automatic motor overload protections.
    - h. Sensors shall detect water level in sump and shall allow enough water volume accumulation to allow the motor to run for a minimum cycle time recommended by the manufacturer.
    - i. Two separate power supplies for control panel: one for control/alarm circuitry and one for electrical power.

- B. Sump: Furnish cast iron or fiberglass basin with gas tight covers. Cover shall have 280 mm by 380 mm (11-inch by 15-inch) manhole with bolted cover, vent connection, openings for pumps and controls. Sump shall be sized to allow an adequate volume of water to accumulate for a minimum one minute cycle of pump operation.
  
- C. Furnish the following items:
  - 1. Provide a check and ball valve in the discharge of each pump.
  - 2. Removal/Disconnect System: In a system utilizing a submersible pump, where sump depth, pump size, or other conditions make removal of the pump unusually difficult or unsafe, a removal/disconnect system shall be provided. The system will consist of a discharge fitting mounted on vertical guide rails attached to the sump. The pump shall be fitted with an adapter fitting that easily connects to/disconnects from the discharge fitting as the pump is raised from or lowered into the sump. The discharge piping will connect to the discharge fitting so that it is not necessary to disconnect any piping in order to remove the pump. Where the sump depth is greater than five feet or other conditions exist to make the removal of the pump difficult or hazardous, the system shall include a rail guided quick disconnect apparatus to allow the pump to be pulled up out of the sump without workers entering the sump and without disconnecting the piping.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install pumps with access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.
  
- B. Support pumps and piping so weight of piping is not supported by pump volute.
  
- C. Install electrical connections for power, controls, and devices.
  
- D. Submersible Sewage Pumps: Set pumps on basin floor. Make connections to sanitary drainage piping.
  - 1. Anchor guide-rail supports to basin or pit bottom and sidewall or cover.
  
- E. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
  
- F. The tests shall include system capacity and all control and alarm functions.
  
- G. When any defects are detected, correct defects and repeat test.
  
- H. The commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Resident Engineer and Commissioning Agent. Provide a minimum of 7 days prior to notice.

3.2 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for four hours to instruct maintenance personnel in operation and maintenance of units.
- B. Submit training plans and instructor qualifications.

END OF SECTION 221429

SECTION 22 33 00 - ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Commercial, light-duty, storage, electric, domestic-water heaters.
  - 2. Flow-control, electric, tankless, domestic-water heaters.
  - 3. Domestic-water heater accessories.

1.3 SUBMITTALS

- A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
  - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Product Certificates: For each type of commercial and tankless, electric, domestic-water heater, from manufacturer.
- D. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- E. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. 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.
- B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
- C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

## 1.5 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

## 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
  - a. Structural failures including storage tank and supports.
  - b. Faulty operation of controls.
  - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Periods: From date of Substantial Completion.
  - a. Commercial, Electric, Storage, Domestic-Water Heaters:
    - 1) Storage Tank: Five years.
    - 2) Controls and Other Components: Five years.
  - b. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:
    - 1) Storage Tank: Five years.
    - 2) Controls and Other Components: Two years.
  - c. Electric, Tankless, Domestic-Water Heaters: Two year(s).
  - d. Compression Tanks: Five years.

## PART 2 - PRODUCTS

### 2.1 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

- A. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:
  1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Bradford White Corporation.
    - b. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
    - c. State Industries.

2. Standard: UL 174.
3. Storage-Tank Construction: Steel, vertical arrangement.
  - a. Tappings: ASME B1.20.1 pipe thread.
  - b. Pressure Rating: 150 psig (1035 kPa).
  - c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
4. Factory-Installed Storage-Tank Appurtenances:
  - a. Anode Rod: Replaceable magnesium.
  - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
  - c. Drain Valve: ASSE 1005.
  - d. Insulation: Comply with ASHRAE/IESNA 90.1.
  - e. Jacket: Steel with enameled finish.
  - f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
  - g. Heating Elements: Two; electric, screw-in immersion type; wired for simultaneous operation unless otherwise indicated. Limited to 12 kW total.
  - h. Temperature Control: Adjustable thermostat.
  - i. Safety Control: High-temperature-limit cutoff device or system.
  - j. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.
5. Special Requirements: NSF 5 construction with legs for off-floor installation.

## 2.2 ELECTRIC, TANKLESS, DOMESTIC-WATER HEATERS

### A. Flow-Control, Electric, Tankless, Domestic-Water Heaters:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Bosch Water Heating.
  - b. Chronomite Laboratories, Inc.
  - c. Eemax, Inc.
2. Standard: UL 499 for electric, tankless, (domestic-water heater) heating appliance.
3. Construction: Copper piping or tubing complying with NSF 61 barrier materials for potable water, without storage capacity.
  - a. Connections: ASME B1.20.1 pipe thread.
  - b. Pressure Rating: 150 psig (1035 kPa).
  - c. Heating Element: Resistance heating system.
  - d. Temperature Control: Flow-control fitting.
  - e. Safety Control: High-temperature-limit cutoff device or system.
  - f. Jacket: Aluminum or steel with enameled finish or plastic.

4. Support: Bracket for wall mounting.

## 2.3 DOMESTIC-WATER HEATER ACCESSORIES

### A. Domestic-Water Compression Tanks:

1. Basis-of-Design Product: Subject to compliance with requirements, provide AMTROL, Inc.; ST-5 or comparable product by one of the following:
  - a. AMTROL Inc.
  - b. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
  - c. State Industries.
  - d. Taco, Inc.
  - e. Wessels Company.
  - f. Wood, John Co.
2. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
3. Construction:
  - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
  - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
  - c. Air-Charging Valve: Factory installed.
4. Capacity and Characteristics:
  - a. Working-Pressure Rating: 150 psig (1035 kPa).
  - b. Capacity Acceptable: 2 gal. (7.6 L) minimum.
  - c. Air Precharge Pressure: 40-psig (275-kPa).

B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 (DN 20) with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.

D. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

E. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

F. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.



- G. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches (457 mm) above the floor.
- H. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

#### 2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
- C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.
- D. Prepare test and inspection reports.

### PART 3 - EXECUTION

#### 3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 033053.1 "Miscellaneous Cast-in-Place Concrete for Mechanical and Electrical Systems."
  - 1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
  - 2. Maintain manufacturer's recommended clearances.
  - 3. Arrange units so controls and devices that require servicing are accessible.
  - 4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 6. Anchor domestic-water heaters to substrate.
- B. Electric, Tankless, Domestic-Water Heater Mounting: Install electric, tankless, domestic-water heaters at least 18 inches (457 mm) above floor on wall bracket.
  - 1. Maintain manufacturer's recommended clearances.
  - 2. Arrange units so controls and devices that require servicing are accessible.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.

5. Anchor domestic-water heaters to substrate.
- C. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
    1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified.
  - D. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
  - E. Install combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
  - F. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."
  - G. Install thermometers on outlet piping of electric, domestic-water heaters.
  - H. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
  - I. Fill electric, domestic-water heaters with water.

### 3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

### 3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
  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 operation.
  4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.
- C. Prepare test and inspection reports.

### 3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain commercial and tankless, electric, domestic-water heaters.

END OF SECTION 223300

## SECTION 22 40 00 - PLUMBING FIXTURES

### PART 1 - GENERAL

#### 1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data for each type of plumbing fixture, including trim, fittings, accessories, appliances, appurtenances, equipment, and supports.

#### 1.2 QUALITY ASSURANCE

- A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

### PART 2 - PRODUCTS

#### 2.1 PLUMBING FIXTURES

- A. Stainless steel single compartment sink with drainboard.
  - 1. Elkay model ESS4924 RW6C, 14 gauge type 304 stainless steel, wall mounted service sink with 20 inch by 18 inch basin, 10 inch deep with drain board and 8 inch high backsplash.
  - 2. Elkay model LK393ABH chrome plated mixing faucet with 6 inch wrist blades 10-1/4 inch swing gooseneck faucet, and vandal resistant anti-hose aerator.
  - 3. Elkay model LK18 stainless steel perforated strainer grid, 1-1/2 inch OD x 4 inch stainless steel tailpiece.
  - 4. Provide 14 gauge stainless steel support brackets and wall hanger.
- B. Self-contained emergency eye wash station.
  - 1. Fendall Pure Flow 1000 model 32-001000-0000 self-contained wall mount emergency eye wash station compliant with ANSI Z358.1 2004 with dust cover and fold down nozzles.
  - 2. Pressure balanced to provide a constant 0.4 gpm at a constant stream height for entire 15 minute flushing cycle.
  - 3. Wall mounting bracket.
- C. Automatic trap primer.
  - 1. Precision Plumbing Products model PR-500 pressure activated trap primer made of corrosion resistant brass.
  - 2. 1/2 inch NPT inlet and outlet.
  - 3. Install to absolutely rigid condition.
- D. Hose reel.
  - 1. Strahman model RS hose reel with spring return; capacity for 50 feet of 5/8 inch ID hose with wall bracket.

2. Strahman model RS multi-purpose water hose 5/8 inch ID with maximum working pressure of 150 psig suitable for temperatures from -20 degrees F to 200 degrees F. Provide with male NPT and female NPT threaded ends for connections to hose reel and spray nozzle.
3. Strahman model Hydro-Pro 150 automatic adjustable spray nozzle, 5-7 gpm at normal (50 psig to 80 psig) conditions.
4. Strahman model M-20-TS thermostatically controlled mixing valve with temperature indicator on discharge.

E. Floor drain (equipment rooms, full grate).

1. Josam number 32320-20-Y, cast iron floor drain with sediment bucket with lift bar, collar, and polished bronze tap.
2. Furnish and install clamp device if drain is installed in floor above slab on grade.
3. Furnish and install required deep seal P-trap.
4. Refer to Contract Drawings for drain size.

## 2.2 WALL-MOUNTED WATER CLOSETS

A. Support:

1. Standard: ASME A112.6.1M.
2. Description: Waste-fitting assembly as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.
3. Water-Closet Mounting Height: Standard Child or Handicapped/elderly according to ICC/ANSI A117.1 as indicated.

## 2.3 WALL HUNG URINALS

- A. Support: ASME A112.6.1M, Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture. Include rectangular, steel uprights.

## 2.4 WALL-MOUNT LAVATORY

A. Vitreous-China Lavatory: Wall-mounting,

1. Basis-of-Design Product: Product indicated on Drawings, or equivalent.

- B. Fixture Support: ASME A112.6.1M, Type II, concealed-arm lavatory carrier with rectangular, steel uprights.

## 2.5 SERVICE SINKS

- A. Support: ASME A112.6.1M, Type II, sink carrier.

## 2.6 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.
- D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Cross handle.
- F. Risers:
  - 1. NPS 1/2 (DN 15).
  - 2. ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose.

## 2.7 ELECTRIC WATER COOLERS

- A. Electric Water Coolers: Wall-mounted,
  - 1. Basis-of-Design Product: Product indicated on Drawings, or equivalent.
- B. Fixture Support: ASME A112.6.1M, Type I, water-cooler carrier with rectangular, steel uprights.

## 2.8 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

- B. Examine walls, floors, and counters for suitable conditions where plumbing fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATIONS

- A. Install fixtures level and plumb according to roughing-in drawings.
- B. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523 “GENERAL-DUTY VALVES FOR PLUMBING PIPING”
- C. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- D. Connect water closets and urinals with water supplies, and soil/ waste, and vent piping. Connect lavatories and sinks with water supplies, stops, and risers, and with traps, soil, waste and vent piping. Use size fittings required to match fixture.
- E. Where installing piping adjacent to plumbing fixtures, allow space for service and maintenance.
- F. Install fixtures with flanges and gasket seals.
- G. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- H. Install accessible, wall-mounted fixtures at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.
- I. Fasten wall-hanging plumbing fixtures securely to supports attached to building substrate.
- J. Fasten floor-mounted fixtures to substrate. Fasten fixtures having holes for securing fixture to wall construction, to reinforcement built into walls.
- K. Water Closet Support Installation:
  - 1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
  - 2. Use carrier supports with waste-fitting assembly and seal.
  - 3. Install floor-mounted, back-outlet water closets attached to building floor substrate, onto waste-fitting seals; and attach to support.
  - 4. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.
- L. Urinal Support Installation:
  - 1. Install supports, affixed to building substrate, for wall-hung urinals.

2. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
  3. Use carriers without waste fitting for urinals with tubular waste piping.
  4. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.
- M. Fasten wall-mounted fittings to reinforcement built into walls.
- N. Fasten counter-mounting plumbing fixtures to casework.
- O. Secure supplies to supports or substrate within pipe space behind fixture.
- P. Set shower receptors and mop basins in leveling bed of cement grout.
- Q. Install individual supply inlets, supply stops, supply risers, and tubular brass traps with cleanouts at each fixture.
- R. Install escutcheons at wall, floor, and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons where required to conceal protruding fittings.
- S. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color.
- T. Install piping connections between plumbing fixtures and piping systems and plumbing equipment.
- U. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible fixtures.
- V. Ground equipment.

### 3.3 ADJUSTING

- A. Operate and adjust plumbing fixtures and controls. Replace damaged and malfunctioning plumbing fixtures, fittings, and controls.
- B. Adjust water pressure at flushometer valves and faucets to produce proper flow.
- C. Adjust water-cooler flow regulators for proper flow and stream height.
- D. Adjust water-cooler temperature settings.
- E. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

### 3.4 CLEANING AND PROTECTION

- A. After completing installation of plumbing fixtures, inspect and repair damaged finishes.
- B. Clean plumbing fixtures and fittings with manufacturers' recommended cleaning methods and materials.



- C. Install protective covering for installed plumbing fixtures and fittings.
- D. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Applicable provisions of this Section apply to all sections of Division 23, Heating, Ventilating and Air Conditioning.

1.2 CONTRACT DOCUMENTS

- A. Examine all drawings and specifications carefully before submitting a bid. Architectural drawings take precedence over mechanical or electrical drawings with reference to building construction. If discrepancies or conflicts occur between drawings, or between drawings and specifications, notify the Engineer in writing prior to bid date; however, the most stringent requirement shall govern.
- B. For purposes of clearness and legibility, drawings are essentially diagrammatic and, although size and location of equipment are drawn to scale wherever possible, Contractor shall make use of all data in all of the contract documents and shall verify this information at the building site.
- C. The drawings indicate required size and points of termination of pipes, conduits and ducts and suggest proper routes to conform to structure avoid obstructions and preserve clearances. However, it is not intended that drawings indicate all necessary offsets, and it shall be the responsibility of the Contractor to make the installation in such a manner as to conform to structure, avoid obstructions, preserve headroom and keep openings and passageways clear, without further instructions or cost to the Owner.
- D. Furnish, install and/or connect with appropriate services all items shown on any drawing without additional compensation.
- E. Consider the terms "provide" and "install" as synonymous with "furnish and install".

1.3 CODE REQUIREMENTS

- A. Perform work in accordance with the following codes and any applicable statutes, ordinances, codes, and regulations of governmental authorities having jurisdiction.
  - 1. ASHRAE:
    - a. Standard 15 – Safety Standard for Refrigeration Systems
    - b. Standard 55 – Thermal Environmental Conditions for Human Occupancy
    - c. Standard 62 – Ventilation Standard for Acceptable Indoor air Quality
    - d. Standard 90.1 – Energy Standard for Buildings Except Low Rise Residential Buildings
  - 2. Occupational Safety and Health Regulations (OSHA)

3. National Fire Protection Association (NFPA):
    - a. NFPA 1 – Uniform Fire Code
    - b. NFPA 54 – National Fuel Gas Code
    - c. NFPA 70 – National Electrical Code
    - d. NFPA 90A – Standard for the Installation of Air Conditioning and Ventilation Systems
    - e. NFPA 90B – Standard for the Installation of Warm Air Heating and Air Conditioning Systems
    - f. NFPA 91 – Standard for the Installation of Blower and Exhaust Systems
    - g. NFPA 101 – Life Safety Code
  4. Florida Building Code 2010 Edition:
    - a. Accessibility Code
    - b. Energy Conservation Code
    - c. Fuel Gas Code
    - d. Mechanical Code
    - e. Plumbing Code
  5. Florida Administrative Code
  6. ADA Accessibility Guidelines for Buildings (ADAAG)
- B. Resolve, in writing, any code violation discovered in contract documents with the Engineer prior to bidding. After award of the contract, make any correction or addition necessary for compliance with applicable codes at no additional cost to Owner.
- C. The installer shall include in the work, without extra cost to the Owner, any labor, materials, services, apparatus and drawings required to comply with all applicable laws, ordinances, rules and regulations.

#### 1.4 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date bids are received. Specifications and standards are minimum requirements for all equipment, material and work. In instances where capacities, size or other feature of equipment, devices or materials exceed these minimums, meet listed or shown capacities.
- B. Whenever a reference is made to a standard, installation and materials shall comply with the latest published edition of the standard at the time project is bid unless otherwise specified herein.

#### 1.5 QUALITY ASSURANCE

- A. The intent of the Division 23 specifications and the accompanying drawings is to provide a complete, operable, and satisfactory HVAC system as shown, specified, and required by applicable codes. Include all work specified in Division 23 and shown on the accompanying drawings.
- B. The drawings that accompany the Division 23 specifications are diagrammatic. They do not show every offset, bend, tee, or elbow which may be required to install work in the

space provided and avoid conflicts. Follow the drawings as closely as is practical to do so and install additional bends, offsets and elbows where required by local conditions from measurements taken at the building, subject to approval, and without additional cost to the contract.

- C. Coordinate exact requirements governed by actual job conditions. Check all information and report any discrepancies before fabricating work. Report changes in time to avoid unnecessary work.
- D. Systems shall be built and installed to deliver their full rated capacity at the efficiency for which they were designed.
- E. The entire HVAC system shall operate at full capacity without objectionable noise or vibration.
- F. Materials and Equipment:
  - 1. Furnish new and unused materials and equipment. Work shall be of good quality, free of faults and defects.
  - 2. All equipment shall fit in the space provided.
  - 3. Each piece of equipment provided shall meet all detailed requirements of the drawings and specifications and shall be suitable for the installation shown.
  - 4. Where two or more units of the same class of equipment are provided, use products of the same manufacturer; component parts of the entire system need not be products of the same manufacturer.
  - 5. Manufacturer's model names and numbers used in these drawings and specifications are subject to change per manufacturer's action. Contractor shall therefore verify model names and numbers with manufacturer's representative before ordering any product or equipment.
- G. Workmanship:
  - 1. Install all materials in a neat and workmanlike manner.
  - 2. Follow manufacturer's directions. If they are in conflict with the contract documents, obtain clarification before starting work.
- H. Cutting and Patching:
  - 1. Cutting, patching and repairing for the proper installation and completion of the work specified in this division, including plastering, masonry work, concrete work, carpentry work, firestopping, and painting, shall be performed by skilled craftsmen of each respective trade in conformance with the appropriate division of work. Additional openings required in building construction shall be made by drilling or cutting.
  - 2. Fill holes which are cut oversize so that a tight fit is obtained around the objects passing through.
  - 3. Do not pierce beams or columns without permission of the Owner and then only as directed.

4. New or existing work that is cut or damaged shall be restored to its original condition. Where alterations disturb existing finishes, the surfaces shall be repaired, refinished and left in condition existing prior to commencement of work.
5. Equipment of higher electrical characteristics may be provided if proposed equipment is approved in writing and connecting electrical services are appropriately modified.

#### 1.6 SUBMITTALS

- A. Submit in accordance with project contract documents.
- B. If not specified in the project contract documents, then submit either a minimum of five hard copies in 3-ring binders or electronic PDFs, as required by the Engineer.
- C. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Engineer to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.
- D. Product Data:
  1. Submit Product Data for review on all scheduled pieces of equipment, equipment requiring electrical connections or connections by other trades, and as required by the contract documents. Include manufacturer's detailed shop drawings, specifications, and data sheets. Data sheets shall include capacities, RPM, BHP, pressure drop, design and operating pressures, temperatures and similar data. Manufacturer's abbreviations or codes are not acceptable.
- E. Operation and Maintenance Data:
  1. Submit operation and maintenance data for review on all scheduled pieces of equipment, and as required by the contract documents.
- F. Commissioning Documentation:
  1. Submit commissioning plans, schedules, and related documentation in accordance with the contract documents.

#### 1.7 PERMITS, FEES, AND INSPECTIONS

- A. Obtain and pay for all permits, fees, tap fees, connection charges, demand charges, systems charges, impact fees and inspections.
- B. Deliver all certificates of inspection issued by authorities having jurisdiction to the Engineer.

#### 1.8 PROVISIONS FOR LARGE EQUIPMENT

- A. Make provisions for the necessary openings in the building to allow for admittance of all equipment.

1.9 PROJECT CONDITIONS

- A. Coordinate exact requirements governed by actual job conditions. Check all information and report any discrepancies before fabricating work. Report changes in time to avoid unnecessary work.

1.10 WARRANTY

- A. Warranty work and equipment for one year from the date of final acceptance of the project. During the warranty period provide labor and materials to make good any faults or imperfections that may arise due to defects or omissions in materials or workmanship.

1.11 RECORD DRAWINGS

- A. Keep a record set of the contract documents at job site and continuously update deviations from design by marking up (in red) drawings. When work is complete give Owner copies of record drawings.

1.12 FILTERS

- A. Provide construction filters during construction and replace with clean filters prior to testing and balancing of system.

PART 2 PRODUCTS

2.1 SLEEVES

- A. Mechanical Sleeve Seals: Modular rubber sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- C. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- D. PVC Pipe: ASTM D 1785, Schedule 40.

2.2 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

2.3 MOTORS

- A. Motor Characteristics:
  - 1. Frequency Rating: 60 Hz.
  - 2. Voltage Rating: NEMA standard voltage for circuit voltage to which motor is connected.

3. Service Factor: 1.15.
4. Duty: Continuous duty at ambient temperature of 105 deg F (40 deg C) and at altitude of 3300 feet (1005 m) above sea level.
5. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
6. Enclosure: Unless otherwise indicated, open dripproof.
7. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

## 2.4 HANGERS AND SUPPORTS

- A. Hanger and Pipe Attachments: Factory fabricated with galvanized coatings; nonmetallic coated for hangers in direct contact with copper tubing.
- B. Powder-Actuated Fasteners: Threaded-steel stud, with pull-out and shear capacities appropriate for supported loads and building materials where used.
- C. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, with pull-out and shear capacities appropriate for supported loads and building materials where used.

## 2.5 VIBRATION ISOLATION CONTROL DEVICES

- A. Vibration Supports:
  1. Elastomeric Isolation Pads: Arranged in single or multiple layers of oil- and water-resistant, of sufficient stiffness for uniform loading over pad area, molded with a non-slip pattern and galvanized-steel baseplates, and factory cut to sizes that match supported equipment.
    - a. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc., Super W; or comparable product by one of the following:
      1. Kinetics Noise Control, Inc.
      2. Vibration Mountings & Controls, Inc.
  2. Elastomeric Isolation Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements with factory-drilled, encapsulated top plate and baseplate. Provide isolator with minimum 0.5-inch (13-mm) static deflection.
    - a. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc., Type ND; or comparable product by one of the following:
      1. Kinetics Noise Control, Inc.
      2. Vibration Mountings & Controls, Inc.
  3. Open-Spring Isolators: Freestanding, laterally stable, open-spring isolators. Provide isolator with minimum 1-inch (25-mm) static deflection.

- a. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc., Type SLFH; or comparable product by one of the following:
  - 1. Kinetics Noise Control, Inc.
  - 2. Vibration Mountings & Controls, Inc.
- 4. Housed-Spring Isolators: Freestanding, laterally stable, open-spring isolators in two-part telescoping housing. Provide isolator with minimum 1-inch (25-mm) static deflection.
  - a. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc., Type C; or comparable product by one of the following:
    - 1. Kinetics Noise Control, Inc.
    - 2. Vibration Mountings & Controls, Inc.
- B. Vibration Hangers:
  - 1. Elastomeric Hangers: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements bonded to steel housings with threaded connections for hanger rods. Provide isolator with minimum 0.5-inch (13-mm) static deflection.
    - a. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc., HD; or comparable product by one of the following:
      - 1. Kinetics Noise Control, Inc.
      - 2. Vibration Mountings & Controls, Inc.
  - 2. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression. Provide isolator with minimum 1-inch (25-mm) static deflection.
    - a. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc., HS-B; or comparable product by one of the following:
      - 1. Kinetics Noise Control, Inc.
      - 2. Vibration Mountings & Controls, Inc.

## 2.6 PRESSURE GAGES AND TEST PLUGS

- A. Pressure Gages: Direct-mounting, indicating-dial type complying with ASME B40.100. Dry metal case, minimum 2-1/2-inch (63-mm) diameter with red pointer on white face, and plastic window. Minimum accuracy 3 percent of middle half of range. Range two times operating pressure.
- B. Test Plug: Corrosion-resistant brass or stainless-steel body with two self-sealing rubber core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping. Minimum pressure and temperature rating of 500 psig at 200 deg F (3450 kPa at 93 deg C).

## 2.7 ACCESS DOCKS AND PANELS

- A. Locate access panels for service of concealed items. Size at 12" x 12" minimum or 16" x 24" when person must pass through opening.



B. ADD SJCEROMG [AGES 5-11]

PART 3 EXECUTION

3.1 INSTALLATIONS

- A. Install materials and equipment in a professional manner. The Engineer may direct replacement of items which, in his opinion, do not present a professional appearance. Replace or reinstall items at the expense of the Contractor.
- B. Obstructions
  - 1. The drawings indicate certain information pertaining to surface and subsurface obstructions which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
  - 2. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided. Verify locations given.
  - 3. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.
  - 4. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.
- C. Where "rated" walls, floor, roofs and ceilings are penetrated or cut to install equipment, materials, devices, etc. the Contractor shall provide and install all materials required to re-establish the rating of the wall, floor, roof or ceiling to the satisfaction of the authority having jurisdiction.
- D. Space Requirements: Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material which is not suitable in this respect.
- E. Select equipment to operate with minimum noise and vibration. If objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, rectify such conditions without cost to the Owner.
- F. Wiring Method: Install cables in raceways and cable trays except low voltage network cable above accessible ceilings. Conceal raceway and cables except in unfinished spaces.
  - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
  - 2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceways and Boxes for Electrical Systems."
- G. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

### 3.2 MOTOR INSTALLATION

- A. Anchor motor assembly to base, adjustable rails, or other support, arranged and sized according to manufacturer's written instructions.

### 3.3 GENERAL PIPING INSTALLATIONS

- A. Install piping free of sags and bends.
- B. Install fittings for changes in direction and branch connections.
- C. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- D. Exterior Wall, Pipe Penetrations: Mechanical sleeve seals installed in steel or cast-iron pipes for wall sleeves.
- E. Comply with requirements in Division 07 Section "Penetration Firestopping" for sealing pipe penetrations in fire-rated construction.
- F. Install unions at final connection to each piece of equipment.
- G. Install dielectric unions and flanges to connect piping materials of dissimilar metals in gas piping.

### 3.4 GENERAL EQUIPMENT INSTALLATIONS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. 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.
- D. Install equipment to allow right of way for piping installed at required slope.

### 3.5 BASES, SUPPORTS, AND ANCHORAGES

- A. Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
  - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
  - 2. Install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base to connect concrete base to concrete floor.
  - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete"

### 3.6 HANGERS AND SUPPORTS

- A. Comply with MSS SP-69 and MSS SP-89. Install building attachments within concrete or to structural steel.
- B. Install hangers and supports to allow controlled thermal and seismic movement of piping systems.
- C. Install powder-actuated fasteners and mechanical-expansion anchors in concrete after concrete is cured. Do not use in lightweight concrete or in slabs less than 4 inches (100 mm) thick.
- D. Load Distribution: Install hangers and supports so piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- E. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
  1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30 (DN 15 to DN 750).
  2. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
  3. Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).
  4. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).
  5. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2 (DN 15 to DN 50).
- F. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
  1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500).
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500), if longer ends are required for riser clamps.

### 3.7 VIBRATION ISOLATION CONTROL DEVICE INSTALLATION

- A. Adjust vibration isolators to allow free movement of equipment limited by restraints.
- B. Install resilient bolt isolation washers and bushings on equipment anchor bolts.

- C. Install cables so they do not bend across sharp edges of adjacent equipment or building structure.

### 3.8 FIELD QUALITY CONTROL

#### A. Tests:

1. Include all tests specified and/or required under laws, rules and regulations of all departments having jurisdiction. Tests shall also be performed as indicated herein and other sections of the specifications.
2. After all mechanical systems have been completed and put into operation, subject each system to an operating test under design conditions to insure proper sequence and operation throughout the range of operation. Make adjustments as required to insure proper functioning of all systems.
3. All parts of the work and associated equipment shall be tested and adjusted to work properly and be left in perfect operating condition.
4. Correct defects disclosed by these tests without any additional cost to the Owner. Repeat tests on repaired or replaced work.
5. Maintain a log of all tests being conducted and have it available for review by the Engineer. Log to indicate date, type of tests, duration, and defects noted and when corrected.
6. Special tests on individual systems are specified under individual sections.
7. Mechanical Contractor shall provide personnel, tools and equipment and assist the Test and Balance Contractor in making any adjustments necessary to meet the test and balance requirements.

END OF SECTION 230500

## SECTION 23 05 29 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

### PART 1 GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following hangers and supports for HVAC system piping and equipment:
  - 1. Steel pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Metal framing systems.
  - 4. Thermal-hanger shield inserts.
  - 5. Fastener systems.
  - 6. Pipe stands.
  - 7. Equipment supports.

#### 1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, “Guidelines on Terminology for Pipe Hangers and Supports.”

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

#### 1.5 SUBMITTALS

- A. Product Data: For the following:
  - 1. Steel pipe hangers and supports.
  - 2. Thermal-hanger shield inserts.
  - 3. Powder-actuated fastener systems.

## 1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1, “Structural Welding Code—Steel.”
  - 2. AWS D1.3, “Structural Welding Code—Sheet Steel.”
  - 3. AWS D1.4, “Structural Welding Code—Reinforcing Steel.”

## PART 2 PRODUCTS

### 2.1 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 “Hanger and Support Applications” Article for where to use specific hanger and support types.
- B. Manufacturers:
  - 1. AAA Technology & Specialties Co., Inc.
  - 2. Bergen-Power Pipe Supports.
  - 3. B-Line Systems, Inc.; a division of Cooper Industries.
  - 4. Carpenter & Paterson, Inc.
  - 5. Empire Industries, Inc.
  - 6. ERICO/Michigan Hanger Co.
  - 7. Globe Pipe Hanger Products, Inc.
  - 8. Grinnell Corp.
  - 9. GS Metals Corp.
  - 10. National Pipe Hanger Corporation.
  - 11. PHD Industries, Inc.
  - 12. PHS Industries, Inc.
  - 13. Piping Technology & Products, Inc.
  - 14. Tolco Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hangers with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

## 2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

## 2.3 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
  - 1. B-Line Systems, Inc.; a division of Cooper Industries.
  - 2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
  - 3. GS Metals Corp.
  - 4. Power-Strut Div.; Tyco International, Ltd.
  - 5. Thomas & Betts Corporation.
  - 6. Tolco Inc.
  - 7. Unistrut Corp.; Tyco International, Ltd.
- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

## 2.4 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- (690-kPa-) minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers:
  - 1. Carpenter & Paterson, Inc.
  - 2. ERICO/Michigan Hanger Co.
  - 3. PHS Industries, Inc.
  - 4. Pipe Shields, Inc.
  - 5. Rilco Manufacturing Company, Inc.
  - 6. Value Engineered Products, Inc.
- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type 1 calcium silicate with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type 1 calcium silicate.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
  - 1. Manufacturers:
    - a. Hilti, Inc.
    - b. ITW Ramset/Red Head.
    - c. Masterset Fastening Systems, Inc.
    - d. MKT Fastening, LLC.
    - e. Powers Fasteners.
- B. Mechanical-Expansion Anchors: Insert-wedge-type zing-coated steel, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
  - 1. Manufacturers:
    - a. B-Line Systems, Inc.; a division of Cooper Industries.
    - b. Empire Industries, Inc.
    - c. Hilti, Inc.
    - d. ITW Ramset/Red Head.
    - e. MKT Fastening, LLC.
    - f. Powers Fasteners.

## 2.6 PIPE STAND FABRICATION

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
  - 1. Manufacturers:
    - a. ERICO/Michigan Hanger Co.
    - b. MIRO Industries.
- C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
  - 1. Manufacturers:



- a. MIRO Industries.
- D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
- 1. Manufacturers:
    - a. ERICO/Michigan Hanger Co.
    - b. MIRO Industries.
    - c. Portable Pipe Hangers.
  - 2. Base: Stainless steel.
  - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
  - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
- 1. Manufacturers:
    - a. Portable Pipe Hangers.
  - 2. Bases: One or more plastic.
  - 3. Vertical Members: Two or more protective-coated-steel channels.
  - 4. Horizontal Member: Protective-coated-steel channel.
  - 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

## 2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

## 2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and –packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

## PART 3 EXECUTION

### 3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS ½ to NPS 30 (DN 15 to DN 750).
  - 2. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS ½ to NPS 24 (DN 15 to DN 600), if little or no insulation is required.
  - 3. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS ½ to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
  - 4. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS ¾ to NPS 8 (DN 20 to DN 200).
  - 5. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS ½ to NPS 8 (DN 15 to DN 200).
  - 6. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS ½ to NPS 8 (DN 15 to DN 200).
  - 7. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS ½ to NPS 2 (DN 15 to DN 50).
  - 8. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8 (DN 10 to DN 200).
  - 9. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3 (DN 10 to DN 80).
  - 10. U-Bolts (MSS Type 24): For support of heavy pipes, NPS ½ to NPS 30 (DN 15 to DN 750).
  - 11. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  - 12. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36 (DN 100 to DN 900), with steel pipe base stanchion support and cast-iron floor flange.

13. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36 (DN 100 to DN 900), with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
  14. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36 (DN 65 to DN 900), if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
  15. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30 (DN 25 to DN 750), from 2 rods if longitudinal movement caused by expansion and contraction might occur.
  16. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20 (DN 65 to DN 500), from single rod if horizontal movement caused by expansion and contraction might occur.
  17. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42 (DN 50 to DN 1050), if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
  18. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24 (DN 50 to DN 600), if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
  19. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30 (DN 50 to DN 750), if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS  $\frac{3}{4}$  to NPS 20 (DN 20 to DN 500).
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS  $\frac{3}{4}$  to NPS 20 (DN 20 to DN 500), if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.

2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads with link extensions.
  11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
- K. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- L. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- M. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

### 3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS Sp-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Stand Installation:
  - 1. Pipe Stand Types: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
- G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- J. Install lateral bracing with pipe hangers and supports to prevent swaying.
- K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through opening at top of inserts.

- L. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- N. Insulated Piping:
  - 1. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
  - 2. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS ¼ to NPS 3-1/2 (DN 8 to DN 90): 12 inches long and 0.048 inch thick.
    - b. NPS 4 (DN 100): 12 inches long and 0.06 inch thick.
    - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches long and 0.06 inch thick.
    - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches long and 0.075 inch thick.
    - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches long and 0.105 inch thick.
  - 3. Pipes NPS 8 (DN 200) and Larger: Include wood inserts.
  - 4. Insert Material: Length at least as long as protective shield.
  - 5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor or roof.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

### 3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### 3.6 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 230500

## SECTION 23 05 53 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

### PART 1 GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation:
  - 1. Equipment nameplates.
  - 2. Access panel and door markers.
  - 3. Pipe markers.
  - 4. Duct markers.
  - 5. Stencils.
  - 6. Valve tags.
  - 7. Valve schedules.

#### 1.3 SUBMITTALS

- A. Valve numbering scheme.
- B. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

#### 1.4 QUALITY ASSURANCE

- A. 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.

#### 1.5 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with location of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.



## PART 2 PRODUCTS

### 2.1 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
  - 1. Data:
    - a. Manufacturer, product name, model number, and serial number.
    - b. Capacity, operating and power characteristics, and essential data.
    - c. Labels of tested compliances.
  - 2. Location: Accessible and visible.
  - 3. Fasteners: As required to mount on equipment.
- B. Access Panel and Door Markers: 1/16-inch-(1.6-mm-) thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.
  - 1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

### 2.2 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
  - 1. Colors: Comply with ASME A13.1, unless otherwise indicated.
  - 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
  - 3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
  - 4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
  - 5. Arrows: Integral with piping system service lettering to accommodate both directions; or as a separate unit on each pipe marker to indicate direction of flow.
- B. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.
- C. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.
  - 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches:  $\frac{3}{4}$  inch minimum.
  - 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 minimum.

## 2.3 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door markers, equipment markers, equipment signs, and similar operational instructions.
  - 1. Stencil Paint: Exterior, gloss, acrylic enamel black, unless otherwise indicated. Paint may be in pressurized spray-can form.
  - 2. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1, unless otherwise indicated.

## 2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4 -inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme approved by Owner. Provide 5/32-inch hole for fastener.
  - 1. Material: 0.0375-inch-thick stainless steel.
  - 2. Valve-Tag Fasteners: To match tag material.

## 2.5 VALVE SCHEDULES

- A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space). Mark valves for emergency shutoff and similar special uses.
  - 1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
  - 2. Frame: Extruded aluminum.
  - 3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

# PART 3 EXECUTION

## 3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

## 3.2 EQUIPMENT IDENTIFICATION

- A. 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. Pumps and similar motor-driven units.
  - 2. Heat exchangers, coils, evaporators, and similar equipment.

3. Fans, blowers, primary balancing dampers, and mixing boxes.
4. Custom air hardy units.
5. Flow meters.
6. Dust collection unit.

### 3.3 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
  1. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, 1-1/2 inches wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
  2. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.
- B. Stenciled Pipe Marker Option: Stenciled markers may be provided instead of manufactured pipe markers, at Installer's option. Install stenciled pipe markers on each piping system.
  1. Identification Paint: Use for contrasting background.
  2. Stencil Paint: Use for pipe marking.
- C. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations as follows:
  1. Near each valve and control device.
  2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  3. Near penetrations through walls, floors, ceilings, and nonaccessible enclosures.
  4. At access doors, manholes, and similar access points that permit view of concealed piping.
  5. Near major equipment items and other points of origination and termination.
  6. Spaced at maximum intervals of 50 feet along each run, unless otherwise indicated. Reduce intervals to 25 feet in mechanical/plumbing rooms.
  7. On piping above removable acoustical ceiling, omit intermediately spaced markers.

### 3.4 DUCT IDENTIFICATION

- A. Stenciled Duct Marker Option: Stenciled markers, showing service and direction of flow for all new ducts shall be provided with lettering 2-inches high for proper identification as supply, return, general exhaust, or dust collection exhaust.
  1. Supply – Blue.
  2. Return – Green.

3. General Exhaust – Yellow.
4. Duct Collection Exhaust – Red.

B. Locate markers near points where ducts enter into concealed spaces and at maximum intervals of 20 feet for all new ductwork.

### 3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule. Valve tags shall be minimum 1-1/2 inches round.

### 3.6 VALVE-SCHEDULE INSTALLATION

A. Mount valve schedule on wall in accessible location in each major equipment room.

### 3.7 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to equipment and other items where required.

### 3.8 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

### 3.9 CLEANING

A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION 230500

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Certified TAB reports.
- B. TAB Firm Qualifications: AABC, NEBB, or TABB certified.
- C. TAB Report Forms: Standard TAB contractor's forms approved by Architect.
- D. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

1.2 SUBMITTALS

- A. Within 15 days from Contractors' Notice to Proceed, submit two copies of evidence that TAB firm and this project's TAB team members meet the qualifications specified in the "Quality Assurance" section.
- B. Existing Systems Verification: Within 30 days from Contractor's Notice to Proceed, submit two copies of certified existing systems verification test and balance report.
- C. Within 60 days from Contractor's Notice to Proceed, submit two copies of TAB strategies and step-by-step procedures as specified in in Part 3 of this section. Include a complete set of report forms that contractor intends to use on the project.
- D. Certified TAB Reports: Submit two copies of reports prepared on approved forms certified by the TAB firm.

1.3 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.
- B. TAB Conference: Meet with Owners' and Architects' representatives on approval of TAB procedures to develop mutual understanding of test and balance plan. Provide 7 days notice of scheduled meeting time and location. Agenda shall include:
  - 1. Submittal distribution requirements.
  - 2. The Contract Documents examination report.
  - 3. The TAB plan.
  - 4. Work schedule, project site access requirements.
  - 5. Coordination of trades and subcontractors.
  - 6. Coordination of documentation and communication flow.

- C. TAB report forms: Use standard forms from AABC's National Standards for Testing and Balancing HVAC Systems" or NEBB's Procedural Standards to Test, Adjust and Balancing of Environmental Systems.
- D. Instrumentation Type, Quantity, and Accuracy: Follow AABC and NEBB.
- E. Instrumentation Calibration: Calibrate instruments every 6 months or less if recommended by manufacturer. Keep updated record showing date of calibration and name of party performing calibration.

#### 1.4 COORDINATION

- A. Coordinate support of factory-authorized service representatives for systems and equipment, HVAC controls contractors, and other mechanics required to operate the equipment.
- B. Provide 7 days advance notice for each test date. Include scheduled test and times.
- C. Perform TAB after leakage and pressure tests on air and water systems have been satisfactorily completed.

#### 1.5 GUARANTEE

- A. Provide a guarantee on AABC's National Standards for Testing and Balancing of HVAC systems forms stating that AABC will assist in completing requirements of Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
  - 1. The certified test and balance firm has tested and balanced systems according to the Contract Documents.
  - 2. Systems balanced to optimum performance capabilities with design and installation limits.
- B. 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.

### PART 2 - PRODUCTS

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. 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.
- B. Examine the approved submittals for HVAC systems and equipment.

- C. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- D. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- E. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- F. Examine equipment performance data including fan and pump curves. Calculate system effect factors when HVAC equipment is installed differently from performance test in factory.
- G. Examine automatic temperature system components to verify the following:
  - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
  - 2. Dampers and valves are in the position indicated by the controller.
  - 3. Integrity of dampers and valves for free and full operation and for tightness of fully closed and fully open positions.
  - 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
  - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
  - 6. Sensors are located to sense only the intended conditions.
  - 7. Sequence of operation for control modes is according to the Contract Documents.
  - 8. Controller set points are set at indicated values.
  - 9. Interlocked systems are operating.
  - 10. Changeover from heating to cooling mode occurs according to indicated values.
  - 11. Safety interlocks and controls are properly installed.
- H. Report deficiencies discovered before and during performance of test and balance procedures.

### 3.2 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Prepare a Testing and Balancing plan that includes stop by stop procedures.
- B. Perform testing and balancing procedures on each system according to the procedures contained in AABC's National Standards for Testing and Balancing for HVAC Systems or NEBB Procedures and Standards for Testing and Balancing of Environmental Systems. .
- C. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish.
- D. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

- E. Take and report testing and balancing measurements in inch-pound (IP) units.
- F. Complete system readiness checks including verifying completion of:
  - 1. Electrical Wiring.
  - 2. Hydronic systems filled, clean, and free of air.
  - 3. Access drawings securely closed.
  - 4. Balance, Fire/Smoke dampers are open.
  - 5. All isolation valves open, control valves operational.
  - 6. Windows and doors are closed.

### 3.3 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare schematic diagrams of systems' "as-built" duct layouts.
- B. For variable-air-volume systems, develop a plan to simulate diversity.
- C. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- D. Verify that motor starters are equipped with properly sized thermal protection.
- E. Check for airflow blockages.
- F. Check condensate drains for proper connections and functioning.
- G. Check for proper sealing of air-handling unit components.
- H. Check for proper sealing of air duct system.

### 3.4 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
  - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
  - 2. Air Outlets and Inlets: Plus or minus 10 percent.
  - 3. Heating-Water Flow Rate: Plus or minus 10 percent.
  - 4. Cooling-Water Flow Rate: Plus or minus 10 percent.

### 3.5 BASIC AIR SYSTEM BALANCING PROCEDURE

- A. Measure outlet static pressure as far downstream from fan as practical.
- B. Measure static pressure directly at fan outlet.
- C. Measure inlet static pressure directly at fan inlet.
- D. Measure differential pressure across each section that makes up the air handling unit.
- E. Do not make fan motor adjustments that result in motor overload.



3.6 MOTORS

- A. Record manufacturer, model number, and serial numbers.
- B. Motor hp rating.
- C. Motor rpm.
- D. Efficiency R
- E. Nameplate electrical
- F. Additional Testing for Motors with Variable Frequency Controllers and Motors
  - 1. Test and prepare operation at speeds varying from maximum to minimum.

3.7 TEMPERATURE MEASUREMENTS

- A. Measure indoor wet and dry bulb temperatures for period of two days hourly.

3.8 FIND REPORT

- A. Air handling units include:
  - 1. Unit Identification
  - 2. Location
  - 3. Make and Type
  - 4. Model and Unit Size
  - 5. Manufacturers Serial Number
  - 6. Discharge Arrangements
  - 7. Sheave make, size and bore
  - 8. Number of Belts, make and size
  - 9. Number of Filters, type and size
  - 10. Total Airflow Rate in CFM
  - 11. Total System Status Pressure in Inches wg
  - 12. Fan rpm
  - 13. Discharges Static Pressure
  - 14. Filter Differential Pressure
  - 15. Outside Air Flow
  - 16. Return Air Flow
  - 17. OSA and RA damper positions
- B. Duct Traverse Reports
  - 1. Location of Test
  - 2. Duct Size
  - 3. Duct Static Pressure
  - 4. Duct Area
  - 5. Air Flow Rate
  - 6. Velocity

### 3.9 INSPECTIONS

- A. After Testing and Balancing makes random check the following system
  - 1. Measure airflow at 10% of air outlets
  - 2. Measure room temperatures
  - 3. Measure sound levels
  - 4. Verify balancing devices are marked at final position
  - 5. Note deviations to contract documents in reports

END OF SECTION

## SECTION 23 07 00 - HVAC INSULATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Insulation Materials:
    - a. Calcium silicate.
    - b. Cellular glass.
    - c. Flexible elastomeric.
    - d. Mineral fiber.
  - 2. Fire-rated insulation systems.
  - 3. Insulating cements.
  - 4. Adhesives.
- B. Related Sections:
  - 1. Division 23 Section "Metal Ducts" for duct liners.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Qualification Data: For qualified Installer.
- C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program in the field of HVAC insulation applications. Installer shall be a company specializing in HVAC insulation applications with a minimum of 5 years of experience. Insulation shall be installed in a neat, workmanlike manner.

- B. 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, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

#### 1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section “Hangers and Supports for HVAC Piping and Equipment.”
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

#### 1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

### PART 2 - PRODUCTS

#### 2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

- C. 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.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
  - 1. Proeducts: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.
    - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
    - d. Or equal.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; SoftTouch Duct Wrap.
    - b. Johns Manville; Microlite.
    - c. Knauf Insulation; Friendly Feel Duct Wrap.
    - d. Manson Insulation Inc.; Alley Wrap.
    - e. Owens Corning; SOFTR All-Service Duct Wrap.
    - f. Or equal.
- H. 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.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; Commercial Board.
    - b. Johns Manville; 800 Series Spin-Glas.
    - c. Knauf Insulation; Insulation Board.
    - d. Owens Corning; Fiberglas 700 Series.
    - e. Or equal.
- I. Mineral-Fiber, Preformed Pipe Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Johns Manville; Micro-Lok.
    - b. Knauf Insulation; 1000-Degree Pipe Insulation.
    - c. Owens Corning; Fiberglas Pipe Insulation.
    - d. Or equal.
- J. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Aeroflex USA, Inc.; Aero seal.
  - b. Armacell LLC; Armaflex 520 Adhesive.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
  - d. K-Flex USA; R-373 Contact Adhesive.
  - e. Or equal.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive 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."
- K. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Eagle Bridges - Marathon Industries; 225.
    - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
    - c. Mon-Eco Industries, Inc.; 22-25.
    - d. Or equal.
  2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive 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."
- L. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
    - b. Vimasco Corporation; 749.
    - c. Or equal.
  2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
  4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  5. Color: White.
- M. Factory-Applied Jackets: When factory-applied jackets are indicated, comply with the following:
1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

- N. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

## 2.2 ADHESIVES

- A. 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.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA Inc.; Aeroseal.
    - b. Armacell LCC; 520 Adhesive.
    - c. Foster Products Corporation, H.B. Fuller Company; 85-75.
    - d. RBX Corporation; Rubatex Contact Adhesive.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-82.
    - b. Foster Products Corporation, H.B. Fuller Company; 85-20.
    - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    - d. Marathon Industries, Inc.; 225.
    - e. Mon-Eco Industries, Inc.; 22-25.
- D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-82.
    - b. Foster Products Corporation, H.B. Fuller Company; 85-20.
    - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    - d. Marathon Industries, Inc.; 225.
    - e. Mon-Eco Industries, Inc.; 22-25.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Chemical Company (The); 739, Dow Silicone.
    - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    - c. P.I.C. Plastics, Inc.; Welding Adhesive.
    - d. Red Devil, Inc.; Celulon Ultra Clear.
    - e. Speedline Corporation; Speedline Vinyl Adhesive.

## PART 3 - EXECUTION

### 3.1 INSULATION INSTALLATION

- A. Comply with requirements of the Midwest Insulation Contractors Association's "National Commercial & Industrial Insulation Standards" for insulation installation on pipes and equipment.

- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated):  
Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: 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).
- D. Insulation Installation at Floor Penetrations:
1. Duct: 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).
  2. Seal penetrations through fire-rated assemblies.
- E. Flexible Elastomeric Insulation Installation:
1. Seal longitudinal seams and end joints with adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
  2. Insulation Installation on Pipe Fittings and Elbows: Install mitered sections of pipe insulation. Secure insulation materials and seal seams with adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- F. Mineral-Fiber Insulation Installation:
1. Insulation Installation on Straight Pipes and Tubes: Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  2. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
  3. For insulation with factory-applied jackets on below ambient surfaces, 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.
  4. Blanket and Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
  5. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier.
- G. Plenums and Ducts Requiring Insulation:
1. Concealed and exposed supply air.
  2. Concealed and exposed return air located in non-conditioned space.
  3. Concealed and exposed exhaust between isolation damper and penetration of building exterior.
- H. Plenums and Ducts Not Insulated:
1. Metal ducts with duct liner.
  2. Factory-insulated plenums and casings.
  3. Flexible connectors.
  4. Vibration-control devices.
  5. Factory-insulated access panels and doors.



- I. Piping Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  - 1. Drainage piping located in crawlspaces.
  - 2. Underground piping.

### 3.2 DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed duct insulation shall be the following:
  - 1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
- B. Exposed duct insulation shall be the following:
  - 1. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

### 3.3 HVAC PIPING INSULATION SCHEDULE

- A. Refrigerant Suction and Hot-Gas Piping: Insulation shall be the following:
  - 1. Flexible Elastomeric: 1 inch (25 mm) thick.
- B. Refrigerant Suction and Hot-Gas Flexible Tubing: Insulation shall be the following:
  - 1. Flexible Elastomeric: 1 inch (25 mm) thick.

END OF SECTION

## SECTION 23 09 00 - INSTRUMENTATION AND CONTROL FOR HVAC

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This section includes control equipment for HVAC systems and components. HVAC control panel will be located in electrical switchgear room and will be the master controller of all HVAC equipment. The HVAC control panel will communicate with application specific controllers at RTU-1, 2, 3; the Fire Alarm panel; all motorized dampers; exhaust fans EF-1, 2, 3, 4. Provide software and hardware to allow HVAC Control Panel to have a user interface at the Owner's operator workstation. Communication protocol shall be BACNET compatible.

#### 1.2 DEFINITIONS

- A. RTU: Rooftop Unit
- B. AI: Analog Input
- C. AO: Analog Output
- D. CS: Current Sensor
- E. DDC: Direct Digital Control
- F. DI: Discreet Input
- G. DO: Discreet Output
- H. DP: Differential Pressure Sensor
- I. EXF: Exhaust Fan
- J. I/O: Input/Output
- K. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.
- L. PC: Personal Computer
- M. PID: Proportional plus integral derivative.
- N. RH: Relative Humidity Sensor
- O. SD: Smoke Detector
- P. T: Temperature Sensor

Q. VFD: Variable Frequency Drive.

### 1.3 SYSTEM PERFORMANCE

- A. Comply with the following performance requirements:
1. Graphic Display: Display graphic with minimum 20 dynamic points.
  2. Graphic Refresh: Update graphic with minimum 20 dynamic points.
  3. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
  4. Alarm Response Time: Annunciate alarm at Owner's workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
  5. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
  6. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
  7. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
    - a. Space Temperature: Plus or minus 1 degree F.
    - b. Outside Air Temperature: Plus or minus 2 degrees F.
    - c. Relative Humidity: Plus or minus 5 percent.

### 1.4 SUBMITTALS

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
  2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
  3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic design.
- B. 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.
1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
  2. Schematic flow diagrams showing fans, filters, coils, dampers, valves, and control devices.
  3. Wiring Diagrams: Power, signal, and control wiring.
  4. Details of control panel faces, including controls, instruments, and labeling.
  5. Written description of sequence of operation.
  6. Schedule of dampers including size, leakage, and flow characteristics.
  7. Schedule of valves including flow characteristics.
  8. DDC System Hardware:
    - a. Wiring diagrams for control units with termination numbers.

- b. Schematic diagrams and floor plans for field sensors and control hardware.
- c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
- 9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
- 10. Controlled Systems:
  - a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
  - b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
  - c. Written description of sequence of operation including schematic diagram.
  - d. Points list.
- C. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135.
- D. Data Communications Protocol Certificates: Certify that each proposed DDC system component is compatible with existing communications protocol at Owner's workstation.
- E. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.
- B. 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

### 2.1 CONTROL SYSTEM

- A. Manufacturers:
  - 1. Johnson Controls Corporation
  - 2. Trane
  - 3. Or Equal.

### 2.2 DDC EQUIPMENT

- A. Operator Workstation: PC-based microcomputer (Owner's specified location).
  - 1. Application Software:
    - a. I/O capability from operator station.
    - b. System security for each operator via software password and access levels.

- c. Automatic system diagnostics; monitor system and report failures.
  - d. Alarm processing, messages, and reactions.
- B. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
- 1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
  - 2. Standard Application Programs:
    - a. HVAC Control Programs: Optimal run time.
    - b. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
    - c. Remote communications.
    - d. Maintenance management.
    - e. Units of Measure: Inch-pound and SI (metric).
  - 3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.

### 2.3 APPLICATION SPECIFIC CONTROLLERS PROVIDED WITH RTU-1,2,3

- A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
- 1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
  - 2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
  - 3. ASHRAE 135 Compliance: Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135. Reside on network using MS/TP datalink/physical layer protocol and have service communication port for connection to diagnostic terminal unit.
  - 4. Communications Protocol Compliance: Control units shall use existing communications protocol and communicate with existing workstation and/or other network controllers through existing communications protocol or BACNET.
  - 5. Enclosure:
    - a. Dustproof rated for operation at 32 to 120 degrees F.
    - b. Waterproof rated for operation at 40 to 150 degrees F.

### 2.4 ALARM PANELS

- A. Unitized cabinet with suitable brackets for wall or floor mounting. Fabricate of 0.06-inch thick, furniture-quality steel or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish. Provide common keying for all panels.

- B. Indicating light for each alarm point, single horn, acknowledge switch, and test switch, mounted on hinge cover.
  - 1. Alarm Condition: Indicating light flashes and horn sounds.
  - 2. Acknowledge Switch: Horn is silent and indicating light is steady.
  - 3. Second Alarm: Horn sounds and indicating light is steady.
  - 4. Alarm Condition Cleared: System is reset and indicating light is extinguished.
  - 5. Contacts in alarm panel allow remote monitoring by independent alarm company.

## 2.5 ANALOG CONTROLLER

- A. Step Controllers: 6 or 10 stage type, with heavy-duty switching rated to handle loads and operated by electric motor.
- B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 degrees F, and single or double-pole contacts.
- C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.
  - 1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.
- D. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.

## 2.6 ELECTRONIC SENSORS

- A. Thermistor Temperature Sensors and Transmitters:
  - 1. Accuracy: Plus or minus 0.5 degrees F at calibration point.
  - 2. Wire: Twisted, shielded-pair cable.
  - 3. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 SF.
  - 4. Averaging Elements in Ducts: 36 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 10 SF.
  - 5. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
  - 6. Room Sensor Cover Construction: Manufacturer's standard locking covers.
    - a. Set-Point Adjustment: Concealed.
    - b. Set-Point Indication: Exposed.
    - c. Thermometer: Exposed, LCD readout.
  - 7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
  - 8. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
- B. Humidity Sensors: Bulk polymer sensor element.
  - 1. Accuracy: 2 percent full range with linear output.

2. Room Sensor Range: 20 to 80 percent relative humidity.
  3. Room Sensor Cover Construction: Manufacturer's standard locking covers.
    - a. Set-Point Adjustment: Concealed.
    - b. Set-Point Indication: Exposed.
    - c. Hygrometer: Exposed LCD readout.
  4. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
  5. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at design outdoor temperatures plus 10 degrees F, minus 20 degrees F.
  6. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.
- C. Pressure Transmitters/Transducers:
1. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.

## 2.7 STATUS SENSORS

- A. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.

## 2.8 ACTUATOR

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
1. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
  2. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running torque of 150 inch x lbf and breakaway torque of 300 inch x lbf.
  3. Spring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running and breakaway torque of 150 inch x lbf.
  4. Nonspring-Return Motors for Dampers Larger Than 25 SF: Size for running torque of 150 inch x lbf and breakaway torque of 300 inch x lbf.
  5. Spring-Return Motors for Dampers Larger Than 25 SF: Size for running and breakaway torque of 150 inch x lbf.
- B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
1. Manufacturers:
    - a. Belimo Aircontrols (USA), Inc.
    - b. Or Equal.
  2. Dampers: Size for running torque calculated as follows:
    - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/SF of damper.
    - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/SF of damper.
    - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/SF of damper.

- d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/SF of damper.
- e. Dampers with 2 to 3 inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
- f. Dampers with 3 to 4 inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.
- 3. Power Requirements (Two-Position Spring Return): 120-V ac.
- 4. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.

## 2.9 DAMPERS

- A. Dampers: AMCA-rated, opposed-blade design; 0.108 inch minimum thick, galvanized-steel or 0.125 inch minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064 inch thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.
  - 1. Secure blades to ½ inch diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
  - 2. Operating Temperature Range: From minus 40 to plus 200 degrees F.
  - 3. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per SF of damper area, at differential pressure of 4 inch wg when damper is held by torque of 50 inch x lbf; when tested according to AMCA 500D.

## 2.10 CONTROL CABLE

- A. Control wiring and conduits are specified in Division 26.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that power supply is available to control units and operator workstation.

### 3.2 INSTALLATION

- A. Install control wiring concealed, except in mechanical rooms, and according to requirements specified in Division 26 Sections.
- B. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- C. Connect and configure equipment and software to achieve sequence of operation specified.
- D. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor.
  - 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.



- E. Install labels and nameplates to identify control components.

### 3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, field-assembled components and equipment installation, including connections. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
  1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
  2. Test and adjust controls and safeties.
  3. Test each point through its full operating range to verify that safety and operating control set points are as required.
  4. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
  5. Test each system for compliance with sequence of operation.
- C. DDC Verification:
  1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
  2. Check instruments for proper location and accessibility.
  3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
  4. Check instrument tubing for proper fittings, slope, material, and support.
  5. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
  6. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
  7. Check temperature instruments and material and length of sensing elements.
  8. Check control valves. Verify that they are in correct direction.
  9. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
  10. Check DDC system as follows:
    - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
    - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
    - c. Verify that spare I/O capacity has been provided.
    - d. Verify that DDC controllers are protected from power supply surges.
    - e. Verify HVAC control panel properly communicates with Fire Alarm panel.

### 3.5 ADJUSTING

- A. Calibrating and Adjusting:
1. Control System Inputs and Outputs:
    - a. Check analog inputs at 0, 50, and 100 percent of span.
    - b. Check analog outputs using milliamperemeter at 0, 50, and 100 percent output.
    - c. Check digital inputs using jumper wire.
    - d. Check digital outputs using ohmmeter to test for contact making or breaking.
    - e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
  2. Pressure:
    - a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
    - b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
  3. Temperature:
    - a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
    - b. Calibrate temperature switches to make or break contacts.
  4. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
  5. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
  6. Provide diagnostic and test instruments for calibration and adjustment of system.
  7. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls.

END OF SECTION

## SECTION 23 09 93 – SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes control sequences for HVAC systems, subsystems, and equipment.
- B. Related Sections include the following:
  - 1. Division 23 Section “Instrumentation and Control for HVAC” for control equipment and devices and submittal requirements.

#### 1.3 DEFINITIONS

- A. DDC: Direct-digital controls.
- B. AI: Analog input.
- C. AO: Analog output.
- D. DI: Digital input.
- E. DO: Digital output.

#### 1.4 ROOFTOP UNIT RTU-1 SEQUENCE OF OPERATION

- A. General: This sequence describes the control of the rooftop mounted air handling unit serving the Switchgear Room, Battery Station Room, and IT Room. RTU-1 will be provided with an Application Specific Controller (APC) from the air handling unit manufacturer.
- B. Auto Control: When the unit is put in auto at the HVAC control panel, the rooftop unit will be controlled by the unit controller supplied by the rooftop unit manufacture.
- C. Occupied Control: When the building is occupied, the unit supply fan shall run continuously.
- D. Normal Cooling Mode: Compressor shall be energized as required to maintain a space temperature of 80 degrees F (adjustable) in the Switchgear Room.
- E. High Humidity Mode: If the space humidity sensor relative humidity rises above 55% (adjustable), then the compressor and condensing fans shall be energized to maintain a space

relative humidity of 55% (adjustable) in the switchgear room. Once the relative humidity falls below 55%, the unit shall return to normal cooling mode.

- F. Heating Mode: If the outside air temperature drops below 45 degrees and the space temperature in the switchgear room falls below 48 degrees F, then unit will switch to heating mode. The compressor and condenser fans shall be de-energized. The first stage of electric heating coil shall be energized to maintain a space temperature of 50 degrees (adjustable). If the space temperature falls below 40 degrees F, then the second stage of electric heat shall be energized.
- G. Smoke Detection: If supply or return duct smoke detectors sense products of combustion, then the supply air fan shall be de-energized, supply air motorized dampers shall be closed, and return air motorized dampers shall be closed.
- H. Outside Air Control: When the supply fan is energized, outside air damper shall be open.
- I. Filter Alarm: When differential air pressure is greater than 1 in-wg then the clean air differential pressure, then the dirty filter alarm will be initiated.
- J. Fire Alarm Initiated Smoke Detection: If Fire Alarm panel sends “smoke alarm” signal to the HVAC control panel, the HVAC control panel shall send a “smoke alarm” signal to the unit controller. Next, the unit controller shall de-energize the supply air fan, close supply air motorized dampers, and close return air motorized dampers.
- K. RTU-1 Control Point List:

Description	Point Type				Alarm
	AI	AO	DI	DO	
Outside Air Temperature	X				
Energize/De-energize supply fan				X	
Open/Close Supply Air Motorized Damper				X	
Open/Close Supply Air Motorized Damper				X	
Open/Close Supply Air Motorized Damper				X	
Open/Close Return Air Motorized Damper				X	
Open/Close Return Air Motorized Damper				X	
Open/Close Return Air Motorized Damper				X	
Enable/Disable Unit Controller				X	
Supply Air Smoke Detection			X		Smoke

					Detected
Return Air Smoke Detection			X		Smoke Detected
Open/Close Outside Air Damper				X	
Filter Status			X		Change Filter

1.5 ROOFTOP UNIT RTU-2 and RTU-3 SEQUENCE OF OPERATION

- A. General: This sequence describes the operation of a rooftop air handling unit that is controlled by a unit controller.
- B. Auto Control: When the HVAC control panel sends an enabling signal to the unit controller the unit controller shall control the unit.
- C. Smoke Control: If products of combustion are detected by smoke detectors located in supply or return air duct, then supply fan shall be de-energized.
- D. Outside Air Control: When the supply fan is energized, outside air damper shall be open.
- E. Filter Alarm: When differential air pressure is greater than 1 in-wg above the clean air differential pressure, then the dirty filter alarm will be initiated.
- F. Fire Alarm Initiated Shut Down: When an alarm signal is sent from the fire alarm panel, the supply fan shall be de-energized, outside air damper close.
- G. RTU-2 and RTU-3 Control Point List

Description	Point Type				Alarm
	AI	AO	DI	DO	
Energize/De-energize supply fan				X	
Enable/Disable Unit Controller				X	
Supply Air Smoke Detection			X		Smoke Detected
Return Air Smoke Detection			X		Smoke Detected
Open/Close Outside Air Damper				X	

Filter Status			X		Change Filter
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1.6 EXHAUST FAN EF-1, EF-2, EF-3

- A. General: This sequence describes the operation of an exhaust fan that is controlled by the HVAC control panel.
- B. On/Off Control: When the HVAC control panel sends a start signal to the unit controller the exhaust fan shall be energized.
- C. Fan Status: When the current sensor senses current within acceptable limits the fan status shall be “operating”.
- D. Air Exhaust Damper Control: When the exhaust fan is energized, outside air damper shall be open
- E. Fire Alarm Initiated Shut Down: When an alarm signal is sent from the fire alarm panel, the exhaust fan shall be de-energized, and the outside air damper shall close.
- F. EF-1, EF-2 and EF-3 Control Point List

Description	Point Type				Alarm
	AI	AO	DI	DO	
Energize/De-energize exhaust fan				X	
Open/Close Outside Air Exhaust Damper				X	
Fire Alarm Initiate Shut Down			X		Alarm Signal Sent From Fire Alarm Panel
Fan Status			X		

1.7 HVAC CONTROL POINT LIST

- A. HVAC Control Point List. Communication from HVAC Control Panel to Fire Alarm Panel.

Description	Point Type				Alarm
	AI	AO	DI	DO	
Receive Fire Detection from Fire Alarm Panel			X		Alarm Signal Sent from FA Panel
Send "Fire Detected" Signal When Smoke Detected				X	To Fire Alarm Panel

END OF SECTION 23 09 93

## SECTION 23 21 13 - HYDRONIC PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
  - 1. Condensate-drain piping.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
  - 1. Condensate-Drain Piping: 150 deg F (66 deg C).

### PART 2 - PRODUCTS

#### 2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B).
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.

#### 2.2 PLASTIC PIPE AND FITTINGS

- A. PVC Plastic Pipe: ASTM D 1785, Schedules 40 and 80, plain ends as indicated in Part 3 "Piping Applications" Article.
- B. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

#### 2.3 JOINING MATERIALS

- A. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.



- C. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- D. Solvent Cements for Joining Plastic Piping:
  - 1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
    - a. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    - b. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    - c. Solvent cement and adhesive primer 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."

## 2.4 TRANSITION FITTINGS

### A. Plastic-to-Metal Transition Fittings:

- 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:
  - a. Charlotte Pipe and Foundry Company.
  - b. IPEX Inc.
  - c. KBi.
- 2. PVC one-piece fitting with one threaded brass or copper insert and one Schedule 80 solvent-cement-joint end.

### B. Plastic-to-Metal Transition Unions:

- 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:
  - a. Charlotte Pipe and Foundry Company.
  - b. IPEX Inc.
  - c. KBi.
  - d. NIBCO INC.
- 2. MSS SP-107, PVC union. Include brass or copper end, Schedule 80 solvent-cement-joint end, rubber gasket, and threaded union.

## 2.5 VALVES

### A. Class 150, Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Conbraco Industries, Inc.; Apollo Valves.
  - b. Hammond Valve, Milwaukee Valve Company.
  - c. NIBCO INC.
  - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Body: Forged or cast brass.
3. Connections: Threaded with union inlet.
4. Valve: Nickel-plated brass ball with EPDM O-rings behind the seals.
5. Size: NPS 2" and smaller.
6. Minimum CWP Rating: 275 psig.
7. Maximum Operating Temperature: 250 deg F.

B. Isolation Union:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Flow Design Inc.
  - b. Griswold Controls.
2. Body: Forged or cast brass.
3. Connections: Threaded.
4. Union: Provide union with four ¼" body tappings with brass end connections. Union seal shall be EPDM O-rings. Provide a pressure/temperature test plug.
5. Size: NPS 2" and smaller.
6. Minimum CWP Rating: 275 psig.
7. Maximum Operating Temperature: 250 deg F.

### PART 3 - EXECUTION

#### 3.1 PIPING APPLICATIONS

- A. Condensate-Drain Piping: Type L (B), drawn-temper copper tubing, wrought-copper fittings, and soldered joints or Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.

#### 3.2 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such 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.
- B. Comply with requirements in Division 23 Section "Common Work Results for HVAC" for basic piping installation requirements.

- C. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Comply with requirements in Division 23 Section "Common Work Results for HVAC" for wall penetration systems.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. 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.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Install piping to permit valve servicing.
- H. Install piping at indicated slopes.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Install piping to allow application of insulation.
- L. Select system components with pressure rating equal to or greater than system operating pressure.
- M. Install drains, consisting of a tee fitting, NPS 3/4 (DN 20) ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- N. Install piping at a uniform slope of 0.2 percent upward in the direction of flow.
- O. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- P. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- Q. Install unions in piping, NPS 2 (DN 50) and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Remove stems, seats, and packing of valves and accessible internal parts at piping specialties before soldering or brazing.
- S. Install sleeves for piping penetrations of walls, ceilings, and floors.
- T. Install sleeve seals for piping penetrations of concrete walls and slabs.
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors.

### 3.3 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. 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.
- D. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. PVC Nonpressure Piping: Join according to ASTM D 2855.

### 3.4 TESTING, ADJUSTING, AND BALANCING

- A. Clean and flush hydronic piping systems.
- B. Hydrostatically test completed piping at a pressure one and one-half times operating pressure. Isolate equipment before testing piping. Repair leaks and retest piping until there are no leaks.

END OF SECTION 232113

## SECTION 23 23 00 - REFRIGERANT PIPING

### PART 1 - GENERAL

#### 1.1 QUALITY ASSURANCE

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."
- C. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

#### 1.2 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410A:
  - 1. Suction Lines for Air-Conditioning Applications: 300 psig (2068 kPa).
  - 2. Suction Lines for Heat-Pump Applications: 535 psig (3689 kPa).
  - 3. Hot-Gas and Liquid Lines: 535 psig (3689 kPa).

### PART 2 - PRODUCTS

#### 2.1 TUBES AND FITTINGS

- A. Copper Tube: ASTM B 88, Type L.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8.

## 2.2 VALVES AND SPECIALTIES

- A. Thermostatic Expansion Valves: Comply with ARI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
  2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
  3. Packing and Gaskets: Non-asbestos.
  4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
  5. Suction Temperature: 40 deg F (4.4 deg C).
  6. Superheat: Adjustable.
  7. Reverse-flow option (for heat-pump applications).
  8. End Connections: Socket, flare, or threaded union.
  9. Working Pressure Rating: 700 psig (4820 kPa).
- B. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.
1. Body and Bonnet: Plated steel.
  2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
  3. Seat: Polytetrafluoroethylene.
  4. End Connections: Threaded.
  5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and 24-V normally closed holding coil.
  6. Working Pressure Rating: 400 psig (2760 kPa).
  7. Maximum Operating Temperature: 240 deg F (116 deg C).
  8. Manual operator.
- C. Service Valves:
1. Body: Forged brass with brass cap including key end to remove core.
  2. Core: Removable ball-type check valve with stainless-steel spring.
  3. Seat: Polytetrafluoroethylene.
  4. End Connections: Copper spring.
  5. Working Pressure Rating: 500 psig (3450 kPa).
- D. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
  2. Piston, Closing Spring, and Seat Insert: Stainless steel.
  3. Seat Disc: Polytetrafluoroethylene.
  4. End Connections: Threaded.
  5. Working Pressure Rating: 400 psig (2760 kPa).
  6. Maximum Operating Temperature: 240 deg F (116 deg C).
- E. Straight-Type Strainers:
1. Body: Welded steel with corrosion-resistant coating.
  2. Screen: 100-mesh stainless steel.
  3. End Connections: Socket or flare.
  4. Working Pressure Rating: 500 psig (3450 kPa).

5. Maximum Operating Temperature: 275 deg F (135 deg C).

F. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig (3450 kPa).
7. Maximum Operating Temperature: 240 deg F (116 deg C).

### 2.3 REFRIGERANTS

- A. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

- A. Suction Lines: Copper, Type L (B), drawn-temper tubing and wrought-copper fittings with soldered joints.
- B. Hot-Gas and Liquid Lines, and Suction Lines for Heat Pump Applications: Copper, Type L (B), drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.
- C. Safety-Relief-Valve Discharge Piping: Copper, Type L (B), drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.

### 3.2 INSTALLATION

- A. Comply with requirements in Division 23 Section "Common Work Results for HVAC" for basic piping installation requirements.
- B. Install wall penetration system at each pipe penetration through foundation wall. Make installation watertight. Comply with requirements in Division 23 Section "Common Work Results for HVAC" for wall penetration systems.
- C. 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 Shop Drawings.
- D. Install refrigerant piping and charge with refrigerant according to ASHRAE 15.

- E. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- F. 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.
- G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- H. Install piping adjacent to machines to allow service and maintenance.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- M. Install refrigerant piping in protective conduit where installed belowground.
- N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- O. Belowground, install copper tubing in PVC conduit. Vent conduit outdoors.
- P. Insulate suction lines to comply with Division 23 Section "HVAC Insulation."
- Q. Slope refrigerant piping as follows:
  - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
  - 2. Install horizontal suction lines with a uniform slope downward to compressor.
  - 3. Liquid lines may be installed level.
- R. Install solenoid valves upstream from each thermostatic expansion valve. Install solenoid valves in horizontal lines with coil at top.
- S. Install thermostatic expansion valves as close as possible to distributors on evaporator coils.
- T. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- U. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- V. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.



END OF SECTION 232300

## SECTION 23 31 00 - HVAC DUCTS AND CASINGS

### PART 1 - GENERAL

#### 1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data for fire and smoke dampers.
- B. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- C. Comply with UL 181 for ducts and closures.

### PART 2 - PRODUCTS

#### 2.1 DUCTS

- A. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip galvanized coating.
- B. Fibrous-Glass Duct Board: Comply with UL 181, Class 1, 1-inch- (25-mm-) thick, fibrous glass with fire-resistant, reinforced foil-scrim-kraft barrier, and having the air-side surface treated to prevent erosion.
- C. Joint and Seam Tape, and Sealant: Comply with UL 181A.
- D. Rectangular Metal Duct Fabrication: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

#### 2.2 ACCESSORIES

- A. Volume Dampers and Control Dampers: Single-blade and multiple opposed-blade dampers, standard leakage rating, and suitable for horizontal or vertical applications; factory fabricated and complete with required hardware and accessories.
- B. Fire Dampers: Rated and labeled according to UL 555 by an NRTL; factory fabricated and complete with required hardware and accessories.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Ruskin Company, IBD or comparable product by one of the following:
    - a. Greenheck Fan Corporation.
    - b. Nailor Industries Inc.
    - c. Ruskin Company.
  - 2. Type: Static; rated and labeled according to UL 555 by an NRTL.

3. Fire Rating: 3 hours.
  4. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.
  5. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
    - a. Minimum Thickness: 0.036 inch thick, as indicated, and of length to suit application.
    - b. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
  6. Mounting Orientation: Vertical or horizontal as indicated.
  7. Blades: Roll-formed, interlocking, 0.024-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.
  8. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
  9. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.
- C. Ceiling Fire Dampers: Labeled according to UL 555C by an NRTL and complying with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory." Provide factory-fabricated units complete with required hardware and accessories.
- D. Smoke Dampers: Labeled according to UL 555S by an NRTL. Combination fire and smoke dampers shall also be rated and labeled according to UL 555. Provide factory-fabricated units complete with required hardware and accessories.
- E. Flexible Connectors: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
- F. Flexible Ducts: Factory-fabricated, insulated, round duct, with an outer jacket enclosing 1-inch-(25-mm-) thick, glass-fiber insulation around a continuous inner liner complying with UL 181, Class 1.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
  1. Outdoor, Supply-Air Ducts: Seal Class A.
  2. Outdoor, Exhaust Ducts: Seal Class C.
  3. Outdoor, Return-Air Ducts: Seal Class C.
  4. Unconditioned Space, Supply-Air Ducts: Seal Class A.

5. Unconditioned Space, Exhaust Ducts: Seal Class C.
  6. Unconditioned Space, Return-Air Ducts: Seal Class B.
  7. Conditioned Space, Supply-Air Ducts: Seal Class B.
  8. Conditioned Space, Exhaust Ducts: Seal Class B.
  9. Conditioned Space, Return-Air Ducts: Seal Class C.
- C. Conceal ducts from view in finished and occupied spaces.
  - D. Avoid passing through electrical equipment spaces and enclosures.
  - E. Support ducts to comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Hangers and Supports."
  - F. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
  - G. Install volume and control dampers in lined duct with methods to avoid damage to liner and to avoid erosion of duct liner.
  - H. Install fire dampers according to UL listing.
  - I. Install fusible links in fire dampers.
  - J. Clean duct system(s) before testing, adjusting, and balancing.
- 3.2 TESTING, ADJUSTING, AND BALANCING
- A. Balance airflow within distribution systems, including submains, branches, and terminals to indicated quantities.

END OF SECTION

## SECTION 23 31 13 - METAL DUCTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes:
  - 1. Single-wall rectangular ducts and fittings.
  - 2. Single-wall round and flat-oval ducts and fittings.
  - 3. Sheet metal materials.
  - 4. Sealants and gaskets.
  - 5. Hangers and supports.
  - 6. Seismic-restraint devices.
- B. Related Sections:
  - 1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
  - 2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

#### 1.3 SYSTEM DESCRIPTION

- A. Dimensions indicated on drawings are inside clear dimension.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Duct Design:
  - 1. Static-Pressure Classes:
    - a. Medium Pressure Supply Ducts: 2-inch wg.
    - b. Return Ducts (Negative Pressure): 2-inch wg.
    - c. General Exhaust Ducts (Negative Pressure): 1-inch wg.
  - 2. Leakage Class:
    - a. Supply Air Ducts: 1 percent of design airflow at maximum duct design static pressure.
    - b. Return Air Ducts: 2 percent of design airflow at maximum duct design static pressure.
    - c. General Exhaust Air Ducts: 2 percent of design airflow at maximum duct design static pressure.
- B. Structural Performance:

## 1.5 SUBMITTALS

- A. Product Data: For each type of the following products:
  - 1. Adhesives.
  - 2. Sealants and gaskets.
  
- B. Shop Drawings:
  - 1. Fabrication, assembly, installation, including plans, elevations, sections, components, and attachments to other work.
  - 2. Factory-and shop-fabricated ducts and fittings.
  - 3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
  - 4. Elevation of top of ducts.
  - 5. Dimensions of main duct runs from building grid lines.
  - 6. Fittings.
  - 7. Reinforcement and spacing.
  - 8. Seam and joint construction.
  - 9. Penetrations through fire-rated and other partitions.
  - 10. Equipment installation based on equipment being used on Project.
  - 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
  - 12. Hangers and supports, including methods for duct and building attachment and vibration isolation.
  
- C. Welding certificates.
  
- D. Field quality-control reports.

## 1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, “Structural Welding Code – Steel,” for hangers and supports and AWS D9.1M/D9.1, “Sheet Metal Welding Code,” for duct joint and seam welding.
  
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, “Structural Welding Code – Steel,” for hangers and supports.
  - 2. AWS D9.1M/D9.1, “Sheet Metal Welding Code,” for duct joint and seam welding.

## PART 2 - PRODUCTS

### 2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA’s “HVAC Duct Construction Standards – Metal and Flexible” based on indicated static-pressure class unless otherwise indicated.
  
- B. Transverse Joints: Select joint types and fabricate according to SMACNA’s “HVAC Duct Construction Standards – Metal and Flexible,” Figure 1-4, “Transverse (Firth) Joints,” for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals,

and other provisions in SMACNA's "HVAC Duct Construction Standards – Metal and Flexible."

- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Figure 1-5, "Longitudinal Seams – Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards – Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Shall be as indicated on drawings and fabricated according to SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards – Metal and Flexible."
  - 1. For mitered 90 degree ells, use single thickness turning vanes.
  - 2. On medium pressure ducts, use high efficiency turning vanes with a minimum 1 inch trailing edge.

## 2.2 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. General Fabricatin Requirements: Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Lindab Inc.
    - b. McGill AirFlow LLC.
    - c. SEMCO Incorporated.
    - d. Spiral Manufacturing Co., Inc.
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter (diameter of the round sides connecting the flat portions of the duct).
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Figure 3-2, "Transverse Joints – Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards – Metal and Flexible."
  - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Figure 3-1, "Seams – Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards – Metal and Flexible."
  - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
  - 2. Fabricate flat-oval ducts larger than 72 inches in width with butt-welded longitudinal seams.

- E. Tees and Laterals: Shall be as indicated on drawings and fabricated according to SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards – Metal and Flexible."
- F. Elbows: Smooth or 5-piece for 90 degree ells with centerline radius of 1.5 times duct dimension in plane of bend. Ells of 45 degrees or less may be 3-piece.

## 2.3 SHEET METAL MATERIALS

- A. General Material Requirements: 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 non-shedding, free of pitting, seam marks, roller marks, stains, discolorations and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: G90 (Z275).
  - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Fibrous-Glass Duct Board: Comply with UL 181, Class 1, 1-inch thick, fibrous glass with fire-resistant, reinforced foil-scrim-kraft barrier, and having the air-side surface treated to prevent erosion.
- D. Aluminum Alloy 3003 per ASTM B209.
- E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
  - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum duct, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- F. Tie Rods: Galvanized steel, ¼ inch minimum diameter for lengths 36 inches or less; 3/8 inch minimum diameter for lengths longer than 36 inches.

## 2.4 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
  - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
  - 2. Tape Width: 4 inches.
  - 3. Sealant: Modified styrene acrylic.
  - 4. Water resistant.
  - 5. Mold and mildew resistant.



6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brushed on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and 20-inch wg negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flange Gaskets: Butyl rubber, neoprene, or EDPM polymer with polyisobutylene plasticizer.

E. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 SF at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EDPM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## 2.5 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

D. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

G. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

## 2.6 VOLUME DAMPERS

- A. Manufacturers:
1. Greenheck.
  2. Leader Industries.
  3. Ruskin Company.
  4. Vent Products Company, Inc.
  5. Air Balance, Inc.
- B. General for all Volume Dampers: Volume dampers (factory fabricated, standard and low leakage) shall include a locking device to hold dampers in a fixed position and shall be provided with opposed blade design if offered by manufacturer.
- C. 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.
1. Pressure Classes of 3-Inch wg or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.
  2. Damper Limit (Height): 11 inch for single-blade; greater than 11-inch shall be multiple blade.
- D. Standard Volume Dampers: Single-blade or multiple opposed-blade design, standard leakage rating, suitable for horizontal or vertical applications. Material to match duct material; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
1. Steel Frames: Hat-shaped, galvanized or stainless sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
  2. Roll-Formed Steel Blades: 0.064 inch thick, galvanized or stainless sheet steel.
  3. Aluminum Frames: Hat-shaped, 0.10 inch thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
  4. Roll-Formed Aluminum Blades: 0.10 inch thick extruded aluminum.
  5. Blade Axles: Galvanized steel, stainless steel, or nonferrous.
  6. Bearings: Oil-impregnated bronze, molded synthetic, or stainless-steel sleeve.
  7. Tie Bars and Brackets: Aluminum or galvanized steel.
- E. Low-Leakage Volume Dampers: Multiple-or single-blade, parallel-or opposed-blade design as indicated, low-leakage rating, and suitable for horizontal or vertical applications. Material to match duct material.
1. Steel Frames: Galvanized or stainless sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
  2. Roll-Formed Steel Blades: 0.064 inch thick, galvanized or stainless sheet steel.
  3. Aluminum Frames: 0.10 inch thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
  4. Roll-Formed Aluminum Blades: 0.10 inch thick aluminum sheet.
  5. Extruded-Aluminum Blades: 0.10 inch thick extruded aluminum.

6. Blade Axles: Galvanized steel.
  7. Bearings: Stainless-steel sleeve thrust or ball.
  8. Blade Seals: Neoprene.
  9. Jamb Seals: Cambered stainless steel.
  10. Tie Bars and Brackets: Galvanized steel.
- F. Jackshaft: 1 inch diameter, galvanized steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.
- G. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32 inch thick zinc-plated steel, and a 3/4 inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform (stand-off bracket) for insulated duct mounting.

## 2.7 FIRE DAMPERS

- A. Manufacturers:
1. Air Balance, Inc.
  2. Leader Industries.
  3. Greenheck.
  4. Ruskin Company.
  5. Vent Products Company, Inc.
- B. Material to match duct material; use galvanized-steel accessories in galvanized-steel ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Each Damper shall bear an UL approved label identifying its classification as a Dynamic Rated Fire Damper, (static dampers not acceptable). Fire dampers shall be labeled according to UL 555 current edition.
- D. Fire Rating: 3 hours.
- E. Dampers shall be capable of the following dynamic rating:
1. Dampers shall have been tested per AMCA 500-90, in which it shall have proven to close under specified static pressure and dynamic airflow conditions.
- F. Frame: Curtain type with blades outside airstream, 100% free area; fabricated with roll-formed, 0.034 inch thick galvanized steel; with mitered and interlocking corners.
- G. Integral Sleeve/Frame: Curtain type with blades outside airstream, 100% free area; fabricated with roll-formed, minimum 0.052 inch thick galvanized steel or adjacent duct sheet metal thickness, whichever is greater; with sleeve and frame of damper roll-formed into integral shape.
- H. Mounting Sleeve: Factory-or field-installed, galvanized sheet steel.
1. Minimum Thickness: 0.052 or 0.138 inch thick as indicated and of length to suit application.

2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angels on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.

- I. Mounting Orientation: Vertical or horizontal as indicated.
- J. Blades: Roll-formed, interlocking, 0.034 inch thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034 inch thick, galvanized-steel blade connections.
- K. Vertical and Horizontal Curtain Fire Dampers: Include blade lock and two stainless steel, constant force closure springs per damper section.
- L. Fire dampers shall be installed in walls/floors utilizing 16 gage UL approved Wrap Around Retaining Angles.
- M. Fusible Links: Replaceable, 165 deg F rated.

## 2.8 MULTI BLADED FIRE DAMPERS, DYNAMIC RATED

- A. General Description: Fire dampers shall be labeled according to UL 555 for 3 hour rating.
- B. Fusible Links: Replaceable, 165 deg F rated.
- C. Frame and Blades: 0.064 inch thick, galvanized sheet steel. Triple crimped blades to be on 6" centers.
- D. Mounting Sleeve: Factory-installed, 0.052 inch thick, galvanized sheet steel; length to suit wall or floor application.
- E. Fire dampers shall be installed in walls/floors utilizing 16 gage UL approved Wrap Around Retaining Angles.

## 2.9 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ductmate Industries, Inc.
  - 2. Nexus PDQ; Division of Shilco Holdings Inc.
  - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

## 2.10 TURNING VANES

- A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes. Single thickness turning vanes may be used in ducts with velocities up to 1200 fpm.
- B. Manufactured Turning Vanes: Fabricate 1-1/2 inch wide, single or double-vane, curved blades of galvanized sheet steel set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into vane runners suitable for duct mounting.
  - 1. Manufacturers:
    - a. Ductmate Industries, Inc.
    - b. Duro Dyne Corp.
    - c. METALAIRE, Inc.
    - d. Ward Industries, Inc.

## 2.11 DUCT-MOUNTED ACCESS DOORS

- A. General Description: Fabricate doors airtight and suitable for duct pressure class.
- B. Door: Double wall, duct mounted, rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1 inch butt or piano hinge and cam latches.
  - 1. Manufacturers:
    - a. Air Balance, Inc.
    - b. Ductmate Industries, Inc.
    - c. Kees, Inc.
    - d. Leader Industries.
  - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
  - 3. Provide number of hinges and locks as follows:
    - a. Less Than 12 Inches Square: Secure with two sash locks.
    - b. Up to 18 Inches Square: Two hinges and two sash locks.
    - c. Up to 24 by 48 Inches: Three hinges and two compression latches with outside handles.
    - d. Sizes 24 by 48 Inches and Larger: One additional hinge.
    - e. Hinges may be replaced with latches where clearance will not allow full range of access door opening.
- C. Door: Double wall, duct mounted, round; fabricated of galvanized sheet metal with insulation fill and 1-inch thickness. Include cam latches.
  - 1. Manufacturers:
    - a. Flexmaster U.S.A., Inc.
    - b. McGill Airflow Corporation.
  - 2. Frame: Galvanized sheet steel, with spin-in notched frame.
- D. Pressure Relief Access Door: Double wall and duct mounting; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated, latches, and retaining chain.
  - 1. Manufacturers:
    - a. Air Balance, Inc.

- b. Ductmate Industries, Inc.
  - c. Greenheck.
  - d. KEES, Inc.
2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
- E. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
- F. Insulation: 1 inch thick, fibrous-glass or polystyrene-foam board.

## PART 3 - EXECUTION

### 3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards – Metal and Flexible" unless otherwise indicated.
- C. Install round and flat-oval ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

### 3.2 SEAM AND JOINT SEALING

- A. Seal duct seams and joints for duct static-pressure and leakage classes specified in "Performance Requirements" Article, according to SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements," unless otherwise indicated.
  - 1. Seal Class:
    - a. Medium Pressure Supply Ducts, up to 9 inches Positive: Seal Class A.
    - b. Return Ducts, Negative 3 inches or Less" Seal Class A.
    - c. Exhaust Ducts, Negative 19 inches or Less: Seal Class B.
    - d. Exhaust Ducts, Negative 2 inches or Less: Seal Class B.

### 3.3 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
  - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Dust Construction Standards – Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum interval of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.4 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

- B. Comply with SMACNA's "HVAC Duct construction Standards – Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### 3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
  - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual."
  - 2. Test the following systems:
    - a. Supply air for AHU-3-1-A and AHU-3-1B.
    - b. Return air for AHU-3-1A and AHU-3-1B.
    - c. Exhaust air including EXF-3-1, EXF-3-2, EXF-3-3 (Dust Collection) and EXF-3-4.
  - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
  - 4. Test for leaks before insulation application.
  - 5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
- C. Duct System Cleanliness Tests:
  - 1. Visually inspect duct system to ensure that no visible contaminants are present.
  - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning, and Restoration of HVAC Systems."
    - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

### 3.6 DUCT SCHEDULE

- A. Intermediate Reinforcement:
  - 1. Galvanized-Steel Ducts: Galvanized steel.
  - 2. 304 Stainless Steel Ducts: Stainless steel.
  - 3. Aluminum Alloy 3003 per ASTM B209.
- B. Elbow Configuration:
  - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Figure 2-2, "Rectangular Elbows."
    - a. Velocity 1000 fpm or Lower:
      - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
      - 2) Mitered Type RE 4 with turning vanes.
    - b. Velocity 1000 to 1500 fpm:



- 1) Radius Type RE 1 with minimum 1.5 radius-to diameter ratio.
  - 2) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
  - c. Velocity 1500 fpm or Higher:
    - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    - 2) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
  2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Figure 3-3, "Round Duct Elbows."
    - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
      - 1) Velocity 1000 fpm or Lower: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
      - 2) Velocity 1000 to 1500 fpm: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
      - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
    - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or welded segmented.
    - c. Round Elbows, 14 Inches and Larger in Diameter: Welded segmented.
- C. Branch Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Figure 2-6, "Branch Connections."
    - a. Rectangular Main to Rectangular Branch: 45-degree entry.
    - b. Rectangular Main to Round Branch: Spin in.
  2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
    - a. Velocity 1000 fpm or Lower: Conical tap.
    - b. Velocity 1000 to 1500: Conical tap.
    - c. Velocity 1500 fpm or Higher: 45-degree lateral, or conical tap.

END OF SECTION

## SECTION 23 34 23 - HVAC POWER VENTILATORS

### PART 1 - GENERAL

#### 1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data.
- B. Products shall be licensed to use the AMCA-Certified Ratings Seal.
- C. Power ventilators shall comply with UL 705.
- D. 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.

### PART 2 - PRODUCTS

#### 2.1 CENTRIFUGAL WALL AND ROOF VENTILATORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. Aerovent.
  - 2. Carnes Company.
  - 3. Greenheck Fan Corporation.
  - 4. Loren Cook Company.
  - 5. Penn Ventilation.
- B. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
  - 1. Upblast Units: Aluminum discharge baffle to direct discharge air upward, with rain and snow drains.
  - 2. Wall-Mounting Units: Aluminum rectangular base with venturi inlet cone, motor mount, and vibration isolators designed for wall mounting.
- C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- D. Belt-Driven Drive Assembly: Resiliently mounted to housing.
  - 1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
  - 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
  - 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
  - 4. Fan and motor isolated from exhaust airstream.
- E. Accessories:

1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
  2. Bird Screens: Removable, 1/2-inch (13-mm) mesh, aluminum or brass wire.
  3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
  4. Extended Lube Lines.
  5. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.
- F. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- (40-mm-) thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch (40-mm) wood nailer. Size as required to suit roof opening and fan base.
1. Configuration: Built-in raised cant and mounting flange.
  2. Overall Height: 12 inches (300 mm).
  3. Pitch Mounting: Manufacture curb for roof slope.
  4. Mounting Pedestal: Galvanized steel with removable access panel.

## 2.2 CEILING-MOUNTED VENTILATORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Carnes Company.
  2. Greenheck Fan Corporation.
  3. Loren Cook Company.
  4. PennBarry.
- B. Housing: Steel, lined with acoustical insulation.
- C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- D. Grille: Painted aluminum, louvered grille with flange on intake and thumbscrew attachment to fan housing.
- E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- F. Accessories:
1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
  2. Ceiling Radiation Damper: Fire-rated assembly with ceramic blanket, stainless-steel springs, and fusible link.
  3. Isolation: Rubber-in-shear vibration isolators.

## 2.3 IN-LINE CENTRIFUGAL FANS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. Carnes Company.
  - 2. Greenheck Fan Corporation.
  - 3. Loren Cook Company.
  - 4. PennBarry.
- B. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.
- C. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.
- D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
- E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.
- F. Accessories:
  - 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
  - 2. Companion Flanges: For inlet and outlet duct connections.
  - 3. Fan Guards: 1/2- by 1-inch (13- by 25-mm) mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
  - 4. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.
- G. Characteristics:
  - 1. Vibration Isolators:
    - a. Type: Spring hangers.
    - b. Static Deflection: 1 inch (25 mm) .
  - 2. Spark Arrestance Class: [A] [B] [C].

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Roof-Mounted Units: Install roof curb on roof structure, according to [ARI Guideline B.] [NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts."] Install and secure roof-mounted fans on curbs, and coordinate roof penetrations and flashing with roof construction.

- B. In-Line Centrifugal Fans: Suspend units from structural-steel support frame using threaded steel rods and vibration isolation springs.
- C. Ceiling-Mounted Units: Suspend units from structure using steel wire or metal straps.
- D. Ground power ventilators.

END OF SECTION

## SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

### PART 1 - GENERAL

#### 1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data and color charts for factory finishes.

### PART 2 - PRODUCTS

#### 2.1 CEILING DIFFUSERS

- A. Square Plaque Ceiling Diffusers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Price; ASPD.
2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Aluminum.
4. Finish: Baked enamel, white.
5. Face Size: 24 by 24 inches (600 by 600 mm) unless indicated otherwise.
6. Face Style: Plaque.
7. Pattern: Fixed.
8. Dampers: Radial opposed blade.

#### 2.2 REGISTERS AND GRILLES

- A. Adjustable Bar Register:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Price; 620DAL.
2. Material: Aluminum.
3. Finish: Baked enamel, white.
4. Face Blade Arrangement: Vertical spaced 3/4 inch (19 mm) apart.
5. Core Construction: Removable.
6. Rear-Blade Arrangement: Horizontal spaced 3/4 inch (19 mm) apart.
7. Frame: 1 inch (25 mm) wide.
8. Mounting: Countersunk screw.
9. Damper Type: Adjustable opposed blade.

- B. Fixed Face Register:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Price; 635DAL/FL.
2. Material: Aluminum.
3. Finish: Baked enamel, white.

4. Face Arrangement: 45 degree louvered blades, ½” spacing.
5. Core Construction: Integral.
6. Frame: 1 inch (25 mm) wide.
7. Mounting: Countersunk screw or lay in as required by ceiling type.
8. Damper Type: Adjustable opposed blade.

C. Fixed Face Grille:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Price; 635FL.
2. Material: Aluminum.
3. Finish: Baked enamel, white.
4. Face Arrangement: 35 degree louvered blades, ½” spacing.
5. Core Construction: Integral.
6. Frame: 1 inch (25 mm) wide.
7. Mounting: Countersunk screw or lay in as required by ceiling type.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel unless otherwise indicated. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

## SECTION 23 81 19 - PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:
  - 1. Direct-expansion cooling.
  - 2. Electric-heating coils.
  - 3. Economizer outdoor- and return-air damper section.
  - 4. Integral, space temperature controls.
  - 5. Roof curbs.

#### 1.3 DEFINITIONS

- A. DDC: Direct-digital controls.
- B. ECM: Electrically commutated motor.
- C. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.
- D. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs.
- E. RTU: Rooftop Unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.
- F. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.
- G. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations.
- H. VVT: Variable-air volume and temperature.



#### 1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design RTU supports to comply with performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Wind-Restraint Performance:
  - 1. Basic Wind Speed: Refer to Structural Drawings.
  - 2. Building Classification Category: Refer to Structural Drawings.
  - 3. Minimum 10 lb/sq. ft multiplied by the maximum area of the mechanical component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

#### 1.5 SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
- B. 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.
  - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Delegated-Design Submittal: For RTU supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
  - 2. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
  - 3. Restraint Details: Detail fabrication and attachment of wind and seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.
- F. Warranty: Special warranty specified in this Section.

#### 1.6 QUALITY ASSURANCE

- A. ARI Compliance:

1. Comply with ARI 210/240 and ARI 340/360 for testing and rating energy efficiencies for RTUs.
2. Comply with ARI 270 for testing and rating sound performance for RTUs.

B. ASHRAE Compliance:

1. Comply with ASHRAE 15 for refrigeration system safety.
2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
3. Comply with applicable requirements in ASHRAE 62.1-2010, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1-2010 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2010, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

E. UL Compliance: Comply with UL 1995.

F. 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.

## 1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
2. Warranty Period for Solid-State Ignition Modules: Manufacturer's standard, but not less than three years from date of Substantial Completion.
3. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

## 1.1 EXTRA MATERIALS

B. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan Belts: One spare set for each belt-driven fan.
2. Filters: Three sets of filters for each unit.

## PART 2 - PRODUCTS

### 2.1 ROOFTOP AIR HANDLING UNITS (RTU-1,2,3)

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
  - a. Carrier Corporation.
  - b. Lennox Industries Inc.
  - c. McQuay International.
  - d. Trane; American Standard Companies, Inc.
  - e. YORK International Corporation.

**B. GENERAL**

1. Provide factory-installed microprocessor controls. Operating range for units with electromechanical controls shall be between 115°F and 40°F. Cooling performance shall be rated in accordance with AHRI testing procedures. All units shall be factory assembled, internally wired, fully charged with R-410A, and 100 percent run tested to check cooling operation, fan and blower rotation, and control sequence before leaving the factory. Wiring internal to the unit shall be colored and numbered for simplified identification. Units shall be cULus listed and labeled, classified in accordance for Central Cooling Air Conditioners.

**C. CASING**

1. Unit casing shall be constructed of zinc coated, galvanized steel. Exterior surfaces shall be cleaned, and phosphatized. Cabinet construction shall allow for all maintenance on one side of the unit. Service panels shall have lifting handles and be removed and reinstalled by removing two fasteners while providing a water and air tight seal. All exposed vertical panels and top covers in the indoor air section shall be insulated with a cleanable foil-faced, fire-retardant permanent, odorless glass fiber material. The base of the unit shall be insulated with 1/8 inch, foil-faced, closed-cell insulation. All insulation edges shall be either captured or sealed. The unit's base pan shall have no penetrations within the perimeter of the curb other than the raised 1 1/8 inch high downflow supply/return openings to provide an added water integrity precaution, if the condensate drain backs up. The base of the unit shall have provisions for forklift and crane lifting, with forklift capabilities on three sides of the unit. The unit top cover shall be double hemmed and gasket sealed.
2. Exterior Casing Material: Zinc galvanized steel shall be dipped in a corrosion-protection coating able to pass a 2,000 hr salt-spray test per ASTM B11, (apply Adsil or Bronz-Glow coating or equal) with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
  - a. Exterior Casing Thickness: 0.052 inch thick.
3. Inner Casing Fabrication Requirements:
  - a. Inside Casing: Galvanized steel, 0.034 inch thick.
4. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
  - a. Materials: ASTM C 1071, Type I.
  - b. Thickness: 1/2 inch.
  - c. Liner materials shall have air-stream surface coated with an erosion- and temperature-resistant coating or faced with a plain or coated fibrous mat or fabric.
  - d. Liner Adhesive: Comply with ASTM C 916, Type I.
5. Condensate Drain Pans: Formed sections of stainless-steel sheet, a minimum of 2 inches deep, and complying with ASHRAE 62.1.
  - a. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
  - b. Drain Connections: Threaded nipple both sides of drain pan.

- c. Pan-Top Surface Coating: Corrosion-resistant compound.
- 6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2010.

D. FANS

- 1. Indoor Fan: The following units shall be equipped with a direct drive plenum fan design (T/YSC120F,T/YHC092F,T/YHC102F, 120E).
  - a. Plenum fan design shall include a backward-curved fan wheel along with an external rotor direct drive variable speed indoor motor.
  - b. All plenum fan designs will have a variable speed adjustment potentiometer located in the control box.
  - c. 3-5 ton units (standard efficiency 3-phase or high efficiency 3-phase with optional motor) are belt driven, FC centrifugal fans with adjustable motor sheaves. 3-5 ton units (1-phase or high efficiency 3-phase) have multispeed, direct drive motors. All 6-8½ ton units (standard efficiency) shall have belt drive motors with an adjustable idler-arm assembly for quick-adjustment to fan belts and motor sheaves.
  - d. All motors shall be thermally protected.
  - e. All 10 tons and 7½-8½ (high efficiency) have variable speed direct drive motors. All indoor fan motors meet the U.S. Energy Policy Act of 1992 (EPACT).
- 2. Outdoor Fan: The outdoor fan shall be direct-drive, statically balanced, draw-through in the vertical discharge position. The fan motor shall be permanently lubricated and shall have built-in thermal overload protection.
- 3. Belt-Driven Supply-Air Fans: Double width, forward curved, centrifugal; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in the casing. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.
- 4. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.
- 5. Plenum Fan: All 10 tons and 7½-8½ ton high efficiency units shall be equipped with a direct drive plenum fan design. Plenum fan design shall include a backward-curved fan wheel along with an external rotor direct drive variable speed indoor motor. All plenum fan designs will have a variable speed adjustment potentiometer located in the control box.

E. COILS

- 1. Supply-Air Evaporator Refrigerant Coil:
  - a. Internally finned, 5/16" copper tubes mechanically bonded to a configured aluminum plate fin shall be standard.
  - b. Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
  - c. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.
  - d. Baked phenolic or Cathodic epoxy coating.
  - e. The evaporator coil shall be leak tested to 600 psig. The assembled unit shall be leak tested to 465 psig.
  - f. Provide a dual-sloped, removable and reversible stainless steel condensate drain pan: with through the base condensate drain, and pitch and drain connections complying with ASHRAE 62.1-2010.
- 2. Outdoor-Air Condenser Refrigerant Coil:
  - a. Internally finned, 5/16" copper tubes mechanically bonded to a configured aluminum plate fin shall be standard.

- b. Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
  - c. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.
  - d. Baked phenolic or Cathodic epoxy coating.
  - e. The condenser coil shall be leak tested to 600 psig. The assembled unit shall be leak tested to 465 psig.
  - f. Provide microchannel type condenser coil for units over 5 tons.
3. Hot-Gas Reheat Refrigerant Coil:
- a. Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
  - b. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.
  - c. Baked phenolic or Cathodic epoxy coating.
4. Electric-Resistance Heating:
- a. Open Heating Elements: Resistance wire of 80 percent nickel and 20 percent chromium, supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized-steel frame. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.
  - b. Over-temperature Protection: Disk-type, automatically reset, thermal-cutout, safety device; serviceable through terminal box.
  - c. Overcurrent Protection: Manual-reset thermal cutouts, factory wired in each heater stage.
  - d. Control Panel: Unit mounted with disconnecting means and overcurrent protection. Include the following controls:
    - 1) SCR Controller: Pilot lights operate on load ratio, a minimum of five steps.
    - 2) Time-delay relay.
    - 3) Airflow proving switch.

F. REFRIGERANT CIRCUIT COMPONENTS

- 1. Compressor: All units shall have direct drive, hermetic, scroll type compressors with centrifugal type oil pumps, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief.
  - a. Motors shall be suction gas-cooled and shall have a voltage utilization range of plus or minus 10 percent of unit nameplate voltage. Internal overloads shall be provided with the scroll compressors.
  - b. Crankcase heaters shall be included on 6-10 ton units.
  - c. Provide dual compressors for humidity control if manufacturer can provide.
  - d. Motor shall be suction gas cooled. Provide informal overloads.
- 2. Each refrigerant circuit provided with thermal expansion valve. Provide service pressure ports, and refrigerant line filter driers: factory-installed. An area shall be provided for replacement suction line driers.
- 3. Refrigeration Specialties:
  - a. Refrigerant: R-410A.
  - b. Expansion valve with replaceable thermostatic element.
  - c. Refrigerant filter/dryer.
  - d. Manual-reset high-pressure safety switch.
  - e. Automatic-reset low-pressure safety switch.
  - f. Minimum off-time relay.

- g. Automatic-reset compressor motor thermal overload.
- h. Brass service valves installed in compressor suction and liquid lines.
- i. Low-ambient kit high-pressure sensor.
- j. Hot-gas reheat solenoid valve with a replaceable magnetic coil.
- k. Hot-gas bypass solenoid valve with a replaceable magnetic coil.

G. AIR FILTRATION

- 1. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
  - a. Pleated: Minimum 90 percent arrestance, and MERV 8.
  - b. Provide 2-inch MERV 13 filters.

H. ELECTRICAL POWER CONNECTION

- 1. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.
- 2. Provide electrical phase monitoring protection.

I. CONTROLS

- 1. Unit shall be completely factory-wired with necessary controls and contactor pressure lugs or terminal block for power wiring. Unit shall provide an external location for mounting a fused disconnect device. A microprocessor control shall be available. Microprocessor controls provide for all 24V control functions. The resident control algorithms shall make all heating, cooling, and/or ventilating decisions in response to electronic signals from sensors measuring indoor and outdoor temperatures. The control algorithm maintains accurate temperature control, minimizes drift from set point, and provides better building comfort. A centralized microprocessor shall provide anti-short cycle timing and time delay between compressors to provide a higher level of machine protection. 24-volt electromechanical control circuit shall include control transformer and contactor pressure lugs for power wiring. Units shall have single point power entry as standard.
- 2. Control equipment and sequence of operation are specified in Division 23 Section "Instrumentation and Control for HVAC."
- 3. High Pressure Control: All units include High Pressure Cutout as standard.
- 4. Electronic DDC Controller:
  - a. Controller shall have volatile-memory backup.
  - b. Safety Control Operation:
    - 1) Smoke Detectors: Stop fan and close outdoor-air damper if smoke is detected. Provide additional contacts for alarm interface to fire alarm control panel.
    - 2) Fire Alarm Control Panel Interface: Provide control interface to coordinate with operating sequence described in Division 28 Section "Fire Detection and Alarm."
  - c. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of two programmable periods per day.
  - d. Unoccupied Period:
    - 1) Heating Setback: 10 deg F.
    - 2) Cooling Setback: System off.
    - 3) Override Operation: Two hours.
  - e. Supply Fan Operation:

- 1) Occupied Periods: Run fan continuously.
- 2) Unoccupied Periods: Cycle fan to maintain setback temperature.
- f. Refrigerant Circuit Operation:
  - 1) Occupied Periods: Cycle or stage compressors, and operate hot-gas bypass to match compressor output to cooling load to maintain discharge temperature and humidity. Cycle condenser fans to maintain maximum hot-gas pressure. Operate low-ambient control kit to maintain minimum hot-gas pressure.
  - 2) Unoccupied Periods: Cycle compressors and condenser fans for heating to maintain setback temperature.
  - 3) Switch reversing valve for heating or cooling mode on air-to-air heat pump.
- g. Hot-Gas Reheat-Coil Operation:
  - 1) Occupied Periods: Humidistat opens hot-gas valve to provide hot-gas reheat, and cycles compressor.
  - 2) Unoccupied Periods: Reheat not required.
- h. Electric-Heating-Coil Operation:
  - 1) Occupied Periods: Cycle coil to maintain discharge temperature.
  - 2) Unoccupied Periods: Energize coil to maintain setback temperature.
5. Interface Requirements for HVAC Instrumentation and Control System:
  - a. Interface relay for scheduled operation.
  - b. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.
  - c. Provide BACnet compatible interface for central HVAC control workstation for the following:
    - 1) Adjusting set points.
    - 2) Monitoring supply fan start, stop, and operation.
    - 3) Inquiring data to include supply- and room-air temperature and humidity.
    - 4) Monitoring occupied and unoccupied operations.
    - 5) Monitoring constant and variable motor loads.
    - 6) Monitoring variable-frequency drive operation.
    - 7) Monitoring cooling load.
    - 8) Monitoring economizer cycles.
    - 9) Monitoring air-distribution static pressure and ventilation air volume.

## J. ACCESSORIES

1. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.
2. Coil guards of painted, galvanized-steel wire.
3. Hinged access doors for filter/evaporator section, fan section, and compressor/control section.

## 2.2 ROOF CURBS

- A. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
  1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
    - a. Materials: ASTM C 1071, Type I or II.

- b. Thickness: 1-1/2 inches.
- 2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
  - a. Liner Adhesive: Comply with ASTM C 916, Type I.
  - b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
  - c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
  - d. Liner Adhesive: Comply with ASTM C 916, Type I.
- B. Curb Height: 14 inches.
- C. Wind Restraints: Metal brackets compatible with the curb and casing, painted to match RTU, used to anchor unit to the curb, and designed for loads at Project site. Comply with requirements in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for wind-load requirements.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.
- B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.
- C. Examine roofs for suitable conditions where RTUs will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Roof Curb: Install on roof structure or concrete base, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Division 07 Section "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.
- B. Unit Support: Install unit level on structural curbs. Coordinate penetrations and flashing with wall and roof construction. Secure RTUs to structural support with anchor bolts.



- C. Install wind and seismic restraints according to manufacturer's written instructions

### 3.3 CONNECTIONS

- A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.
- B. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
  - 1. Install ducts to termination at top of roof curb.
  - 2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
  - 3. Connect supply ducts to RTUs with flexible duct connectors specified in Division 23 Section "Air Duct Accessories."
  - 4. Install return-air duct continuously through roof structure.

### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Tests and Inspections:
  - 1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
  - 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.

### 3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
  - 1. Inspect for visible damage to unit casing.
  - 2. Inspect for visible damage to furnace combustion chamber.
  - 3. Inspect for visible damage to compressor, coils, and fans.
  - 4. Inspect internal insulation.
  - 5. Verify that labels are clearly visible.
  - 6. Verify that clearances have been provided for servicing.

7. Verify that controls are connected and operable.
8. Verify that filters are installed.
9. Clean condenser coil and inspect for construction debris.
10. Clean furnace flue and inspect for construction debris.
11. Connect and purge gas line.
12. Remove packing from vibration isolators.
13. Inspect operation of barometric relief dampers.
14. Verify lubrication on fan and motor bearings.
15. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
16. Adjust fan belts to proper alignment and tension.
17. Start unit according to manufacturer's written instructions.
  - a. Start refrigeration system.
  - b. Do not operate below recommended low-ambient temperature.
  - c. Complete startup sheets and attach copy with Contractor's startup report.
18. Inspect and record performance of interlocks and protective devices; verify sequences.
19. Operate unit for an initial period as recommended or required by manufacturer.
20. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency.
  - a. Measure gas pressure on manifold.
  - b. Inspect operation of power vents.
  - c. Measure combustion-air temperature at inlet to combustion chamber.
  - d. Measure flue-gas temperature at furnace discharge.
  - e. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
  - f. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
21. Calibrate thermostats.
22. Adjust and inspect high-temperature limits.
23. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
24. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:
  - a. Coil leaving-air, dry- and wet-bulb temperatures.
  - b. Coil entering-air, dry- and wet-bulb temperatures.
  - c. Outdoor-air, dry-bulb temperature.
  - d. Outdoor-air-coil, discharge-air, dry-bulb temperature.
25. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
26. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
  - a. Supply-air volume.
  - b. Return-air volume.
  - c. Relief-air volume.

- d. Outdoor-air intake volume.
27. Simulate maximum cooling demand and inspect the following:
- a. Compressor refrigerant suction and hot-gas pressures.
  - b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.
28. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
- a. High-temperature limit on gas-fired heat exchanger.
  - b. Low-temperature safety operation.
  - c. Filter high-pressure differential alarm.
  - d. Economizer to minimum outdoor-air changeover.
  - e. Relief-air fan operation.
  - f. Smoke and firestat alarms.
29. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

### 3.6 CLEANING AND ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.
- B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

### 3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 238119

SECTION 26 05 00 – COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL - BASIC METHODS AND REQUIREMENTS

1.1 DESCRIPTION

- A. Related Documents: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this Section.
- B. This Section, Common Work Results for Electrical applies to all sections of Divisions 26.
- C. Furnish and install electrical wiring, systems, equipment and accessories in accordance with the specifications and drawings. Generally, capacities and ratings of motors, transformers, cables, switchgear, panelboards, and other items and arrangements for the specified items are shown on drawings.
- D. Wiring ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways accordingly sized. Aluminum conductors are prohibited.
- E. Electrical service entrance equipment (arrangements for temporary and permanent connections to the power company's system) shall conform to the power company's requirements.

1.2 References – Latest adopted editions of:

- A. FBC - Florida Building Code
- B. OSHA – Occupational Safety and Health Administration
  - 1. PART 1910 - Occupational Safety and Health Standard
  - 2. PART 1926 - Safety and Health Regulations for Construction
- C. American National Standards Institute:
  - 1. ANSI C2 – National Electrical Safety Code
- D. National Fire Protection Association (NFPA):
  - 1. NFPA 70 –National Electric Code
  - 2. NFPA 70E – Electrical Safety in the Workplace
  - 3. NFPA 72 – National Fire Alarm Code
  - 4. NFPA 101 – Life Safety Code
  - 5. NFPA780 – Lightning Protection Code
- E. The installation shall also comply with all applicable rules and regulations of local and state laws and ordinances. Include in the work, without extra cost, any labor, materials, services, apparatus and drawings required to comply with all applicable laws, ordinances, rules and regulations. Inform the Engineer of any work or material which conflict with any applicable codes, standards, laws and regulations before submitting the bid.

- F. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

### 1.3 TEST STANDARDS

- A. All materials and equipment shall be listed, labeled or certified by a nationally recognized testing laboratory to meet Underwriters Laboratories, Inc., standards where test standards have been established. Equipment and materials which are not covered by UL Standards will be accepted provided equipment and material is listed, labeled, certified or otherwise determined to meet safety requirements of a nationally recognized testing laboratory.
- B. Definitions:
  - 1. Listed; equipment or device of a kind mentioned which:
    - a. Is published by a nationally recognized laboratory which makes periodic inspection of production of such equipment.
    - b. States that such equipment meets nationally recognized standards or has been tested and found safe for use in a specified manner.
  - 2. Labeled; equipment or device is when:
    - a. It embodies a valid label, symbol, or other identifying mark of a nationally recognized testing laboratory such as Underwriters Laboratories, Inc.
    - b. The laboratory makes periodic inspections of the production of such equipment.
    - c. The labeling indicated compliance with nationally recognized standards or tests to determine safe use in a specified manner.
  - 3. Certified; equipment or product is which:
    - a. Has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards or to be safe for use in a specified manner.
    - b. Production of equipment or product is periodically inspected by a nationally recognized testing laboratory.
    - c. Bears a label, tag, or other record of certification.
  - 4. Nationally recognized testing laboratory; laboratory which approved, in accordance with OSHA regulations, by the Secretary of Labor.

### 1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)

- A. Manufacturer's Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project and shall have manufactured the item for at least three years.
- B. Product Qualification:
  - 1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
  - 2. The Owner reserves the right to require the contractor to submit a list of installations where the products have been in operation before approval.
- C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organization.

## 1.5 MANUFACTURED PRODUCTS

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.
- B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
  - 1. Components of an assembled unit need not be products of the same manufacturer.
  - 2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
  - 3. Components shall be compatible with each other and with the total assembly for the intended service.
  - 4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.
- E. When Factory Testing Is Specified :
  - 1. The Owner shall have the option of witnessing factory tests. The contractor shall notify the Engineer a minimum of 15 working days prior to the manufacturers making the factory tests.
  - 2. Four copies of certified test reports containing all test data shall be furnished to the Engineer prior to final inspection and not more than 90 days after completion of the tests.
  - 3. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including the expenses of the Owner.

## 1.6 EQUIPMENT REQUIREMENTS

- A. Where variations from the contract requirements are requested in accordance with Divisions 00 and 01, the connecting work and related components shall include, but not be limited to additions or changes to circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.
- B. No substitution will be considered unless written request has been submitted to the Owner at least ten (10) days prior to the date for receipt of bids.
- C. If the Owner approves any proposed substitutions, such approval will be set forth in an addendum.

## 1.7 EQUIPMENT PROTECTION

- A. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.
- B. Devices, manufactured items, and equipment shall be visually inspected by the contractor when received and prior to acceptance from conveyance. Store equipment and materials at the site,

unless off-site storage is authorized in writing. Stored items shall be protected from the environment in accordance with the manufacturer's published instructions; covering equipment with tarps while exposed, is unacceptable. The new 13.2 kV switchgear shall be stored in a conditioned, secure, and protective space (preferably the switchgear room). Storing it in unconditioned spaces will not be allowed.

1. During installation, enclosures, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of foreign matter; and be vacuum cleaned both inside and outside before testing, operating, final inspection, and repainting if required.
2. Damaged equipment shall be, as determined by the Architect/Engineer, placed in first class operating condition or be returned to the source of supply for repair or replacement.
3. Painted surfaces shall be protected with a factory installed removable heavy kraft paper, sheet vinyl or equal.
4. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

C. Coordinate deliveries of electrical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for smooth and efficient flow of installation. Schedule the delivery of the new 13.2 kV switchgear when the building is ready to accept it. See above.

D. Rough-in:

1. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
2. Verify above and below counter locations at millwork locations with Architect prior to rough-in.
3. As a general rule, receptacle and telecom outlets shall be located 6" centerline to centerline unless otherwise noted or prohibited by code.
4. Refer to equipment specifications in Divisions 02 through 28 for additional rough-in requirements.

## 1.8 WORK PERFORMANCE

- A. All electrical work shall comply with the requirements listed in this specification and to other references required by contract.
- B. All wiring, conduit, ducts, and all electrical equipment, etc. regardless of its nature, shall be installed by workers trained and qualified in the electrical trade and closely supervised by licensed electricians.
- C. Job site safety and worker safety is the responsibility of the contractor.
- D. Electrical work shall be accomplished with all affected circuits or equipment deenergized. When an electrical outage cannot be accomplished in this manner for the required work, the following requirements are mandatory :
  1. Electricians must use and wear full protective equipment (PPE) (i.e., certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools, etc.) while working on energized systems in accordance with NFPA 70E. The level of PPE shall be determined by a computer generated arc flash calculation

provided and paid for by the contractor. The arc flash data shall be presented with the project submittals.

2. Work on energized circuits or equipment cannot begin until prior written approval is obtained from the Owner.
- E. Arrange, phase and perform work to ensure electrical service is not interrupted for other buildings, cranes, and facilities at all times. Refer to Division 01, General Requirements.
- F. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Divisions 00 and 01.

#### 1.9 EQUIPMENT INSTALLATION AND REQUIREMENTS

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Working spaces shall not be less than specified in the NEC for all voltages specified.
- C. Inaccessible Equipment :
  1. Where the Owner determines that the contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Owner.
  2. "Conveniently accessible" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

#### 1.10 PAINTING OF EQUIPMENT

- A. Factory Applied
  1. Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test and the additional requirements specified in the technical sections.
- B. Field Applied
  1. Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in the section specifying the associated electrical equipment.

#### 1.11 DEMOLITION

- A. Visit the site before submitting a bid to observe existing conditions.
- B. Work in existing buildings and or existing facilities shall be scheduled well in advance with Owner. Work shall be performed at such times and under such conditions as suit the convenience of the Owner. Plan the work to minimize disruption of normal operations. Notify Owner minimum 21 calendar days before any existing circuit is de-energized.



- C. Where circuit is interrupted by removal of a device or fixture from that circuit, install conductors/cabling and conduit as required to restore service to the remaining devices and fixtures on that circuit. Ensure proper grounding is maintained.
- D. In areas to be remodeled remove existing conduit and wire not required to remain in use back to nearest wiring to remain in use. Splice and Terminate in junction boxes as appropriate. Where entire circuit is to be removed, remove conduit and wire back to existing panelboard. Where such work would not be possible without disturbing areas not to be renovated, consult with the Owner prior to performing the work.
- E. Lighting fixtures, wiring devices, panelboards, and equipment removed shall be transported to the Owner's designated location and offered to the Owner's representative. If he chooses to retain these items, turn those chosen over to him. Items rejected by the Owner's representative shall be removed completely from the project site and disposed of legally by the Contractor.

#### 1.12 ELECTRICAL INSTALLATIONS

- A. Make a thorough examination of the site and the contract documents. No claim for extra compensation will be recognized if difficulties are encountered which an examination of site conditions and contract documents prior to executing contract would have revealed.
- B. Coordinate electrical equipment and materials installation with existing site conditions and other building components. The drawings are generally diagrammatic, and where conflict exists, the Owner/Engineer will decide location prior to beginning work.
- C. Verify all dimensions by field measurements.
- D. Arrange for chases, slots and openings to allow for electrical installations.
- E. Coordinate installations of required raceways, boxes, supporting devices, and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed. Sequence, coordinate and integrate installations of electrical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing-in the building.
- F. Coordinate the cutting and patching of building components to accommodate the installation of electrical equipment and materials.
- G. Install electrical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
- H. Coordinate the installation of electrical materials and equipment above ceilings with suspension system, mechanical equipment and systems, and structural components.
- I. Temporary electrical service and construction lighting shall be provided under this section. Provide for all electrical service for construction period, making all connections and removal of same at job conclusion. Furnish and install temporary lighting for construction period. At job completion, all temporary lamps shall be removed and replaced with new lamps.

- J. All new conduit/raceways within this project area shall be properly supported. Add support to existing conduit as required to comply with NEC.
- K. Coordinate location of equipment and conduit with other trades to minimize interference. See Divisions 00 and 01.

#### 1.13 CUTTING AND PATCHING

- A. Refer to the Divisions 00 and 01 for general requirements for cutting and patching.
- B. Do not endanger or damage installed work through procedures and processes of cutting and patching.
- C. Arrange for repairs required to restore other work because of damage caused as a result of electrical installations.
- D. No additional compensation will be authorized for cutting and patching that is necessitated by ill-timed, defective, or non-conforming installations.
- E. Perform cutting, fitting, and patching of electrical equipment and materials required to :
  - 1. Uncover work to provide installations of ill-timed work.
  - 2. Remove and replace defective work.
  - 3. Remove and replace work not conforming to requirements of the contract documents.
  - 4. Remove samples of installed work as specified for testing.
  - 5. Install equipment and materials in existing structures.
  - 6. Upon written instructions from the Architect/Engineer, uncover and restore work to provide for Architect/Engineer observation of concealed work.
- F. Cut, remove and legally dispose of, selected electrical equipment, components, and materials as indicated; including, but not limited to, removal of electrical items indicated to be removed and items made obsolete by the new work.
- G. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
- H. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
- I. Locate, identify, and protect electrical services passing through remodeling or demolition area and serving other areas required to be maintained operational. When transit services must be interrupted, provide temporary services for the affected areas and notify the Owner minimum 21 days prior to changeover.
- J. All opening sleeves, and holes in walls and slabs between floors shall be properly sealed, fire proofed and water proofed.

1.14 EQUIPMENT IDENTIFICATION

- A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as panelboards, switchboards, transformers, pull boxes, fire alarm, motor controllers (starters), safety switches, separately enclosed circuit breakers, switchgear, control devices, low voltage boxes, and other significant equipment. See Section 26 05 53.

1.15 SUBMITTALS

- A. Submit in accordance with project contract documents.
- B. Submit seven (7) hardcopy sets plus one (1) electronic copy. The Owner/Engineer will return two (2) sets.
- C. Submit hard copies in 3-ring binders.
- D. Approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval, will not be permitted at the job site.
- E. Submittals shall be to an acceptable level of review status as determined by the Owner/Architect and Engineer shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment of material which has not made it to this acceptable level will not be permitted at the job site.
- F. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Architect/Engineer to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.
- G. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
  - 1. Mark the submittals, "SUBMITTED UNDER SECTION \_\_\_\_\_".
  - 2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
  - 3. Submit each section separately.
- H. Submittal of shop drawings, product data, and samples will be accepted only when submitted by the contractor. Data submitted from subcontractors and material suppliers directly to the Architect/Engineer will not be processed.
- I. Product Options and Substitutions: Refer to the Instructions to Bidders and the Division 1 Section "Products and Substitutions" for requirements in selecting products and requesting substitutions.
- J. Submittals shall include the following :

1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
  2. Elementary and interconnection wiring diagrams for all switchgear, communication, and signal systems, low voltage systems and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
  3. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.
- K. Manuals: Submit in accordance with project contract documents.
1. Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections. Furnish seven (7) copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.
  2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, equipment, building, name of contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.
  3. Provide a "Table of Contents" and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
  4. The manuals shall include:
    - a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
    - b. A control sequence describing start-up, operation, and shutdown.
    - c. Description of the function of each principal item of equipment.
    - d. Installation and maintenance instructions.
    - e. Safety precautions.
    - f. Diagrams and illustrations.
    - g. Testing methods.
    - h. Performance data.
    - i. Lubrication schedule including type, grade, temperature range, and frequency.
    - j. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
    - k. Appendix; list of qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.
- L. Approvals will be based on complete submission of manuals. Submit no later than 180 days after the product shop drawings and submittals.
- M. In addition to the requirement of SUBMITTALS, the Owner reserves the right to request the manufacturer to arrange for an Owner representative to see typical active systems in operation, when there has been no prior experience with the manufacturer or the type of equipment being submitted.
- N. Record Documents :

1. Refer to the Divisions 00 and 01 for requirements. The following paragraphs supplement the requirements of Divisions 00 and 01.
2. Accurately and clearly red-line clean drawings to indicate revisions to conduit size and location, both exterior and interior; actual equipment locations, dimensioned from column lines; concealed equipment, dimensioned to column lines; distribution and branch electrical circuitry; fuse and circuit breaker size and arrangements; support and hanger details; change orders; concealed control system devices.
3. Accurately and clearly red-line clean specifications to indicate approved substitutions; change orders; actual equipment and materials used.

#### 1.16 SINGULAR NUMBER

- A. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., “the switch”), this reference shall be deemed to apply as many such devices as are required to complete the installation as shown on the drawings.

#### 1.17 TRAINING

- A. Training shall be provided in accordance with Article, INSTRUCTIONS, of Divisions 00 and 01.
- B. Training shall be provided for the particular equipment or system as required in each associated specification.
- C. A training schedule shall be developed and submitted by the contractor and approved by the Owner at least 30 days prior to the planned training.
- D. The Training sessions shall be digitally recorded on a DVD at the contractor’s expense. Three copies of each DVD shall be submitted to the Owner prior to project completion. There shall be one DVD per system being recorded. Label and index all DVDs.

#### 1.18 WARRANTIES

- A. Refer to the Division 01 Section: Specific Warranties for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements.
- B. Compile and assemble the warranties specified in Division 26 into separated set of vinyl-covered, three-ring binders, tabulated and indexed for easy reference.
- C. Provide complete warranty information for each item to include product or equipment; date or beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

END OF SECTION

## SECTION 26 05 13 – MEDIUM VOLTAGE CABLES

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. This section specifies the furnishing, installation and connection of the medium voltage cables.

#### 1.2 RELATED WORK

- A. Bedding of conduits: Section 31 20 00, Earth Moving.
- B. General electrical requirement and items that are common to more than one section of Division 26: Section 26 05 00, Common Work Results for Electrical.
- C. Conduits for medium voltage cables: Section 26 05 33, Raceway and Boxes for Electrical Systems.
- D. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 26 05 26, Grounding and Bonding for Electrical Systems.
- E. Section 26 05 43, Underground Ducts and Raceways for Electrical Systems.

#### 1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, Shop Drawings, Product Data, and Samples and Section 26 05 00, Common Work Results for Electrical.
- B. Shop Drawings:
  - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
  - 2. Include splice and termination kit information prior to purchase and installation.
  - 3. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
  - 4. Include splice and termination kit information prior to purchase and installation.
  - 5. Manufacturer shall determine maximum cable pulling tensions for each proposed run. Submit with cable submittal.
- C. Certifications:
  - 1. Factory test reports: Prior to installation of the cables, submit four copies of the manufacturer's certified NEMA WC 74, standard factory test report for the close-out document.
  - 2. Field test reports: After testing, submit four certified copies of each of the graphs, specified under field testing. Adequate information shall be included identifying the cable locations, types, voltage rating and sizes.
  - 3. Splices and terminations, after having been installed and tested, submit four copies of a

certificate which includes the following:

- a. A statement that the materials, detail drawings and printed instructions used were those contained in the kits approved for this contract.
  - b. Statement that each splice and each termination was completely installed without any overnight interruption.
- D. List all of the materials purchased and installed for the splices and terminations for this contract including the material descriptions, manufacturer's names, catalog numbers and total quantities.
- E. Installer Approval:
1. Employees who install the splices and terminations shall have not less than three years of experience splicing and terminating cables which are equal to those being spliced and terminated, including experience with the materials in the kits. Each employee shall successfully complete a 3M Medium Voltage Training Class prior to installing Splices or Terminations.
  2. Furnish satisfactory proof of such experience for each employee who splices or terminates the cables.
- F. Cable Voltage Ratings
1. Medium voltage power cables shall be as shown on the drawings.
- G. Shipment:
1. Cable shall be shipped on reels such that cable will be protected from mechanical injury. Each end of each length of cable shall be hermetically sealed with a heat shrink end cap and securely attached to the reel.

#### 1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. Underwriters Laboratories (UL):
1. 1072 – Safety Medium-Voltage Power Cables.
- C. National Fire Protection Association (NFPA):
1. 70 – National electrical Code (NEC)
  2. 70E – Standard for Electrical Safety in the Work Place.
- D. National Electrical Manufacturers Association (NEMA):
1. WC74 – 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electrical Energy.
- E. Institute of Electrical and Electronic Engineers, Inc. (IEEE):
1. 48 – Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765 kV.
  2. 386 – Separable Insulated Connector Systems for Power Distribution Systems above 600 volts.
  3. 400-01 – Guide for Field Testing and Evaluation of the Insulation of Shielded Power

Cable Systems.

4. 400.2-04 – Guide for field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF).
  5. 400.3-06 – Guide for Partial Discharge Testing of Shielded Power Cable systems in a Field Environment.
  6. 404 – Extruded and Laminated Dielectric Shielded Cable Joints rated 2500-500,000 volts.
  7. 592 – Exposed Semi-Conducting Shields on High-Voltage Cable Joints and Separable Insulated Connectors.
- F. American Society for Testing and Materials (ASTM):
1. B3-01 (2007) – Standard Specification for Soft or Annealed Copper Wire.
- G. Underwriters Laboratories (UL):
1. 1072-06 – Medium-Voltage Power Cables.

## PART 2 - PRODUCTS

### 2.1 MATERIAL - HIGH VOLTAGE CABLE

- A. Medium voltage cable shall be in accordance with the NEC and NEMA WC 74 and UL 1072.
- B. Shall be single conductor stranded copper.
- C. Insulation:
  1. Insulation level shall be 133 percent.
  2. Types of insulation:
    - a. Cable type abbreviation, EPR: Ethylene propylene rubber insulation shall be thermosetting, light and heat stabilized.
- D. Conductors and insulation shall be wrapped separately with semi-conducting tape.
- E. Insulation shall be wrapped with non-magnetic, metallic shielding.
- F. Heavy duty, overall protective jacket of polyvinyl chloride (PVC) shall enclose every cable.
- G. Cable temperature ratings for continuous operation, emergency overload operation and short circuit operation shall be not less than the NEMA WC74 Standard for the respective cable. Cables shall be MV-105 rated.
- H. Manufacturer's name and other pertinent information shall be marked or incorporated on marker tapes within the cables at reasonable intervals.

### 2.2 MATERIAL, SPLICES AND TERMINATIONS

- A. The materials shall be compatible with the conductors, insulations and protective jackets on the cables and wires.



- B. The splices shall insulate and protect the conductors not less than the insulation and protective jackets on the cables and wires which protect the conductors. In locations where moisture might be present, the splices shall be watertight. In manholes and handholes the splices shall be submersible. Acceptable kits are 3M Quick Splice III.
  
- C. Splicing and Terminating Fittings: Shall be in accordance with IEEE 386, 404 and 592.
  - 1. Shall be heavy duty, pressure type fittings, which will assure satisfactory performance of the connections under conditions of temperature cycling and magnetic forces from available short circuit currents.
  - 2. The fittings shall be suitable designed and the proper size for the cables and wires being spliced and terminated. Terminations to bus shall be with two hole lugs.
  - 3. Where the owner determines that unsatisfactory fittings have been installed, remove the unsatisfactory installations and install approved fittings at no additional cost to the owner.
  
- D. Splicing and Terminating Kits:
  - 1. General:
    - a. Splice Kits to be 3M Cold Shrink QSIII Series.
    - b. Termination Kits shall be 3M cold Shrink QTIII Series.
    - c. Shall be assembled by the manufacturer or supplier of the materials shall be packaged for individual splices and terminations or for groups of splices and terminations.
    - d. Shall consist of materials designed for the cables being spliced and terminated and shall be suitable for the prevailing environmental conditions.
    - e. Shall include detail drawings and printed instructions for each type of splice and termination being installed, as prepared by the manufacturers of the materials in the kits.
    - f. Detail drawings, and printed instructions shall indicate the cable type, voltage rating, manufacturer's name and catalog numbers for the materials indicated.
    - g. Voltage ratings for the splices and terminations shall not be less than the voltage ratings for the cables on which they are being installed.
    - h. Shall include shielding and stress cone materials.
    - i. 5 & 8 kV Motor Termination Kits shall be 3M # 5380 Series.
  - 2. Epoxy resin kits shall be as follows:
    - a. Compatible with the cable insulations and jackets and make the splices watertight and submersible.
    - b. Thermosetting and generate its own heat so that external fire or heat will not be required.
    - c. Set solid and cure in approximately 60 minutes in 21 degree C (70 degree F) ambient temperature.
    - d. Not deteriorate when subjected to oil, water, gases, salt water, sewage and fungus.
    - e. Furnished in pre-measured quantities, sized for each splice and each termination, with two resin components in an easy mixing plastic bag which will permit mixing the resin components without entrapping air or contaminants. Other methods of packaging and mixing the epoxy resin components will be considered for approval, provided they include adequate safeguards to assure precise proportioning of the resin components and to prevent entrapping air contaminants.
  
- E. Premolded Rubber Splices and Terminations:
  - 1. Splices and terminations shall be in accordance with IEEE 48, 386, 404 and 592.
  - 2. Kits shall be 3M Cold Shrink QSIII Series.

3. Premolded rubber devices shall have a minimum of 3 mm (0.125 inch) semiconductive shield material covering the entire housing. Test each rubber part prior to shipment from the factory.
4. Grounding of metallic shields shall be accomplished by a solderless connector enclosed in a watertight rubber housing covering the entire assembly. The grounding device and splice or terminator shall be of the same manufacturer to insure electrical integrity of the shielded parts.
5. The premolded parts shall be suitable for indoor, outdoor, submersible, or direct-burial applications.

F. For crane cable connections, installation shall match existing. Refer also to drawings.

G. Terminations

1. Class 1 terminations for indoor use: Kit with stress-relief tube, non-tracking insulator tube, shield ground strap, compression-type connector, and end seal.
2. Dead-break terminations for outdoor use: 600 A dead-break pre-molded rubber elbow connectors with bushing inserts, suitable for submersible applications. Separable connectors shall comply with the requirements of IEEE 386, and shall be interchangeable between suppliers. Allow sufficient slack in medium-voltage cable, ground, and drain wires to permit elbow connectors to be moved to their respective parking stands. Refer to drawings for more information.
3. Ground metallic cable shields with a device designed for that purpose, consisting of a solderless connector enclosed in watertight rubber housing covering the entire assembly.
4. Provide insulated cable supports to relieve any strain imposed by cable weight or movement. Ground cable supports to the ground system.

### 2.3 MATERIAL, FIREPROOFING TAPE

- A. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer. 3M # 77 Arc & Fireproofing Tape.
- B. The tape shall be self-extinguishing and shall not support combustion. It shall be arc proof and fireproof.
- C. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus. It shall be resistant to sunlight and ultraviolet light.
- D. The finished application shall withstand a 200 ampere arc for not less than 30 seconds.
- E. Securing tape: Shall be glass cloth electrical tape not less than 0.18 mm (7 mils) thick, and 19 mm (3/4 inch) wide. 3M # 69 Fiberglass Tape.

### 2.4 MATERIAL, WARNING TAPE

- A. The tape shall be standard, 76 mm (3 inch) wide, 4-Mil polyethylene detectable type.
- B. The tape shall be red with black letters indicating "CAUTION BURIED ELECTRIC LINE BELOW".

- C. 3M # 406 Detectable Tape

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, MEDIUM VOLTAGE CABLE

- A. Installation shall be in accordance with the NEC and as shown on the drawings.
- B. Splicing is not allowed unless fully demonstrated by the contractor that it is absolutely necessary and first approved by the owner and engineer.
- C. If splicing does occur, then splice the cables and wires only in manholes. Ground shields in accordance with Section Grounding.
- D. Contractor shall ensure that radii of bends fittings, cable risers, and other conditions are suitable for the cable and conform with the recommendations of the cable manufacturer.
- E. Cable shall be installed in conduit above ground and duct bank below grade.
- F. All cables/conductors of a feeder shall be pulled simultaneously.
- G. Conductors of different systems (e.g., 5 kV and 15 kV) shall not be installed in the same raceway.
- H. Ground shields in accordance with Section 26 05 26, Grounding and Bonding for Electrical Systems.
- I. Cable maximum pull length, maximum pulling tension, and minimum bend radius shall conform with the recommendations of the manufacturer. Submit pulling plan with pulling tensions calculated for review and comment.
- J. Seal the cable ends prior to pulling, to prevent the entry of moisture or lubricant.
- K. Use suitable lubricating compounds on the cables and conductors to prevent damage to them during pulling-in. Provide compounds that are not injurious to the cable and wire jackets and do not harden or become adhesive.
- L. In manholes, trenches and vaults install the cables on suitable porcelain insulators with cable racks in accordance with Section Grounding.
- M. Install the materials as recommended by their manufacturer including special precautions pertaining to air temperature during installation.
- N. Installation shall be accomplished by qualified personnel trained to accomplish medium-voltage equipment installations. All instructions of the manufacturer shall be followed in detail.
- O. Develop and submit cable pull plan prior to beginning work.
- P. Terminating of cables shall be expedited to minimize exposure and cable deterioration.

- Q. Installation shall include prefabricated cold shrink terminations at the terminals of all shielded cables.
- R. In manholes, underground raceways and other outdoor locations:
  - 1. Seal the cable ends prior to pulling them in to prevent the entry of moisture. 3M EC Series Cold Shrink End Caps.
  - 2. For ethylene propylene rubber and polyethylene insulated cables, use bags of epoxy resin which are not less than 6 mm (1/4 inch) larger in diameter than the overall diameter of the cable. Clean each end of each cable before installing the epoxy resin over it.

### 3.2 PROTECTION DURING OPERATIONS AND PULLING IN CABLES

- A. Blowers shall be provided to force fresh air into manholes where free movement or circulation of air is obstructed. Waterproof protective coverings shall be available on the work site to provide protection against moisture. Pumps shall be used to keep manholes dry. Under no conditions shall a splice or termination be made that exposes the interior of a cable to moisture. A manhole ring at least 150 mm (6 inches) above ground shall be used around the manhole entrance to keep surface water from entering the manhole. Unused ducts shall be plugged and water seepage through ducts in use shall be stopped before splicing.
- B. Cables shall be pulled into ducts with equipment designed for this purpose, including power-driven winches, cable-feeding flexible tube guides, cable grips, pulling eyes, and lubricants. A sufficient number of qualified workers and equipment shall be employed to ensure the careful and proper installation of the cable.
- C. Cable reels shall be set up at the side of the manhole opening and above the duct or hatch level, allowing cables to enter through the opening without reverse bending. Flexible tube guides shall be installed through the opening in a manner that will prevent cable from rubbing on the edges of any structural member.
- D. Cable shall be unreeled from the top of the reel. Run-out shall be carefully controlled. Cables to be pulled shall be attached through a swivel to the main pulling wire by means of a suitable cable grip and pulling eye.
- E. Woven-wire cable grips shall be used to grip the cable end when pulling small cables and short straight lengths of heavier cables.
- F. Pulling eyes shall be attached to the cable conductors to prevent damage to the cable structure.
- G. Cables shall be pulled into ducts at a reasonable speed. Cable pulling using a vehicle shall not be permitted. Pulling operations shall be stopped immediately at any indication of binding or obstruction, and shall not be resumed until the potential for damage to the cable is corrected. Sufficient slack shall be provided for free movement of cable due to expansion or contraction.
- H. Splices in manholes shall be firmly supported on cable racks. Cable ends shall overlap at the ends of a section to provide sufficient undamaged cable for splicing.
- I. Cables cut in the field shall have the cut ends immediately sealed to prevent entrance of moisture.

- J. Pulling force shall not exceed manufacture's recommendation. A dynamometer shall be used in the pulling line to ensure that the pulling force is not exceeded. Pulling force shall not exceed the manufacturer's recommendations. Submit the recommendations when submitting product data.
- K. Pulling eyes and cable grips shall be used together for nonmetallic sheathed cables to prevent damage to the cable structure.
- L. Cables shall be liberally coated with a suitable water based cable-pulling lubricant as it enters the tube guide or duct. Cables shall be covered with wire-pulling compounds when required which have no deleterious effects on the cable. Rollers, sheaves, or tube guides around which the cable is pulled shall be sufficiently large as not to exceed the sidewall pressure limitations.

### 3.3 INSTALLATION - SPLICES AND TERMINATIONS

- A. Install the materials as recommended by 3M Company including special precautions pertaining to air temperature during installation.
- B. Ethylene Propylene Rubber Cables:
  - 1. Cables rated 8000 volts or less: Install epoxy resin splices and terminations, or premolded rubber splices and terminations.
  - 2. Cables rated more than 8000 volts: Install taped splices and terminations, or premolded rubber splices and terminations.
- C. Installation shall be accomplished by qualified personnel trained to accomplish medium voltage equipment installations. All instructions of the manufacturer shall be followed in detail. All installers shall successfully complete a 3M Medium Voltage Training Seminar prior to any and all work.

### 3.4 INSTALLATION - FIREPROOFING

- A. Cover all power cables located in manholes, handholes and junction boxes with arc proof and fireproof tape. 3M # 77 Tape.
- B. Apply the tape in a single layer, one-half lapped or as recommended by the manufacturer. Install the tape with the coated side towards the cable and extend it not less than 25 mm (one inch) into each duct.
- C. Secure the tape in place by a random wrap of glass cloth tape. 3M # 69 Tape.

### 3.5 FEEDER IDENTIFICATION

- A. In each vault, manhole, and pullbox install permanent tags on each circuit's cables and wires to clearly designate their circuit identification and voltage. In vaults the tags shall be the embossed brass type and shall also show the cable type and voltage rating. Position the tags so they will be easy to read after fireproofing is installed. 3M PLE Series Metal Embossing Tape.

3.6 FIELD TESTS FOR MEDIUM VOLTAGE CABLE

- A. Perform tests in accordance with the manufacture’s recommendations. Include the following visual and electrical inspections.
- B. Test equipment, labor, and technical personnel shall be provided as necessary to perform the acceptance tests. Arrangements shall be made to have tests witnessed by the Owner/Engineer.
- C. Visual Inspection:
  - 1. Inspect exposed sections of cables for physical damage.
  - 2. Inspect shield grounding, cable supports, splices, and terminations.
  - 3. Verify that visible cable bends meet manufacture’s minimum bending radius requirement.
  - 4. Verify installation of fireproofing tape and identification tags.
- D. New Cable:
  - 1. Acceptance tests shall be performed on new cable in accordance with IEEE and as specified herein.
  - 2. Test new cable after installation, splices and terminations have been made, but before connection to equipment and existing cable.
  - 3. Refer to manufacturer’s recommendations.
- E. Existing Cable:
  - 1. Maintenance tests shall be performed on existing cable interconnected to new cable. See test voltages below.
  - 2. After new cable test and connection to an existing cable, test the interconnected cable. Disconnect cable from all equipment that might be damaged by the test voltages.
- F. High Potential Test:
  - 1. Leakage current test shall be by high potential dc step voltage method.
  - 2. Prior to high potential test, test the cable and shields for continuity, shorts, and grounds.
  - 3. High potential test shall measure the leakage current from each conductor to the insulation shield. Use corona shields, guard rings, taping, mason jars, or plastic bags to prevent corona current from influencing the readings. Unprepared cable shield ends shall be trimmed back 25 mm (1 inch) or more for each 10 kV of test voltage.
- G. Safety Precautions: Exercise suitable and adequate safety measures prior to, during, and after the high potential tests, including placing warning signs and preventing people and equipment from being exposed to the test voltages.
- H. Test Voltages:
  - 1. New shielded EPR cable dc test voltages shall be as follows:

		Test Voltage kV
Rated Circuit Voltage Phase-to-Phase Volt	Wire Size AWG or MCM	133 percent Insulation Level
2001-5000	8-1000	25

5001-8000	6-1000	35
8001-15000	2-1000	65
15001-25001	1-1000	100
25001-28000	1-1000	-
28001-35000	1/0-1000	-

2. Existing cable of all types interconnected to a new cable shall be tested at 1.7 times the existing cable rated voltage (maintenance test).
- I. High Potential Test Method:
1. Apply voltage in approximately 8 to 10 equal steps.
  2. Raise the voltage slowly between steps.
  3. At the end of each step, allow the charging currents to decay, and time the interval of decay.
  4. Read the leakage current and plot a curve of leakage currents versus test voltage on graph paper as the test progresses. Read the leakage current at the same time interval for each voltage step.
  5. Stop the test if leakage currents increase excessively of a “knee” appears in the curve before maximum test voltage is reached.
    - a. For new cable, repair or replace the cable and repeat the test.
    - b. For existing cable interconnected to new cable, notify the Resident Engineer for further instructions.
  6. Upon reaching maximum test voltage, hold the voltage for five minutes. Read the leakage current at 30 second intervals and plot a curve of leakage current versus time on the same graph paper as the step voltage. Stop the test if leakage current starts to rise, or decreases and again starts to rise. Leakage current should decrease and stabilize for good cable.
  7. Terminate test and allow sufficient discharge time before testing the next conductor.
- J. The contractor shall furnish the instruments, materials and labor for these tests.
- K. Test Data: Test data shall be recorded and shall include identification of cable and location and the leakage current readings versus time.
- L. Final Acceptance: Final acceptance shall depend upon satisfactory performance of the cable under test. No cable shall be energized until recorded test data have met the criteria. Final test reports shall be included with close-out documents. Reports shall have a cover letter/sheet clearly marked with the System name, Date, and the words “Final Test Report.”

END OF SECTION

## SECTION 26 05 19 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes 600 volt and less conductors and cables.
- B. Related Sections:
  - 1. Section 26 05 00 – Common Work Results for Electrical.
  - 2. Section 26 05 03 – Equipment Wiring Connections.
  - 3. Section 26 05 26 – Grounding and Bonding for Electrical Systems.
  - 4. Section 26 05 33 – Raceway and Boxes for Electrical Systems.
  - 5. Section 26 05 43 – Underground Ducts and Raceways for Electrical Systems
  - 6. Section 26 05 53 - Identification for Electrical Systems.
  - 7. Section 07 84 00 – Fire Stopping.

#### 1.2 REFERENCES - Latest Adopted Editions of:

- A. International Electrical Testing Association:
  - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. National Fire Protection Association:
  - 1. NFPA 70 - National Electrical Code.
  - 2. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
- C. Underwriters Laboratories, Inc.:
  - 1. UL 1277 - Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
  - 2. 44 – Thermoset-Insulated Wires and Cables.
  - 3. 83 – Thermoplastic-Insulated Wires and Cables.
  - 4. 467 – Electrical Grounding and Bonding Equipment.
  - 5. 486A – Wire Connectors and Soldering Lugs for Use with Copper Conductors.
  - 6. 486C – Splicing Wire Connectors
  - 7. 486D – Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations.
  - 8. 486E – Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors.
  - 9. 493 – Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable.
  - 10. 514B – Fittings for Cable and Conduit
  - 11. 1479 – Fire Tests of Through-Penetration Fire Stops.



### 1.3 SYSTEM DESCRIPTION

- A. Cables and Conductors shall (be):
1. Factory-fabricated wires of sizes, ampacity ratings and materials for applications and services indicated.
  2. Annealed copper.
  3. Inside building conductor insulation shall be dual type THHN/THWN 90°C (194°F) with a maximum conductor temperature of 90°C (194°F) in dry locations and 75°C (167°F) in wet locations.
  4. Exterior: XHHW – XHHW - 2 shall be used, no exceptions.
  5. Solid conductor for feeders and branch circuits 10 AWG and smaller. Shall be stranded for No. 8 AWG and larger.
  6. Stranded conductors for control circuits.
  7. Not smaller than 12 AWG for power and lighting circuits.
  8. Not smaller than 14 AWG for control circuits.
  9. Increase wire size in branch circuits to limit voltage drop to a maximum of 3 percent.

### 1.4 SPLICES AND JOINTS

- A. General: Install electrical cables, wires and wiring connectors as indicated, in compliance with applicable requirements of NEC, NEMA, UL and NECA's "Standard of Installation" and in accordance with recognized industry practices.
- B. Branch circuits (No. 10 AWG and smaller):
1. Connectors: Solderless, screw on, reusable pressure cable type, 600 Volt, 105 degree C with integral insulation, approved for copper and aluminum conductors.
  2. The integral insulator shall have a skirt to completely cover the stripped wires.
  3. The number, size, and combination of conductors, as listed on the manufacturers packaging shall be strictly complied with.
  4. 20 amp, 120 volt, branch circuits over 75 feet in length shall be minimum No. 10 AWG unless otherwise noted.
  5. 20 amp, 277 volt branch circuits over 175 feet in length shall be minimum No. 10 AWG unless otherwise noted.
- C. Feeder Circuits:
1. Connectors shall be indent, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material.
  2. Field installed compression connectors for cable sizes 250 kcmil and larger shall have not less than two clamping elements or compression indents per wire.
  3. Insulate splices and joints with materials approved for the particular use, location, voltage, and temperature. Insulate with not less than that of the conductor level that is being joined.
  4. Plastic electrical insulating tape: Fed Spec. HH-I-595 shall apply including flame retardant, cold and weather resistant.

1.5 CONTROL WIRING

- A. Control wiring shall be large enough so that the voltage drop under inrush conditions does not adversely affect operation of the controls.
- B. Unless otherwise specified in other sections of these specifications, control wiring shall be as specified for power and lighting wiring, except the minimum size shall be not less than No. 14 AWG.

1.6 COMMUNICATION AND SIGNAL WIRING

- A. Shall conform to the recommendations of the manufacturers of the communication and signal systems; however, not less than what is shown.
- B. Wiring shown is for typical systems. Provide wiring as required for the systems being furnished.
- C. Multi-conductor cables shall have the conductors color-coded.

1.7 WIRE LUBRICATING COMPOUND

- A. Suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.
- B. Shall not be used on wire for isolated type electrical power systems.

1.8 FIREPROOFING TAPE

- A. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.
- B. The tape shall be self-extinguishing and shall not support combustion. It shall be arc-proof and fireproof.
- C. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus and be resistant to sunlight and ultraviolet light.
- D. The finished application shall withstand a 200-Ampere arc for not less than 30 seconds.
- E. Securing tape: Glass cloth electrical tape not less than 7 mils thick, and 3/4 inch wide.

1.9 WARNING TAPE

- A. The tape shall be standard, 3 inch wide, 4-Mil polyethylene detectable type.

- B. The tape shall be red with black letters indicating “CAUTION BURIED ELECTRIC LINE BELOW”.

#### 1.10 DESIGN REQUIREMENTS

- A. Conductor sizes are based on copper.

#### 1.11 SUBMITTALS

- A. Refer to Division 01: Requirements for submittals.
- B. Product Data: Submit for each building and conductor cable assembly type.
- C. Certificates; Two weeks prior to final inspection, deliver to the Owner four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

#### 1.12 CLOSEOUT SUBMITTALS

- A. Refer to Division 01: Requirements for submittals.
- B. Project Record Documents: Record actual locations of components and circuits.

#### 1.1 QUALITY ASSURANCE

- C. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet when tested in accordance with NFPA 262.
- D. Perform Work in accordance with Authority Having Jurisdiction’s requirements, codes and standards, and standard industry practice.
- E. Maintain minimum one copy of each document on site.

#### 1.13 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience. Product shall be manufactured in North America.

#### 1.14 FIELD MEASUREMENTS

- A. Verify field measurements are as indicated on Drawings.

### 1.15 COORDINATION

- A. Refer to Division 01: Requirements for coordination.
- B. Where conductors and cable destination is indicated and routing is not shown, determine routing and lengths required.

## PART 2 - PRODUCTS

### 2.1 TERMINATIONS

- A. Terminal Lugs for Wires 6 AWG and Smaller: Solderless, compression type copper.
- B. Lugs for Wires 4 AWG and Larger: Color keyed, compression type copper, with insulating sealing collars.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Refer to Division 01: Coordination and project conditions.
- B. Verify interior of building has been protected from weather.
- C. Verify mechanical work likely to damage wire and cable has been completed.
- D. Verify raceway installation is complete and supported.

### 3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

### 3.3 EXISTING WORK

- A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.
- B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.
- C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel.

- D. Extend existing circuits using materials and methods as specified.
- E. Clean and repair existing wire and cable remaining or wire and cable to be reinstalled.

### 3.4 INSTALLATION

- A. Route wire and cable to meet Project conditions.
- B. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- C. Identify and color code wire and cable under provisions of Section 26 05 53 in each junction box, panelboards, and all terminations. Identify each conductor with its circuit number or other designation indicated.
- D. Special Techniques--Building Conductors in Raceway:
  - 1. Pull conductors into raceway at same time.
  - 2. Install building wire 4 AWG and larger with pulling equipment.
- E. Special Techniques - Cable:
  - 1. Protect exposed cable from damage.
  - 2. Support cables above accessible ceiling, using wire management system, spring metal clips or metal cable ties to support cables from structure. Do not rest cable on ceiling panels.
  - 3. Use suitable cable fittings and connectors.
- F. Special Techniques - Wiring Connections:
  - 1. Clean conductor surfaces before installing lugs and connectors.
  - 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
  - 3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
  - 4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
  - 5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
  - 6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- G. The lighting circuit “switch legs” and 3-way switch “traveling wires” shall have color coding unique and distinct (i.e. pink and purple) from the color coding indicated above. The unique color codes shall be solid and in accordance with the NEC.
- H. No more than (3) single-phase branch circuits shall be installed in any one conduit.
- I. The wires shall be de-rated in accordance with NEC Article 310. Neutral wires, under conditions defined by the NEC, shall be considered current-carrying conductors.

### 3.5 INSTALLATION - GENERALLY

- A. Install in accordance with the NEC, and as specified.
- B. Install all building conductors and wiring in raceway systems unless specifically excluded.
- C. Splice cables and wires only in outlet boxes, junction boxes, pull boxes, manholes, or handholes.
- D. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type, which firmly clamps each individual cable and tightens due to cable weight.
- E. For panelboards, cabinets, wireways, switches, and equipment assemblies, neatly form, train, and tie the cables in individual circuits.
- F. Seal cable and wire entering a building from underground, between the wire and conduit where the cable exits the conduit, with a nonhardening approved compound.
- G. Wire Pulling:
  - 1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
  - 2. Use ropes made of nonmetallic material for pulling feeders.
  - 3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the Owner/Engineer.
  - 4. Pull in multiple cables together in a single conduit.

### 3.6 INSTALLATION IN MANHOLES

- A. Install and support conductors/cables in manholes on the steel racks with porcelain or equal insulators. Train the cables around the manhole walls, but do not bend to a radius less than six times the overall cable diameter.
- B. Do not share conduits or racks with any other system (medium voltage cables, communications, fiber optics, etc.)
- C. Fireproofing:
  - 1. Where low voltage cables are installed in the same manholes with medium voltage cables, also cover the low voltage cables with arc proof and fireproof tape.
  - 2. Use tape of the same type as used for the medium voltage cables, apply the tape in a single layer, one-half lapped or as recommended by the manufacturer. Install the tape with the coated side towards the cable and extend it not less than one inch into each duct.
  - 3. Secure the tape in place by a random wrap of glass cloth tape.

### 3.7 SPLICE INSTALLATION

- A. Splices and terminations shall be mechanically and electrically secure.

- B. Where the Owner or Engineer determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices at no additional cost to the Owner /Engineer.
- C. Prior to beginning splice work, obtain Owner/Engineer's approval for all splices for conductors No. 3 and larger.

### 3.8 CONTROL, COMMUNICATION AND SIGNAL WIRING INSTALLATION

- A. Unless otherwise specified in other sections of these specifications, install wiring and connect to perform the functions shown and specified in other sections of these specifications.
- B. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system will not affect other systems.
- C. Where power supply circuits are not shown for systems, connect them to the nearest panelboards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.
- D. Install a red warning indicator on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems.
- E. System voltages shall not exceed 120 Volts and shall be lower voltages where shown on the drawings or required by the NEC.

### 3.9 CONTROL, COMMUNICATION AND SIGNAL SYSTEM IDENTIFICATION

- A. Install a permanent wire marker on each wire at each termination.
- B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- C. Wire markers shall retain their markings after cleaning.
- D. In each manhole and handhole, install embossed brass tags to identify the system served and function.

### 3.10 FEEDER IDENTIFICATION

- A. In each interior pullbox and junction box, install labels on each circuit cables and wires to clearly designate their circuit identification and voltage.
- B. In manholes and handholes, provide tags of the embossed brass type, and also show the cable type and voltage rating. Attach the tags to the cables with slip-free plastic cable lacing units.

### 3.11 WIRE COLOR

- A. General:
  - 1. For wires sizes 10 AWG and smaller, Install conductor colors in accordance with the following:
    - a. Black and red for single phase circuits at 240/120 volts.
    - b. Black, red, and blue for circuits at 208/120 volts single or three phase.
    - c. Brown, orange, and yellow for circuits at 480/277 volts single or three phase.
  - 2. For wire sizes 8 AWG and larger, identify wire with colored tape at terminals, splices and boxes. Colors are as follows:
    - a. Black and red for single phase circuits at 240/120 volts.
    - b. Black, red, and blue for circuits at 208/120 volts single or three phase.
    - c. Brown, orange, and yellow for circuits at 480/277 volts single or three phase.
- B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number.
- C. Branch Circuit Conductors: Install home runs with each phase uniquely color coded.
- D. Parallel Circuit Conductors: Uniquely identify each phase.
- E. Ground Conductors:
  - 1. For 6 AWG and smaller: Green.
  - 2. For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

### 3.12 FIELD QUALITY CONTROL

- A. Refer to Division 01: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

### 3.13 FIELD TESTING

- A. Prior to energization of circuitry, check installed feeder wires and cables with megohm meter to determine insulation resistance levels to ensure requirements are fulfilled. A list of feeders tested shall be submitted to the Engineer indicating the insulation resistance level for each cable.
- B. Tests shall be performed by megger and conductors shall test free from short-circuits and grounds.
- C. Test conductors phase-to-phase and phase-to-ground.
- D. The Contractor shall furnish the instruments, materials, and labor for these tests.



END OF SECTION

## SECTION 26 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This section specifies general grounding and bonding requirements of electrical installations for personnel safety and to provide a low impedance path for possible ground fault currents.
- B. “Grounding Electrode system” refers to all electrodes required by NEC, as well as including made, supplementary, lightning protection system and telecommunications system grounding electrodes.
- C. The terms “connect” and “bond” are used interchangeably in this specification and have the same meaning.
- D. The type of electrical grounding and bonding work specified in this Section includes the following: Solidly Grounded.
- E. Applications of electrical grounding and bonding include but are not limited to:
  - 1. Electrical Power Systems.
  - 2. Telecommunications Systems.
  - 3. Low Voltage Systems.
  - 4. Separately Derived Systems.
  - 5. Service Equipment.
  - 6. Raceways and Enclosures.
  - 7. Interior, Exterior, and Site Lighting.
  - 8. Equipment – interior and exterior.
- F. Related Sections:
  - 1. Section 03 20 00 - Concrete Reinforcing: Bonding or welding bars when reinforcing steel is used for electrodes.
  - 2. Section 26 41 00 - Facility Lightning Protection: Grounding of lightning protection system.
- G. Section 26 05 26, BASIC METHODS AND REQUIREMENTS (ELECTRICAL): General electrical requirements and items that are common to more than one section of Division 26.
- H. This section is a part of each Division 26 making reference to grounding specified herein, regardless of voltage level.

#### 1.2 REFERENCES

- A. Institute of Electrical and Electronics Engineers:

1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
  2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.
- B. International Electrical Testing Association:
1. ANSI/NETA ATS-2009 – Standard for testing specifications for electrical power equipment and systems.
- C. National Fire Protection Association:
1. NFPA 70 - National Electrical Code.
- D. Underwriters Laboratories, Inc (UL):
1. 44-1999 – Thermoset-Insulated Wires and Cables.
  2. 83-1998 – Thermoplastic-Insulated Wires and Cables.
  3. 467-1993 – Grounding and Bonding Equipment.
  4. 486A – 2000 – Wire Connectors and Soldering Lugs for Use with Copper Conductors.
  5. 869 – Electrical Service Equipment.
- E. American Society for Testing and Materials (ASTM):
1. B1-2001 – Standard Specification for Hard-Drawn Copper Wire.
  2. B8-1999 – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

### 1.3 SYSTEM DESCRIPTION

- A. Grounding systems use the following elements as grounding electrodes:
- B. Metal underground water pipe.
1. Metal building frame.
  2. Concrete-encased electrode.
  3. Rod electrode.

### 1.4 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 25 ohms maximum unless otherwise shown on drawings.

### 1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on grounding electrodes and connections.
- C. Test Reports: Indicate overall resistance to ground.
- D. Manufacturer's Installation Instructions: Submit for active electrodes.

- E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of components and grounding electrodes.

#### 1.7 QUALITY ASSURANCE

- A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.
- B. Perform Work in accordance AHJ requirements, codes and standards, and generally accepted industry practices.
- C. Maintain one copy of each document on site.

#### 1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum five years documented experience.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
- D. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

#### 1.10 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Complete grounding and bonding of building reinforcing steel prior concrete placement.

## PART 2 - PRODUCTS

### 2.1 ROD ELECTRODES

- A. Manufacturers:
  - 1. Erico, Inc. Model
  - 2. O-Z Gedney Co. Model
  - 3. Thomas & Betts, Electrical Model
  - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description:
  - 1. Material: Copper-clad steel. Stainless steel where shown on the drawings.
  - 2. Diameter: 3/4 inch.
  - 3. Length: 10 feet. 20 feet where shown on the drawings.
- C. Connector: Connector for exothermic welded connection.

### 2.2 WIRE

- A. Material: Stranded copper. Tinned copper where shown on the drawings.
- B. Foundation Electrodes: size as shown on drawings.
- C. Grounding Electrode Conductor: Copper conductor bare.
- D. Bonding Conductor: Copper conductor bare.

### 2.3 GROUNDING WELL COMPONENTS

- A. Well Pipe: 8 inches NPS by 24 inches long concrete pipe with belled end.
- B. Well Cover: Cast iron or Fiberglass with legend "GROUND" embossed on cover.

### 2.4 MECHANICAL CONNECTORS

- A. Manufacturers:
  - 1. Erico, Inc.
  - 2. ILSCO Corporation.
  - 3. O-Z Gedney Co.
  - 4. Thomas & Betts, Electrical.
  - 5. Substitutions: Section 01 60 00 - Product Requirements.
- B. Description: Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

## 1.1 EXOTHERMIC CONNECTIONS

- C. Manufacturers:
  - 1. Copperweld, Inc.
  - 2. ILSCO Corporation.
  - 3. O-Z Gedney Co.
  - 4. Thomas & Betts, Electrical.
  - 5. Substitutions: Section 01 60 00 - Product Requirements.
- D. Furnish materials in accordance with AHJ requirements and applicable codes and standards.
- E. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify final backfill and compaction has been completed before driving rod electrodes.

### 3.2 PREPARATION

- A. Remove all surface contaminants at connection points.

### 3.3 EXISTING WORK

- A. Modify existing grounding system to maintain continuity to accommodate renovations.
- B. Extend existing grounding system using materials and methods as specified.

### 3.4 INSTALLATION

- A. Install in accordance with IEEE 142 and 1100.
- B. Install electrical grounding and bonding systems as indicated, in accordance with manufacturer's instructions; applicable portions of NEC, NECA's "Standard of Installation", and in accordance with recognized industry practices, to ensure that products comply with requirements.
- C. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panelboards, switch and starter enclosures, motor

frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.

- D. Coordinate with other electrical work as necessary to interface installation of electrical grounding and bonding system work with other work.
- E. Ground electrical service system neutral at service entrance to the building cold water line, building structural steel, and to a minimum three ground rods spaced ten feet (10') apart.
- F. Install required number of rod electrodes to achieve specified resistance to ground.
- G. System Grounding:
  - 1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at related transformers.
  - 2. Separately derived systems (Transformers downstream from the service entrance): Ground the secondary neutral to separate grounding electrode.
  - 3. Standby Systems: Ground the neutral to separate grounding electrodes.
  - 4. Isolation transformers and isolated power systems shall not be system grounded.
- H. Install grounding and bonding conductors concealed from view.
- I. Install grounding well pipe with cover at each rod location. Install well pipe top flush with finished grade.
- J. Install grounding electrode conductor and connect to reinforcing steel in foundation footing as indicated on Drawings. Electrically bond steel together.
- K. Bond together metal siding not attached to grounded structure; bond to ground.
- L. Equipment Grounding Conductor (E.G.): Install separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- M. Connect to site grounding system. Refer to Section 33 79 00.
- N. Bond to lightning protection system. Refer to Section 26 41 00.
- O. Install continuous grounding using underground cold water system (1" Diameter or larger) building steel and driven ground rods as grounding electrode. Where water piping is not available, install artificial station ground by means of driven rods or buried electrodes.
- P. Install branch circuits feeding isolated ground receptacles with separate insulated grounding conductor, connected only at isolated ground receptacle, ground terminals, and at ground bus of serving panel.
- Q. Accomplish grounding of electrical system by using insulated grounding conductor installed within feeder and branch circuit raceway. Grounding conductor sizes in accordance with drawings and NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal

enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panelboards with installed number 12 conductor to grounding bus.

- R. Ground electrical system using continuous metal raceway system enclosing circuit conductors in accordance with NEC.
- S. Permanently attach equipment and grounding conductors prior to energizing equipment.
- T. Equipment Grounding: Metallic structures (including ductwork and building steel), enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.
- U. Connect together system neutral, service equipment enclosures, exposed noncurrent carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors and plumbing systems.
- V. All raceways with No. 10 or 12 AWG phase conductors for receptacles, lighting fixtures and similar circuits shall be provided with a parity-sized green equipment ground conductor. Ground conductor shall be installed in entire raceway system, including wall switches and flexible conduit to light fixtures. Equipment ground conductor sizes for circuits with phase conductors larger than No. 12 AWG are indicated on drawings. Ground conductors shall be connected to ground bus in panelboards.
- W. Terminate feeder and branch circuit insulated equipment-grounding conductors with grounding lug, bus or bushing. Conductors looped under screw or bolt heads will not be permitted.
- X. Install clamp-on connectors on clean metal contact surfaces to ensure electrical conductivity and circuit integrity.
- Y. Provide grounding busing and a continuous copper-bonding jumper from the busing to the equipment ground bus in all feeders. The bonding jumper shall be the same size as the equipment ground conductor.
- Z. Motors and Starters: Provide lugs in motor terminal box and starter housing or motor control center compartment to terminate equipment grounding conductors.
- AA. Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.
- BB. Ground lighting fixtures to the equipment grounding conductor of the wiring system. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.
- CC. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.



### 3.5 INACCESSIBLE GROUNDING CONNECTIONS

- A. Make grounding connections which are buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.

### 3.6 MEDIUM-VOLTAGE EQUIPMENT AND CIRCUITS

- A. Switchgear: Provide a bare grounding electrode conductor from the switchgear ground bus to the grounding electrode system. Refer also to drawings.
- B. Duct Banks and Manholes: Provide an insulated equipment grounding conductor in each duct containing medium voltage conductors, sized as shown on drawings except that minimum size shall be No. 2 AWG. Bond the equipment grounding conductors to the switchgear ground bus, if the length is over 2,000 feet, to the cable shielding grounding provisions of medium voltage cable splices and terminations, and equipment enclosures.
- C. Pad Mounted Transformers:
  - 1. Provide a driven ground rod and bond with a grounding electrode conductor to the transformer grounding pad.
  - 2. Ground the secondary neutral.
- D. Lightning Arresters: Connect lightning arresters to the equipment ground.
- E. Metallic Conduit: Metallic conduits which terminate without mechanical connection to an electrical equipment housing by means of locknut and bushings or adapters, shall be provided with grounding bushings. Connect bushings with a bare grounding conductor to the equipment ground bus.

### 3.7 CONDUCTIVE PIPING

- A. Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.
- B. In operating rooms and at intensive care and coronary care type beds, bond the gases and suction piping, at the outlets, directly to the room or patient ground bus.

### 3.8 LIGHTNING PROTECTION SYSTEM

- A. Bond the lightning protection system to the electrical grounding electrode system.

### 3.9 TELECOMMUNICATIONS SYSTEM

- A. Bond telecommunications system grounding equipment to the electrical grounding electrode system.

3.10 GROUND ROD INSTALLATION

- A. Drive each rod vertically in the earth.
- B. Make connections by the exothermic process to form solid metal joints.
- C. Where rock prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified resistance.

3.11 FIELD QUALITY CONTROL

- A. Section 01400 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform ground resistance testing in accordance with IEEE 142.
- D. Perform continuity testing in accordance with IEEE 142.

END OF SECTION

SECTION 26 05 29 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Conduit supports.
  2. Formed steel channels.
  3. Spring steel clips.
  4. Sleeves.
  5. Equipment bases and supports.

1.2 REFERENCES

A. ASTM International:

ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E119	Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E814	Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
ASTM E1966	Standard Test Method for Fire-Resistive Joint Systems

B. FM Global:

FM	Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
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C. National Fire Protection Association:

NFPA 70	National Electrical Code
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D. Underwriters Laboratories Inc.:

UL 263	Fire Tests of Building Construction and Materials
UL 723	Tests for Surface Burning Characteristics of Building Materials
UL 1479	Fire Tests of Through-Penetration Firestops
UL 2079	Tests for Fire Resistance of Building Joint Systems
UL	Fire Resistance Directory

### 1.3 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

### 1.4 SYSTEM DESCRIPTION

- A. Firestopping Materials: Achieve fire ratings as noted on Drawings for adjacent construction, but not less than 1 hour fire rating.
  - 1. Ratings may be 3-hours for firestopping in through-penetrations of 4-hour fire rated assemblies unless otherwise required by applicable codes.
- B. Surface Burning: UL 723 with maximum flame spread / smoke developed rating of 25/450.
- C. Firestop interruptions to fire rated assemblies, materials, and components.

### 1.5 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to applicable code for fire resistance ratings and surface burning characteristics.
- B. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.
- C. Hangers, struts, etc.: For outdoor use, shall be Type 316 stainless steel unless otherwise noted.

### 1.6 SUBMITTALS

- A. Divisions 00 and 01 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
  - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
  - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- C. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.
- D. Design Data: Indicate load carrying capacity of trapeze hangers and hangers and supports for feeders greater than 400 Amps.
- E. Manufacturer's Installation Instructions:
  - 1. Hangers and Supports: Submit special procedures and assembly of components.
  - 2. Firestopping: Submit preparation and installation instructions.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

- G. Engineering Judgments: For conditions not covered by UL or WH listed designs, submit judgments by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

## 1.7 QUALITY ASSURANCE

- A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
  - 1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
  - 2. Floor Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
    - a. Floor Penetrations within Wall Cavities: T-Rating is not required.
- B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.
  - 1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
  - 2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
- C. Coordinate with Architectural Drawings for roof penetrations.
- D. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
- E. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
- F. Surface Burning Characteristics: 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- G. Perform Work in accordance with AHJ's requirements and applicable codes and standards.
- H. Maintain one copy of each document on site.

## 1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing work of this section with minimum two years documented experience.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Divisions 00 and 01 - Product Requirements: Requirements for transporting, handling, storing,

and protecting products.

- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

#### 1.10 ENVIRONMENTAL REQUIREMENTS

- A. Divisions 00 and 01 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.
- C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.
- D. Provide ventilation in areas to receive solvent cured materials.
- E. Provide stainless steel Type 316 for all exterior uses. No exceptions and refer to drawings for additional requirements.

### PART 2 - PRODUCTS

#### 2.1 CONDUIT SUPPORTS

- A. Manufacturers:
  - 1. Allied Tube & Conduit Corp.
  - 2. Electroline Manufacturing Company.
  - 3. O-Z Gedney Co.
- B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.
- C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.
- D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.
- E. Conduit clamps - general purpose: One hole malleable iron for surface mounted conduits.
- F. Cable Ties: High strength nylon temperature rated to 185 degrees F. Self locking.

## 2.2 FORMED STEEL CHANNEL

- A. Manufacturers:
  - 1. Allied Tube & Conduit Corp.
  - 2. B-Line Systems.
  - 3. Midland Ross Corporation, Electrical Products Division.
  - 4. Unistrut Corp.
- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

## 2.3 SLEEVES

- A. Furnish materials in accordance with AHJ, codes and standards, and generally accepted industry practices.
- B. Sleeves through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.
- C. Fire-stopping Insulation: Glass fiber type, non-combustible.

## 2.4 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
  - 1. Thunderline Link-Seal, Inc.
  - 2. NMP Corporation.
  - 3. Substitutions: Divisions 00 and 01 - Product Requirements.
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

## 2.5 FIRESTOPPING

- A. Manufacturers:
  - 1. Dow Corning Corp.
  - 2. Fire Trak Corp.
  - 3. International Protective Coating Corp.
  - 4. 3M fire Protection Products.
  - 5. Specified Technology, Inc.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements.
- C. Color: As selected from manufacturer's full range of colors.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Divisions 00 and 01 - Verification of existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.
- C. Verify openings are ready to receive firestopping.

### 3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install materials to arrest liquid material leakage.
- D. Obtain permission from Owner before using powder-actuated anchors.
- E. Do not drill or cut structural members.

### 3.3 INSTALLATION - HANGERS AND SUPPORTS

- A. Install conduit and raceway support and spacing in accordance with NEC.
- B. Install hangers, anchors, sleeves, and seals as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to insure supporting devices comply with requirements. Comply with requirements of NECA and NEC for installation of supporting devices.
- C. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.
- D. Install hangers, supports and attachments to support piping properly from building structure. Arrange for grouping of parallel runs horizontal conduits to be supported together on trapeze type hangers where possible. Install supports with spacings indicated and in compliance with NEC requirements.
- E. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- F. Install multiple conduit runs on common hangers.
- G. Supports:
  - 1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.



2. Install surface mounted cabinets and panelboards with minimum of four anchors.
3. Support vertical conduit at every floor.

### 3.4 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating.
- D. Compress fibered material to maximum 40 percent of its uncompressed size.
- E. Remove dam material after firestopping material has cured.
- F. Fire Rated Surface:
  1. Seal opening as follows:
    - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
    - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
    - c. Pack void with backing material.
    - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
  2. Where cable tray and conduit penetrate fire rated surface, install firestopping product in accordance with manufacturer's instructions.
- G. Non-Rated Surfaces:
  1. Seal opening through non-fire rated wall, partition, floor, ceiling, and roof opening as follows:
    - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
    - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
    - c. Install type of firestopping material recommended by manufacturer.
  2. Install escutcheons where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
  3. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.
  4. Interior partitions: Seal pipe penetrations at telecommunication rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

### 3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Using templates furnished with equipment, install anchor bolts, and accessories for mounting

and anchoring equipment.

- B. Construct supports of steel members or formed steel channel. Brace and fasten with flanges bolted to structure.

### 3.6 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with adjustable interlocking rubber links.
- B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
- C. Set sleeves in position in forms. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Extend sleeves through floors 4 inches above finished floor level. Caulk sleeves.
- F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with fire stopping insulation and caulk. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- G. Install stainless steel escutcheons at finished surfaces.

### 3.7 FIELD QUALITY CONTROL

- A. Divisions 00 and 01 - Field inspecting, testing, adjusting, and balancing.
- B. Inspect installed firestopping for compliance with specifications and submitted schedule.

### 3.8 CLEANING

- A. Divisions 00 and 01 - Requirements for cleaning.
- B. Clean adjacent surfaces of firestopping materials.

### 3.9 PROTECTION OF FINISHED WORK

- A. Divisions 00 and 01 - Requirements for protecting finished Work.
- B. Protect adjacent surfaces from damage by material installation.

END OF SECTION

## SECTION 26 05 33 – RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes, and handholes.
- B. Related Sections:
  - 1. Section 26 05 00 - Common Work Results for Electrical.
  - 2. Section 26 05 03 - Equipment Wiring Connections.
  - 3. Section 26 05 19 - Low Voltage Electrical Power Conductors and Cables.
  - 4. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
  - 5. Section 26 05 29 - Hangers and Supports for Electrical Systems.
  - 6. Section 26 05 53 - Identification for Electrical Systems.
  - 7. Section 26 27 26 - Wiring Devices.
  - 8. Section 26 05 43 - Underground Ducts and Raceways for Electrical Systems.

#### 1.2 REFERENCES – latest adopted editions of:

- A. American National Standards Institute:
  - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
  - 2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
- B. National Electrical Manufacturers Association:
  - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
  - 2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
  - 3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
  - 4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
  - 5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
  - 6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
  - 7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
- C. Underwriters Laboratories, Inc. (UL):
  - 1. 1 – Flexible Metal Conduit
  - 2. 5 – Surface Metal Raceway and Fittings
  - 3. 6 – Rigid Metal Conduit
  - 4. 50 – Enclosures for Electrical Equipment
  - 5. 467 – Grounding and Bonding Equipment
  - 6. 514A – Metallic Outlet Boxes
  - 7. 514B – Fittings for Cable and Conduit
  - 8. 651 – Schedule 40, 80 and Type EB and A Rigid PVC Conduit and Fittings
  - 9. 651A – Schedule 40 and 80 High Density Polyethylene (HDPE) Conduit

10. 797 – Electrical Metallic Tubing

1.3 SYSTEM DESCRIPTION

- A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceways to complete wiring system.
- B. Underground More than 5 feet outside Foundation Wall: Provide schedule 40 PVC conduit unless otherwise shown on drawings. Provide cast metal boxes or handholes as described elsewhere in specifications.
- C. Underground within 5 feet from Foundation Wall and when stubbing up above grade: Provide plastic coated (PVC coated) RMC. Rigid conduit shall be used when stubbing up above grade indoors.
- D. Outdoor Locations, Above Grade: Provide rigid stainless steel. Provide either cast metal, stainless steel, or nonmetallic outlet, pull, and junction boxes for the appropriate raceway system.
- E. In Slab Above Grade: Provide Schedule 40 PVC. Provide cast boxes unless otherwise noted.
- F. Concealed Dry Locations: Provide electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet boxes in finished areas. Provide hinged enclosure for large pull boxes.
- G. Exposed Dry Locations: Provide either rigid steel (RMC) or electrical metallic tubing. Provide either cast or sheet-metal boxes. Provide flush mounting outlet boxes in finished areas. Provide hinged enclosure for large pull boxes. RMC shall be used for all interior exposed medium voltage conduits.
- H. Refer also to section 26 05 43

1.4 DESIGN REQUIREMENTS

- A. Minimum Raceway Size: 1/2 inch unless otherwise specified.

1.5 SUBMITTALS

- A. Refer to Division 01: Submittal procedures.
- B. Product Data: Submit for the following:
  - 1. All types of conduit planned for the project.
  - 2. Handholes, manholes, and pullboxes.
- C. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include

instructions for storage, handling, protection, examination, preparation, and installation of Product.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Refer to Division 01: Closeout procedures.
- B. Project Record Documents:
  - 1. Record actual routing of conduits larger than 2 inch.
  - 2. Record actual locations and mounting heights of outlet, pull, and junction boxes.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Division 01: Product storage and handling requirements.
- B. Protect conduits from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- C. Protect PVC conduit from sunlight.

#### 1.8 COORDINATION

- A. Refer to Division 01: Coordination and project conditions.
- B. Coordinate installation of outlet boxes for equipment connected under Section 26 05 03.
- C. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, in backsplashes, and in millwork with Owner/Architect.

### PART 2 - PRODUCTS

#### 2.1 MATERIAL

- A. General: Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thickness) for each service indicated.
- B. Where types and grades are not indicated, provide proper selection determined by installer to fulfill wiring requirements and comply with applicable portions of NEC for raceways.
- C. Conduit Size: In accordance with the NEC, but not less than 1/2 inch unless otherwise shown. Where permitted by the NEC, 1/2 inch flexible conduit may be used for tap connections to recessed lighting fixtures.
- D. Conduit:
  - 1. Rigid Metal Conduit (RMC): UL 6, hot dipped galvanized, threaded type.
  - 2. PVC coated RMC

3. Stainless steel RMC
4. Electrical metallic tubing (EMT): U.L. 797. Maximum size 5 inch. Permitted only with cable rated 600 volts or less.
5. Flexible steel conduit (commercial Greenfield): UL 1, formed from continuous length of spirally-wound, interlocked, zinc-coated strip steel. Permitted only with cable rated 600 volts or less.
6. Liquid-tight flexible metal conduit: Flexible galvanized steel tubing covered with extruded liquid-tight jacket of polyvinyl chloride (PVC). Provide conduit with a continuous copper bonding conductor wound spirally between convolutions. Permitted only with cable rated 600 volts or less.
7. Underground PVC plastic conduit: UL 651 and UL 651A, heavy wall PVC. Heavy Wall Conduit: C, UL-listed, constructed of Schedule 40, polyvinyl chloride. For direct burial, UL listed and in conformity with NEC Article 347.
8. Surface metal raceway: UL 5. Permitted only with cable rated 600 volts or less.

E. Conduit Fittings:

1. Rigid steel conduit fittings:
  - a. Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable.
  - b. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
  - c. Bushings: Metallic insulation type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
  - d. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fitting to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank coverplates having the same finishes as that of other electrical plates in the room.
2. Electrical metallic tubing fittings:
  - a. Only steel material is acceptable.
  - b. Couplings and connectors: Concrete tight and rain tight, with connectors having insulated throats. Use gland and ring compression type couplings and connectors for conduit sizes over 2 inches. If set screw type is used, then set screw or compression types are permitted for conduits less than 2 inches. Use set screws of case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
  - c. Indent type connectors or couplings are prohibited.
  - d. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
3. Flexible steel conduit (Greenfield) fittings:
  - a. UL 5. Only steel material is acceptable.
  - b. Straight Terminal Connectors: One piece body. Female end with clamp and deep slotted machine screw for securing conduit and male threaded end provided with locknut.
  - c. 45° or 90° Terminal Angle Connectors: Two-piece body construction with removable upper section, female end with clamp and deep slotted machine screw for securing conduit and male threaded end provided with locknut.
4. Liquid-tight flexible metal conduit fittings:
  - a. Only steel material is acceptable.
  - b. Fittings must incorporate a threaded grounding cone, a steel or plastic compression

- ring, and a gland for tightening. Connectors shall have insulated throats.
5. Underground PVC plastic conduit fittings: As recommended by the conduit manufacturer. Make solvent cemented joints in accordance with recommendations of manufacturer.
  6. Surface metal raceway fittings: As recommended by the raceway manufacturer.
  7. Expansion and deflection couplings:
    - a. UL 467 and UL 514B.
    - b. Accommodate, 0.75 inch deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
    - c. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, and the NEC code tables for ground conductors.
    - d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.
- F. Conduit Supports:
1. Parts and hardware: Interior: Zinc-coat or provide equivalent corrosion protection. Exterior: Stainless Steel.
  2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
  3. Multiple conduit (trapeze) hangers: Not less than 1-1/2 by 1-1/2 inch, 12 gage steel, cold formed, lipped channels; with not less than 3/8 inch diameter steel hanger rods.
  4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.
- G. Outlet, Junction, and Pull Boxes:
1. UL-50 and UL-514A.
  2. Cast metal where required by the NEC and equipped with waterproof, rustproof covers.
  3. Sheet metal boxes: Galvanized steel, except where otherwise shown.
  4. Floor boxes: As shown on Drawings.
- H. Wireways: Equip with hinged covers, except where removable covers are shown.
- I. Warning Tape: Standard, 4-Mil polyethylene 3 inch wide tape detectable type, red with black letters, and imprinted with "CAUTION BURIED ELECTRIC LINE BELOW".
- J. Equipment Wireways:
1. Recess into walls where practicable.
  2. Discuss routing with Owner prior to work.
- 2.2 OUTLET BOXES
- A. Manufacturers:
1. Carlon Electrical Products.
  2. Hubbell Wiring Devices.
  3. Thomas & Betts Corp.
  4. Walker Systems Inc.
  5. The Wiremold Co.
  6. Substitutions: Refer to Division 01 - Product Requirements.

- B. Outlet Boxes:
  - 1. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
  - 2. Non-metallic Boxes: NEMA OS 2.
  - 3. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required.
  - 4. Concrete Ceiling Boxes: Concrete type.
  - 5. Cast Boxes: NEMA FB 1, Type FD, cast ferrous alloy. Furnish gasketed cover by box manufacturer. Furnish threaded hubs.
- C. Wall Plates for Finished Areas: As specified in Section 26 27 26.
- D. Wall Plates for Unfinished Areas: Furnish gasketed cover.
- E. Floor boxes shall be as specified in drawings unless pre-approved by Architect/Engineer. Include all connectors, fittings, devices, and covers for a complete system. Coordinate cover and installation requirements with Architect.

### 2.3 PULL AND JUNCTION BOXES

- A. Manufacturers:
  - 1. Carlon Electrical Products.
  - 2. Hubbell Wiring Devices.
  - 3. Thomas & Betts Corp.
  - 4. Walker Systems Inc.
  - 5. The Wiremold Co.
  - 6. Substitutions: Refer to Division 01 - Product Requirements.
- B. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- C. Surface Mounted Cast Metal Box: NEMA 250, Type 4X; flat-flanged, surface mounted junction box:
  - 1. Material: Galvanized cast iron.
  - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.
- D. Requires Engineer approval: In-Ground Cast Metal Box: NEMA 250, Type 6, flanged, recessed cover box for flush mounting:
  - 1. Material: Galvanized cast iron.
  - 2. Cover: Nonskid cover with neoprene gasket and stainless steel cover screws.
  - 3. Cover Legend: "ELECTRIC".
  - 4. Size as required. Minimum size is 18"x18"x18".
  - 5. Refer to drawings for requirements; provide HS-20 rating for box, frame, and lid.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Refer to Division 01: Coordination and project conditions.



- B. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

### 3.2 EXISTING WORK

- A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.
- B. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.
- C. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.
- D. Extend existing raceway and box installations using materials and methods as specified.
- E. Clean and repair existing raceway and boxes to remain or to be reinstalled.

### 3.3 INSTALLATION

- A. Ground and bond raceway and boxes in accordance with Section 26 05 26.
- B. Fasten raceway and box supports to structure and finishes in accordance with Section 26 05 29.
- C. Identify raceway and boxes in accordance with Section 26 05 53.
- D. Arrange raceway and boxes to maintain headroom and present neat appearance.
- E. Flexible Metal Conduit shall be used for interior vibrating equipment. Length shall not exceed 6 feet. Where exposed to continuous or intermittent moisture, conduit shall be liquid-tight.
- F. Exposed conduits for medium voltage systems shall be rigid steel conduit.

### 3.4 INSTALLATION - RACEWAY

- A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.
- B. Arrange raceway supports to prevent misalignment during wiring installation.
- C. Support raceway using coated steel or malleable straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- D. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29.
- E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports.

- F. Do not attach raceway to ceiling support wires or other piping systems.
- G. Construct wireway supports from steel channel specified in Section 26 05 29.
- H. Route raceway installed above accessible ceilings parallel and perpendicular to walls.
- I. Route conduit in and under slab from point-to-point.
- J. Coordinate and obtain approval by Architect and Structural Engineer prior to in-slab conduit runs including locations, conduit sizes, quantities, and clearances.
- K. Maximum Size Conduit in Slab Above Grade: 3/4 inch. Do not cross conduits in slab larger than 1/2 inch.
- L. Maintain clearance between raceway and piping for maintenance purposes.
- M. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104 degrees F.
- N. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- O. Bring conduit to shoulder of fittings; fasten securely.
- P. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.
- Q. Install conduit hubs to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- R. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install factory elbows for bends in metal conduit larger than 2 inch size.
- S. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.
- T. Install fittings to accommodate expansion and deflection where raceway crosses control and expansion joints. Exposed conduits shall have an expansion fitting maximum every 150'.
- U. Install suitable pull string or cord in each empty raceway except sleeves and nipples.
- V. Install suitable caps to protect installed conduit against entrance of dirt and moisture.
- W. Cap and label ends of spare conduits.
- X. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.
- Y. Close ends and unused openings in wireway.

- Z. Conduits shall be run parallel and at right angles to building lines.
- AA. Metal Conduit system shall be electrically continuous.
- BB. Conduits passing through floor slabs (ground floor excluded) shall be sealed with UL listed fire-stopping material. Seal around all penetrations through smoke and fire rated walls.
- CC. Expansion fittings or flexible conduit shall be used across building expansion joints.
- DD. Mixed voltage conductors shall not share the same conduits.
- EE. Install raceways as high as possible to maintain above ceiling and/or access clearances.

### 3.5 INSTALLATION - BOXES

- A. Provide each fixture, switch, receptacle, and other wiring device with a galvanized outlet box of appropriate size and depth for its particular location and use.
- B. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings.
- C. Adjust box location up to 1 foot prior to rough-in to accommodate intended purpose.
- D. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
- E. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- F. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 18 inches from ceiling access panel or from removable recessed luminaire.
- G. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting with Owner/Architect to achieve neat opening.
- H. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches separation in non-fire rated walls. Install with minimum 24 inches separation in acoustic rated walls.
- I. Installation in a minimum 1-hour fire rated wall or partition shall be in such a manner that the required fire resistance is not reduced, unless one of the following is met:
  - 1. Any steel electrical box not exceeding 0.1 ft<sup>2</sup> shall be permitted where the aggregate area of the openings provided for the boxes does not exceed 0.7 ft<sup>2</sup> in any 100 ft<sup>2</sup> of wall area and where outlet boxes are installed on opposite sides of the wall, the boxes shall be separated by one of the following:
    - a. Horizontal distance of not less than 24 inches.
    - b. Horizontal distance of not less than the depth of the wall cavity, where the wall cavity is filled with cellulose loose-fill, rock wool, or slag wool insulation.
    - c. Solid fire blocking.
  - 2. Membrane penetrations for any listed electrical outlet box made of any material shall be permitted, provide that such boxes have been tested for use in fire resistance-rated assemblies and are installed in accordance with the instructions included in the listing.

- J. Electrical outlet boxes shall not be installed in vertical fire rated assemblies classified as fire or smoke partitions without written approval and direction from Architect.
- K. Secure flush mounted box to interior wall and partition studs. Accurately position to allow for surface finish thickness. No deviations.
- L. Install stamped steel bridges to fasten flush mounting outlet box between studs.
- M. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- N. Install adjustable steel channel fasteners for hung ceiling outlet box.
- O. Do not fasten boxes to ceiling support wires or other piping systems.
- P. Support boxes independently of conduit.
- Q. Install gang box where more than one device is mounted together. Do not use sectional box.
- R. Install gang box with plaster ring for single device outlets.
- S. Minimum box size shall be per NEC.
- T. Pay extra special attention to floor box installations. Ensure finished product is at manufacturer recommended height and square in all directions in floor. Avoid concrete chips around floor box and seal as required to maintain rating. The complete assembly and installation will be approved by Architect and Engineer.
- U. Install visible boxes in walls perpendicular to building lines. No deviations.

### 3.6 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods.
- B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate requirements, sealing, and locations with Architect prior to work.
- C. Locate outlet boxes to allow luminaires positioned as indicated on Drawings.
- D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

### 3.7 ADJUSTING

- A. Refer to Division 01: Testing, adjusting, and balancing.
- B. Adjust flush-mounting outlets to make front flush with finished wall material.
- C. Install knockout closures in unused openings in boxes.

- D. Adjust floor boxes as required by Architect/Engineer.

### 3.8 CLEANING

- A. Refer to Division 01: Final cleaning.
- B. Clean interior of boxes to remove dust, debris, and other material.
- C. Clean exposed surfaces and restore finish.

END OF SECTION

## SECTION 26 05 43 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. This section specifies the furnishing and installation of ducts and installing and connecting of manholes, vaults, pullboxes, and ducts to form a complete underground raceway system.
- B. Refer to structural for additional manhole and vault specifications.
- C. "Duct" and "conduit", and "rigid metal conduit" and "rigid conduit," and "pullboxes," and "handholes." are used interchangeably in this specification and have the same meaning.

#### 1.2 RELATED WORK

- A. Section 31 20 00 – Earthwork: Trenching, backfill and compaction.
- B. Section 07 92 00 – Sealants and Caulking: Sealing of conduit penetrations.
- C. Section 26 05 00 – Common Work Results for Electrical: General electrical requirements and items that are common to more than one section of Division 26.
- D. Section 26 05 33 – Raceway and Boxes for Electrical Systems: Conduits and outlet boxes.
- E. Section 26 05 26 – Grounding and Bonding for Electrical Systems: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- F. Section 26 05 13 – Medium-Voltage Cables.
- G. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.

#### 1.3 SUBMITTALS

- A. Submit in accordance with Section 26 05 00, Basic Methods and Requirements (Electrical).
- B. Shop Drawings:
  - 1. Include sufficient information, clearly presented, to determine compliance with drawings and specifications.
  - 2. Include handholes, duct materials, and hardware. Proposed deviations from details on the drawings shall be clearly marked on the submittals.
  - 3. If necessary to locate manholes or handholes at locations other than shown on the drawings, show the proposed locations accurately on scaled site drawings, and submit four copies to the Engineer for approval prior to construction.
  - 4. Manhole and pullbox hardware.

#### 1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. U.S. General Services Administration (GSA):
  - 1. A-A-60005 – Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole.
  - 2. SS-S-210A - Sealing Compound, Preformed Plastic for Expansion Joints And Pipe Joints.
- C. Underwriters Laboratories, Inc. (UL):
  - 1. UL 6 - Electrical Rigid Metal Conduit-Steel
  - 2. UL 467 - Grounding and Bonding Equipment.
  - 3. UL 651 - Schedule 40 and 80 Rigid PVC Conduit.
  - 4. UL 651A - Type EB and A Rigid PVC Conduit and HDPE Conduit.
  - 5. 651B-07 – Continuous Length HDPE Conduit
- D. National Fire Protection Association (NFPA):
  - 1. 70 – National Electrical Code (NEC).
  - 2. 70E – Electrical Safety in the Workplace
- E. National Electrical Manufacturers Association (NEMA):
  - 1. RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit.
  - 2. TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
  - 3. TC3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
  - 4. TC6 & 8 - PVC Plastic Utilities Duct For Underground Installations.
  - 5. TC 9 - Fittings For PVC Plastic Utilities Duct For Underground Installation.
- F. American Concrete Institute (ACI):
  - 1. 318 - Building Code Requirements for Structural Concrete.
- G. American Society for Testing and Materials. (ASTM):
  - 1. C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
  - 2. C478M - Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric).
  - 3. C858-10e1 – Underground Precast Concrete Utility Structures.
  - 4. C990-09 – Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants.
  - 5. F512-95 - Standard Specification for Smooth-Wall Polyvinyl Chloride (PVC) Conduit and Fittings for Underground Installation.
- H. American National Standards Institute (ANSI):
  - 1. 77-10 – Underground Enclosure Integrity.

PART 2 - PRODUCTS

2.1 PRE-CAST CONCRETE MANHOLES AND HARDWARE

- A. Structure: Size as indicated on the drawings. Factory-fabricated reinforced-concrete, monolithically-poured walls and bottom. Frame and cover shall form top of manhole. Aircraft rated, 200,000 lbs minimum including frame and cover.
- B. Manhole Hardware:
  - 1. Frames and covers (traffic type):
    - a. Covers, Type D, labeled “Electrical”. Minimum diameter: 22 ¾”.
    - b. Refer to details on plans.
  - 2. Pulling Irons: 22 mm (7/8 inch) diameter hot-dipped galvanized steel bar with exposed triangular shaped opening.
  - 3. Cable supports:
    - a. Cable stanchions, 1” deep by 4” wide by minimum 36” long, made from 50% glass reinforced nylon or a heavy duty NON-METALLIC material having equal mechanical strength, thermal resistance, chemical resistance, dielectric strength, and physical properties to the listed manufacturer. Stanchions shall incorporate multiple arm mounting holes and recessed bolt mounting holes.
    - b. Cable arms, 3” wide by minimum 8” long, made from 50% glass reinforced nylon or a heavy duty NON-METALLIC material having equal mechanical strength, thermal resistance, chemical resistance, dielectric strength, and physical properties to the listed manufacturer. Cables shall be secured to arms with cable ties per manufacturer requirements. Racks shall meet or exceed capacities shown in Table 1, below.

**Table 1 – Heavy Duty Cable Rack Arm Capacities\*\*\***

Length (inches)	3	4.9	4	6	8	11	14	20
Rated Working Load (lbs.)*	450	300	450	450	450	400	350	250
Deflection at Rated Working Load (inches)**	NA	NA	.082	.156	.218	.250	.369	.294
Ultimate Load (lbs)* (Short Term)	1000+	1000+	1000+	1000+	1000+	1000+	1000+	1000+
*Load concentrated 1” from outer end of arm. **Deflection is measured 1’ from the outer end of arm. ***Arm and stanchion are to be conditioned at 50% relative humidity prior to test.								

- c. Drop-in or cast in place anchors shall be acceptable. Conform to manufacturer’s requirements.
- d. Spares: Equip each cable stanchion with two spare cable arms.
- e. Miscellaneous hardware, 316 stainless steel.



- f. Manufacturer: Underground Devices Incorporated, OldeCastle, or approved equal.
- C. Pullboxes
- 1. General: Size as indicated on the drawings. Provide pullboxes with weatherproof, non-skid covers with recessed hook eyes, secured with corrosion – and tamper resistant hardware. Cover material shall be identical to pullbox material. Covers shall have molded lettering, ELECTRICAL or SIGNAL as applicable. Pullboxes shall comply with the requirements of ANSI 77 Tier 22 loading. Provide pulling irons, 22 mm (0.875 inch) diameter galvanized steel bar with exposed triangular-shaped opening.
- D. Handhole Hardware:
- 1. Frames and covers configuration as shown on the drawings.
  - 2. Pulling irons, 22 mm (7/8 inch) diameter galvanized steel bar with exposed triangular shaped opening.
  - 3. Cable supports are not required.
- E. Ducts:
- 1. Number and sizes shall be as shown on the drawings.
  - 2. Ducts (concrete-encased):
    - a. Plastic Duct:
      - 1) UL 651 and 651A Schedule 40 and Schedule 80 PVC conduit.
      - 2) Duct shall be suitable for use with 90° C (194° F) rated conductors.
      - 3) NEMA TC2
  - 3. Concrete: ACI-318, 3000 psi minimum 28 day compressive strength.
  - 4. Reinforcing Steel: Number 4 minimum.
  - 5. Size shall be as shown on drawings.
  - 6. Rigid metal conduit, PVC-coated: UL6 and NEMA RN1 galvanized rigid steel, threaded type, coated with PVC sheath bonded to the galvanized exterior surface nominal 1 mm (0.040 inch) thick.
  - 7. HDPE use for Directional Boring. SDR-13.5 (heavy wall thickness), TC 7, UL Listed.
    - a. All conduits shall have the diameters, quantities and colors as shown on the project detail sheet and shall be compliant with all ASTM and Bellcore TW-NWT-000356 requirements.
    - b. All HDPE conduit shall be factory lubricated, low friction, high-density conduit constructed of virgin high-density polyethylene resin. Conduit shall be capable of being coiled on reels in continuous lengths, transported, stored outdoors, and subsequently uncoiled for installation, without affecting its properties or performance.
- F. Ground Rods: Per Section 26 05 26, Grounding and Bonding.
- G. Ground Wire (Inside manholes, pullboxes, and handholes): Tinned bare copper, refer also to drawings.
- H. Manhole Ladders: Aluminum with 400 mm (16 inch) rung spacing, and per the requirements of Section 05500, Metal Fabrications.
- I. Conduit Spacers: Prefabricated plastic.

- J. Warning Tape: Standard 4-mil polyethylene tape, detectable type, red with black letters, imprinted with “CAUTION BURIED ELECIC DUCTBANK BELOW”.
- K. Pull Rope: Plastic with 890N (200 pound) minimum tensile strength.

### PART 3 - EXECUTION

#### 3.1 MANHOLE AND HANDHOLE CONSTRUCTION AND INSTALLATION

##### A. Manhole and Pullbox Installation

1. Assembly and installation shall be per the requirements of the manufacture.
  - a. Install manholes and pullboxes level and plumb.
  - b. Units shall be installed on a 300 mm (12 inches) thick level bed of 90% compacted granular fill, well-graded from the 25 mm (1 inches) sieve to the No. 4 sieve. Granular fill shall be compacted with a minimum of four passes with a plate compactor.
2. Access: Ensure the top of frames and covers are flush with finished grade.
3. Grounding in Manholes:
  - a. Ground Rods in Manholes: Drive a ground rod into the earth, through the floor sleeve, after the manhole is set in place. Fill the sleeve with sealant to make a watertight seal. Rods shall protrude approximately 100 mm (4 inches) above the manhole floor.
  - b. Install a No. 3/0 AWG bare copper ring grounding conductor around the inside perimeter of the manhole and anchor to the walls with metallic cable clips.
  - c. Connect the ring grounding conductor to the ground rod by an exothermic welding process.
  - d. Bond the ring grounding conductor to the duct bank, the exposed non-current carrying metal parts of ladders, racks, sump covers, and like items in the manholes with a minimum No. 6 AWG bare copper jumper using an exothermic welding process.

##### B. General Requirements (In addition to the drawings):

1. Locate manholes and handholes at the approximate locations shown on the drawings with due consideration given to the location of other utilities, grades, and paving.
2. Duct terminations: Shall be sealed watertight.

##### C. Manhole Access:

1. Manhole chimney shall consist of a sufficient number of collars to reach the required level.
2. The top of frames and covers shall be flush type, with the finish flush with finished grade in paved and unpaved areas.

##### D. Access for Handholes: Make the top of frames and covers flush with finished grade.

##### E. Manhole Cable Racks:

1. Provide cable racks with porcelain insulator supports in each manhole.
2. Cable support intervals shall not exceed 36 inches.

3. Install racks at the above spacing on all walls for not less than one cable, whether or not the racks will be used for cables. Install additional racks as required for the cables.
- F. Ladders: Provide securely-mounted ladder for every manhole over 1200 mm (4 feet) deep.

### 3.2 TRENCHING

- A. Refer to Section 30 20 00 - EARTHWORK for trenching back-filling, and compaction.
- B. Before performing trenching work at existing facilities, a Ground Penetrating Radar Survey shall be carefully performed by a certified technician to reveal all existing underground ducts, conduits, cables, and other utility systems.
- C. Work with extreme care near existing ducts, conduits, cables, and other utilities to avoid damaging them.
- D. Cut the trenches neatly and uniformly.
- E. For Concrete Encased Ducts:
  1. After excavation of the trench, stakes shall be driven in the bottom of the trench at 1200 mm (four foot) intervals to establish the grade and route of the duct bank.
  2. Pitch the trenches uniformly towards manholes or both ways from high points between manholes for the required duct line drainage. Avoid pitching the ducts towards buildings wherever possible.
  3. The walls of the trench may be used to form the side walls of the duct bank provided that the soil is self-supporting and that concrete envelope can be poured without soil inclusions. Forms are required where the soil is not self-supporting.
  4. After the concrete encased duct has sufficiently cured, the trench shall be backfilled to grade with earth, with appropriate warning tape attached.
- F. Conduits to be installed under existing paved areas, roads, and railroad tracks which are not to be disturbed shall be directional bored as shown on drawings.

### 3.3 DIRECTIONAL BORING

- A. Before performing directional boring work at existing facilities, a Grounding Penetrating Radar Survey shall be carefully performed by a certified technician to reveal all existing underground ducts, conduits, cables, and other utility systems.
- B. The installation of conduit shall be performed in such a manner as to avoid unnecessary damage to streets, sidewalks, utilities, landscaping, and tenant operations. Excavations and conduit installation shall be performed in a continuous operation. The material from excavating operations shall be placed in a location that will not cause damage or obstruction to vehicular or pedestrian traffic or interfere with surface drainage.
- C. The Contractor shall take all necessary precautions to avoid heaving any existing asphalt/concrete materials or over-excavating, whether caused by equipment directly or by dislodging rocks and boulders. Any such heaving or over-excavation shall be repaired or

replaced at the Contractor's expense. The Contractor shall bear the cost of backfilling all over-excavated areas with the appropriate backfill material as approved by the project engineer.

- D. The Contractor shall restore all surface materials to their preconstruction condition, including but not limited to pavement, sidewalks, sprinkler systems, landscaping, shrubs, sod, or native vegetation that is disturbed by the conduit installation operation. All repairs shall be included in the cost of the conduit.
- E. If the Contractor is unable to bore the conduit at the lengths shown on the plans from access point to access point, all splice couplings and associated work to splice conduit shall be included in the cost of this item. The coupling technology shall allow the conduit to be connected without the need for special tools, and shall form a watertight, airtight seal. Breaking force between segments shall exceed 250 pounds of force. No metal fittings shall be allowed. No elevation difference between the conduit run and the splice location will be allowed. Conduit splices shall be kept to a minimum and all locations shall be approved by the project engineer. Additional pull boxes shall not be substituted for splices.
- F. Conduit plugs shall be supplied and installed in all conduit ends as soon as the conduit is installed. Conduit shall be plugged at all termination points such as pull boxes, manholes, controller cabinets, and node buildings. Conduits containing cables shall be plugged with durable and reusable split type plugs, fabricated without metallic parts, and allow easy removal and reinstallation around in-place cables. Split type plugs shall provide a water and air-tight seal of at least 50 psi and shall be installable by hand without using special tools and without damaging the cable. All plugs shall be correctly sized to fit the conduit being plugged. Empty conduits shall be sealed with removable type duct plugs that provide a watertight barrier.
- G. All conduits shall use sweeps to elevate the buried conduits to within 4 inches of the bottom of the pull box or manhole, as shown in project details. The sweeps shall be terminated within the pull boxes and manholes to allow for easy installation and removal of the conduit plugs. The sweeps shall be set above the ground surface within the pull box at a height that does not interfere with the coiling of the cables.
- H. All conduit runs shall have a limited number of bends. The sum of the individual conduit bends on a single conduit run between two pull boxes shall not exceed 270 degrees. No individual bend shall be greater than 90 degrees. All conduit bends shall have a minimum acceptable radius. The minimum radius for 90 degree bends is 48 inches, and the minimum radius for all other bends is 24 inches.
- I. If new conduits are installed in existing pull boxes, manholes or cabinet bases, the Contractor shall carefully excavate around the pull box or manhole and install the new conduit as shown in the plans. The Contractor shall not damage the existing pull box, manhole or their contents. If the existing pull box, lid, or the concrete collars are cracked or damaged during conduit installation, the Contractor shall restore the damaged section to preconstruction condition at no additional cost.
- J. The Contractor is responsible for removing and hauling the spoils from their excavations within two days of completion of their work. The spoils shall be hauled to a County facility under County supervision. Upon dumping, the contractor must provide the County with the address and the quantity of material dumped. No foreign spoils that are not created by work within project limits will be permitted to be dumped at the County site. Any unauthorized material

dumping at the County site will be grounds for immediate termination of the contract, and potentially legal action.

- K. The contractor is required to take digital photos of the pre-existing conditions, prior to excavation, part of their normal process. Such becomes invaluable for cases of hitting of mis-marked utilities and restoration complaints. Contractor shall provide access to all pictures related to County work upon request.

### 3.4 DUCT INSTALLATION

#### A. General Requirements:

1. Ducts shall be in accordance with the NEC, as shown on the drawings, and as specified.
2. Slope ducts to drain towards manholes and handholes, and away from building and equipment entrances. Pitch not less than 100 mm (4 inches) in 30 m (100 feet).
3. Underground conduit stub-ups and sweeps to equipment inside of buildings shall be PVC-coated galvanized rigid steel, and shall extend a minimum of 1500 mm (5 feet) outside of building foundation.
4. Stub-ups, sweeps, and risers to equipment mounted on outdoor concrete slabs shall be stainless rigid steel, and shall extend a minimum of 1500 mm (5 feet) away from edge of slab.
5. Install insulated grounding bushings on the terminations.
6. PVC-coated rigid steel conduits shall be coupled to the ducts with suitable adapters, and the whole encased with 75 mm (3 inches) of concrete.
7. PVC coated rigid steel conduit turns of direction for all duct lines shall have minimum 1200 mm (4 feet) radius in the horizontal and vertical directions. PVC conduit sweeps for all duct lines shall have a minimum 12000 mm (40 feet) radius in the horizontal and 1200 mm (4 feet) in the vertical directions. Where a 12000 mm (40 feet) radius is not possible, horizontal turns of direction shall be PVC coated rigid steel.
8. All multiple conduit runs shall have conduit spacers. Spacers shall securely support or maintain uniform spacing of the duct assembly a minimum of 75 mm (3 ½ inches) above bottom of trench during the concrete pour). Spacer spacing shall not exceed 1500 mm (5 feet).
9. Duct lines shall be installed no less than 300 mm (36 inches) from other utility systems, such as water, sewer, and chilled water unless first approved by Engineer.
10. Clearances between individual ducts:
  - a. For like services, not less than 75 mm (3 ½ inches).
  - b. For power and signal services, not less than 150 mm (12 inches).
  - c. Provide plastic spacers to maintain clearances.
  - d. Provide nonferrous tie wires to prevent displacement of the ducts during pouring of concrete. Tie wires shall not act as substitute for spacers.
11. Duct lines shall terminate at window openings in manhole walls as shown on the drawings. All ducts shall be fitted with end bells.
12. Couple the ducts with proper couplings. Stagger couplings in rows and layers to insure maximum strength and rigidity of the duct bank.
13. Keep ducts clean of earth, sand, or gravel during construction, and seal with tapered plugs upon completion of each portion of the work.
14. Use Schedule 80 PVC from transition from concrete encasement to vault connections. Refer also to drawings.

- B. Concrete Encased Ducts and Conduits:
1. Install concrete-encased ducts for medium voltage systems, low voltage systems, and communication systems unless otherwise shown on the drawings.
  2. Duct lines shall consist of single or multiple duct assemblies encased in concrete. Ducts shall be uniform in size and material throughout the installation.
  3. Tops of concrete-encased ducts shall be:
    - a. Not less than shown on the drawings, below finished grade.
    - b. Conduits crossing under grade slab construction joints shall be installed a minimum of 1200 mm (4 feet) below slab.
  4. Extend the concrete envelope encasing the ducts not less than 75 mm (3 ½ inches) beyond the outside walls of the outer ducts and conduits.
  5. To provide a protective cage, install #4 rebar on 18” centers for the entire length. Install longitudinal #4 rebar on corners with maximum 24” spacing. Submit cross-sectional designs for review and comment.
  6. Where new ducts, conduits, and concrete envelopes are to be joined to existing manholes, handholes, ducts, conduits, and concrete envelopes, make the joints with the proper fittings and fabricate the concrete envelopes to ensure smooth durable transitions.
  7. Use Schedule 40 PVC conduits unless curves, bends, or transitions as mentioned above.
- C. Spare Ducts and Conduits: Where spare ducts are shown, they shall have a nylon pull rope installed. They shall be capped at each end and labeled as to location of the other end.
- D. Duct and Conduit Cleaning:
1. Upon completion of the duct bank installation or installation of direct buried ducts, a standard flexible mandrel shall be pulled through each duct to loosen particles of earth, sand, or foreign material left in the line. The mandrel shall not be less than 3600 mm (12 inches) long, and shall have a diameter not less than 13 mm (1/2 inch) less than the inside diameter of the duct. A brush with stiff bristles shall then be pulled through each duct to remove the loosen particles. The diameter of the brush shall be the same as, or slightly larger than the diameter of the duct.
  2. Mandrel pulls shall be witnessed by the Resident Engineer.
- E. Duct and Conduit Sealing: Seal the ducts and conduits at building entrances, and at outdoor terminations for equipment, with a suitable non-hardening compound to prevent the entrance of moisture and gases.
- F. Connections to Manholes: Duct bank envelopes connecting to underground structures shall be flared to have enlarged cross-section at the manhole entrance to provide additional shear strength. Dimensions of the flared cross-section shall be larger than the corresponding manhole opening dimensions by no less than 300 mm (12 inches) in each direction. Perimeter of the duct bank opening in the underground structure shall be flared toward the inside of keyed to provide a positive interlock between the duct bank and the wall of the structure. Use vibrators when this portion of the encasement is poured to assure a seal between the envelope and the wall of the structure.
- G. Connections to Existing Manholes: For duct bank connections to existing structures, break the structure wall out to the dimension required and preserve steel in the structure wall. Cut steel and extend into the duct bank envelope. Chip the perimeter surface of the duct bank opening to form a key or flared surface, providing a positive connection with the duct bank envelope.

- H. Connections to Existing Ducts: Where connections to existing duct banks are indicated, excavate around the duct banks as necessary. Cut off the duct banks and remove loose concrete from the conduits before installing new concrete-encased ducts. Provide a reinforced concrete collar, poured monolithically with the new duct bank, to take the shear at the joint of the duct banks.
- I. Partially Completed Duct Banks: During construction wherever a construction joint is necessary in a duct bank, prevent debris such as mud and dirt from entering ducts by providing suitable conduit plugs. Fit concrete envelope of a partially completed duct bank with reinforcing steel extending a minimum of 600 mm (2 feet) back into the envelope and a minimum of 600 mm (2 feet) beyond the end of the envelope. Provide one No. 4 bar in each corner, 75 mm (3 inches) from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately 300 mm (1 foot) apart. Restrain reinforcing assembly from moving during pouring of concrete.

### 3.5 EXISTING DUCT AND CONDUIT CLEANING AND INSPECTION

- A. Upon completion and removal of existing wire in conduit, the following procedure shall be performed to fully verify and inspect the integrity of the existing conduit:
  - 1. A standard flexible mandrel shall be pulled through each duct to loosen particles of earth, sand, or foreign material left in the line. The mandrel shall not be less than 3,600 mm (12 inches) long, and shall have a diameter not less than 13 mm (1/2 inch) less than inside diameter of the duct.
  - 2. A wire brush shall then be pulled through each duct to remove loosened particles. The diameter of the brush shall be the same or slightly larger than the diameter of the duct.
  - 3. A long duct swab shall then be pulled through each duct as a final method to clean dirt and residue from the ducts. Select swab based on size of conduit/duct being pulled through.
  - 4. Perform TV/Video inspection of all existing ducts after cleaning has been completed. The inspection shall be recorded for review by resident engineer and engineer of record.
  - 5. All cleaning and inspections shall be witnessed by resident engineer.

END OF SECTION

## SECTION 26 05 53 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Nameplates.
  - 2. Labels.
  - 3. Wire markers.
  - 4. Conduit markers.
  - 5. Stencils.
  - 6. Underground Warning Tape.
  - 7. Lockout Devices.
- B. Related Sections:
  - 1. Section 09 90 00 - Painting and Coating: Execution requirements for painting specified by this section.
  - 2. Section 26 05 00 – Common Work Results for Electrical
  - 3. Section 26 05 13 – Medium Voltage Cables
  - 4. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables
  - 5. Section 26 05 43 – Underground Ducts and Raceways for Electrical System

#### 1.2 SUBMITTALS

- A. Refer to Division 01: Submittal procedures.
- B. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Refer to Division 01: Requirements for submittals.
- B. Project Record Documents: Record actual locations of tagged devices; include tag numbers.

### PART 2 - PRODUCTS

#### 2.1 NAMEPLATES

- A. Engraved Plastic-Laminate Signs:
  - 1. General: Provide engraving stock melamine plastic laminate in sizes and thicknesses indicated, engraved with engraver's standard letter style of sizes and wording indicating; punched for mechanical fastening means can be used (see below).



2. Signs shall be colored face with white core plies (letter color).
  - a. Thickness: 1/16", except as otherwise indicated.
  - b. Letters shall be minimum 1/2" high for equipment such as panel boards and disconnect switches and 1" high for switchboards and pad mount transformers.
  - c. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot, or should not, penetrate substrate.
  - d. Nameplate colors shall be:
    - 1) Black – Normal, utility power, less than 600 Volts
    - 2) Orange – Medium voltage power.
    - 3) Red – fire alarm system.
    - 4) Blue – UPS power.
3. Cable Tags, refer also to 26 05 13 Medium Voltage Cables.

## 2.2 LABELS

- A. Dymo-Labels (interior only): Identify all receptacles and wall switches (new and existing) with panelboard and branch circuit number. Attach to coverplate.

## 2.3 CONDUIT AND RACEWAY MARKERS

- A. Description: Nameplate fastened with straps or Stencils.
- B. Color:
  1. Medium Voltage System: Orange lettering on white background.
  2. 480 Volt System: Black lettering on white background.
  3. 208 Volt System: Black lettering on white background.

## 2.4 UNDERGROUND WARNING TAPE

- A. Description: 4 inch wide plastic tape, detectable type, colored red with suitable warning legend describing buried electrical lines.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. General Installation Requirements:
  1. Install electrical identification products as indicated, in accordance with manufacturer's written instructions and requirements of NEC.
  2. Coordination: Where identification is to be applied to surfaces that require finish, install identification after painting.
  3. Regulations: Comply with governing regulations and requests of governing authorities for identification of electrical work.
- B. Equipment/system Identification:

1. General: Install engraved plastic-laminate sign on each major unit or electrical equipment in building; including central or master unit of each electrical system including communication/control/signal systems, unless unit is specified with its own self-explanatory identification or signal system. Provide text matching terminology and numbering of the contract documents and shop drawings. Provide signs for each unit of the following categories of electrical work:
    - a. Access panels/doors to electrical facilities.
  2. Install signs at locations indicated or, where not otherwise indicated, at location for best convenience of viewing without interference with operation and maintenance equipment. Secure to substrate with self-tapping stainless steel screws (use GE sealant or equivalent around screws to maintain water tightness) except use adhesive where fasteners should not, or cannot, penetrate substrate.
- C. Degrease and clean surfaces to receive adhesive for identification materials.
- D. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.
- E. Coordinate names, abbreviations, and other designations used in electrical identification work with corresponding designations shown, specified, or scheduled. Provide numbers, lettering and wording as indicated, or if not otherwise indicated, as recommended by manufacturer or as required for proper identification and operation/maintenance of electrical systems and equipment.
- 3.2 EXISTING WORK
- A. Install identification on existing equipment to remain in accordance with this section.
  - B. Install identification on unmarked existing equipment.
  - C. Replace lost nameplates.
  - D. Re-stencil existing equipment.
- 3.3 INSTALLATION
- A. Install identifying devices after completion of painting.
  - B. Nameplate Installation:
    1. Install nameplate parallel to equipment lines.
    2. Install nameplate for each electrical distribution and control equipment enclosure with: Interior - corrosive-resistant mechanical fasteners or adhesive; Exterior – use stainless steel screws with GE exterior sealant to maintain water tightness.
    3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.
    4. Secure nameplate to equipment front using screws, rivets, or adhesive.
    5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
    6. Install nameplates on the following:

- a. Switchgear.
  - b. Panelboards.
  - c. Transformers, including pad-mounts.
  - d. Disconnect Switches.
  - e. Motor Starters.
  - f. Fire Alarm Equipment Panels.
- C. Label Installation:
- 1. Install label parallel to equipment lines.
- D. Wire Marker Installation:
- 1. Install wire marker for each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.
  - 2. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
  - 3. Install labels at data outlets identifying patch panel and port designation.
- E. Stencil Installation:
- 1. Apply stencil painting in accordance with Section 09 90 00.
- F. Underground Warning Tape Installation:
- 1. Install underground warning tape along length of each underground conduit, raceway, or cable 6 to 8 inches below finished grade, directly above buried conduit, raceway, or cable.

END OF SECTION

## SECTION 26 05 73 – OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. This section specifies the requirements of the Electrical System Protective Device Study.
- B. A short circuit, coordination study, and arc-flash study shall be prepared for the electrical overcurrent equipment and devices to be installed under this project to ensure proper equipment and personnel protection.
- C. The study shall present an organized time-current analysis of each protective device in series from the individual device back to the utility. The study shall reflect the operation of each device during normal and abnormal current conditions.
- D. Perform all work in accordance with the applicable codes and standards of the following agencies except as provided otherwise herein:
  - 1. National Fire Protection Association – NFPA
    - a. ANSI/NFPA 70: National Electrical Code
    - b. NFPA 70E: Standard for Electrical Safety in the Workplace

#### 1.2 RELATED WORK

- A. Section 26 05 00 – Common Work Results for Electrical: General electrical requirements that are common to more than one section of Division 26.
- B. Section 26 05 13 – Medium Voltage Cables
- C. Section 26 05 19 – Low Voltage Electrical Power Conductors and Cables
- D. Section 26 12 19 – Pad-Mounted, Liquid-Filled, Medium-Voltage Transformers
- E. Section 26 13 26 – Medium Voltage Metal-Clad Switchgear
- F. Section 26 22 00 – Low-Voltage Transformers
- G. Section 26 24 16 – Panelboards

#### 1.3 SUBMITTALS

- A. In accordance with Section 26 05 00, Basic Methods and Requirements (Electrical), submit the following:
- B. Complete short circuit, coordination, and arc-flash study as described herein.

- C. Protective equipment shop drawings shall be submitted simultaneously with or after the protective device study. Protective equipment shop drawings will not be accepted prior to protective device study.
- D. Certification: Two weeks prior to final inspection, submit four copies of the following to the Engineer:
  - 1. Certificate by the Contractor that the protective devices have been adjusted and set in accordance with the approved protective device study.
- E. All analyses shall be performed using either SKM or EasyPower. No exceptions. Submit electronic files with studies.

#### 1.4 QUALIFICATIONS

- A. The protective device study shall be prepared by qualified engineers of equipment manufacturer. The Contractor is responsible for providing all pertinent information required by the preparers to complete the study.

#### 1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. Institute of Electrical and Electronics Engineers (IEEE):
  - 1. 242-01 – Protection and Coordination of Industrial and Commercial Power Systems.
  - 2. 399-97 – Industrial and Commercial Power Systems Analysis
  - 3. 1584a-04 – Guide for Performing Arc-Flash Hazard Calculations.

#### 1.6 REQUIREMENTS

- A. The complete study shall include a system one line diagram, short circuit and ground fault analysis, and protective coordination plots.
- B. One Line Diagram:
  - 1. Show, on the one line diagram, all electrical equipment and wiring to be protected by the overcurrent devices installed under this project. Clearly show, on the one line, the schematic wiring of the electrical distribution system. Include but not limited to the new utility services, the switchgear, 13.2 kV site distributions, distributions and branch circuit panels, and motors.
  - 2. Also show on the one line diagram the following specific information:
    - a. Calculated fault impedance, X/R ratios, and short circuit values.
    - b. Breaker and fuse ratings.
    - c. Relays and current transformers
    - d. Transformer kVA and voltage ratings, percent impedance, X/R ratios, and wiring connections.

- e. Voltage at each bus.
  - f. Identification of each bus.
  - g. Conduit material, feeder sizes, length, and X/R ratios.
- C. Short Circuit Study:
- 1. Systematically calculate the fault impedance to determine the available short circuit and ground fault currents at each bus. Incorporate the motor and gantry crane contributions in determining the momentary and interrupting rating of the protective devices.
  - 2. The study shall be calculated by means of a computer program. Pertinent data and the rationale employed in developing the calculations shall be incorporated in the introductory remarks of the study.
  - 3. Present the data determined by the short circuit study in a table format. Include the following:
    - a. Device identification. Identify location.
    - b. Operating voltage.
    - c. Protective device.
    - d. Device rating.
    - e. Calculated short circuit current.
  - 4. The study shall include these conditions:
    - a. Utility power maximum available fault current, either one or two sources. Include also ultimate build out for future substation. Coordinate with utility for maximum available fault currents.
- D. Coordination Curves and Settings:
- 1. Using computer modeling software, prepare the coordination curves to determine the required settings of protective devices to ensure selective coordination. Graphically illustrate on log-log paper that adequate time separation exists between series devices, including the utility company upstream device. Plot the specific time-current characteristics of each protective device in such a manner that all upstream devices will be clearly depicted on one sheet. Time scale shall be from 0.1 seconds to 1,000 seconds.
  - 2. The following specific information shall also be shown on the coordination curves:
    - a. Device identification and graphical representation of branch being coordinated.
    - b. Voltage and current ratio for curves.
    - c. 3-phase and 1-phase ANSI damage points for each transformer.
    - d. No-damage, melting, and clearing curves for fuses.
    - e. Cable damage curves.
    - f. Transformer inrush points.
    - g. Maximum short circuit cutoff point.
    - h. Motor inrush.
  - 3. Develop a table to summarize the setting selected for the protective devices. Include the following in the table:
    - a. Device identification. Identify location.
    - b. Relay CT ratios, tap, time dial, instantaneous pickup and relay curve, all relays and all settings.
    - c. Circuit breaker sensor and trip ratings, long-time, short-time, and instantaneous settings, and time bands.
    - d. Fuse ratings and type.
    - e. Ground fault pickup and time delay.

E. Arc-Flash

1. Incident Energy Study – An incident energy study shall be done in accordance with the IEEE 1584-(latest edition), “IEEE Guide for Performing Arch Flash Hazard Calculations” as referenced in NFPA 70, latest edition, in order to quantify the hazard for selection of personal protective equipment (PPE). Tables that assume fault current levels and clearing time for proper PPE selection are not acceptable.
2. The supplier shall supply a comprehensive report that includes:
  - a. Incident energy level (calories/cm<sup>2</sup>) for each equipment location and recommended PPE.
3. Labels
  - a. Based on the results of the incident energy study, the supplier shall produce and install a warning label (orange <40 cal/cm<sup>2</sup>) or danger label (red > 40 cal/cm<sup>2</sup>) for each piece of equipment as specified in “Section A” in accordance with ANSI Z535.4-2002. The label must be readable in both indoor and outdoor environments for at least 3 years and contain the following information:
    - 1) Arc hazard boundary (inches)
    - 2) Working distance (inches)
    - 3) Arc flash incident energy at the working distance (calories/ cm<sup>2</sup>)
    - 4) PPE category and description including the glove rating
    - 5) Voltage rating of the equipment
    - 6) Limited approach distance (inches)
    - 7) Restricted approach distance (inches)
    - 8) Prohibited approach distance (inches)
    - 9) Equipment/bus name
    - 10) Date prepared
    - 11) Supplier name and address
4. For the main and tie circuit breaker relays, include settings for:
  - a. 81: Over and under frequency.
  - b. 46: Neg. sequence overcurrent.
  - c. 50/51: Phase overcurrent.
  - d. 50G/51G: Ground overcurrent.
  - e. 67/67N: Directional overcurrent.
  - f. 59: Over voltage.
  - g. 27: Under voltage.
5. For the feeder circuit breaker relays include settings for:
  - a. 50/51: Phase overcurrent.
  - b. 50G/51G: Ground overcurrent.
  - c. 59: Over voltage.
  - d. 27: under voltage.

1.7 ANALYSIS

- A. Analyze the short circuit calculations, and highlight any equipment that is determined to be underrated as specified. Propose approaches to effectively protect the underrated equipment, also propose settings that optimize the protection of personnel from the Arc-Flash Study. Provide minor modifications to conform to the study (Examples of minor modifications are trip sizes within the same frame, the time curve characteristics of induction relays, C.T. ranges, etc.).

- B. After developing the coordination curves, highlight areas lacking coordination. Present a technical evaluation with a discussion of the logical compromises for best coordination.

1.8 ADJUSTMENTS, SETTINGS AND MODIFICATIONS

- A. Necessary final field adjustments, settings and minor modifications shall be made to conform with the protective device study without additional cost to the Owner.
- B. All final circuit breaker and relay settings and fuse sizes shall be made in accordance with the recommendations of the protective device study.

END OF SECTION



## SECTION 26 05 83 – WIRING CONNECTIONS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes electrical connections to equipment.
- B. Related Sections:
  - 1. Section 26 05 00 - Common Work Results for Electrical.
  - 2. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
  - 3. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
  - 4. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
- C. Related Documents:
  - 1. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this Section.
  - 2. This Section is a Division 26 Basic Electrical Materials and Methods section, and is part of each Division 23 and Division 26 section making reference to electrical connections for equipment specified herein.

#### 1.2 REFERENCES

Latest Adopted Editions of:

- A. National Electrical Manufacturers Association:
  - 1. NEMA WD 1 - General Requirements for Wiring Devices.
  - 2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.
- B. NEC Compliance: Comply with applicable requirements of NEC as to type products used and installation of electrical power connections (terminals and splices) for junction boxes, motor starters, and disconnect switches.
- C. UL Compliance: Comply with UL Std 486A, “Wire Connectors and Soldering Lugs for Use with Copper Conductors” including, but not limited to, tightening of electrical connectors to torque values indicated. Provide electrical connection products and materials which are UL listed and labeled.

#### 1.3 SUBMITTALS

- A. Refer to Division 01: Submittal procedures.
- B. Product Data: Submit wiring device manufacturer’s catalog information showing dimensions, configurations, and construction.

- C. Manufacturer's installation instructions.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Refer to Division 01: Submittal procedures.
- B. Project Record Documents: Record actual locations, sizes, and configurations of equipment connections.

#### 1.5 COORDINATION

- A. Refer to Division 01: Coordination and project conditions.
- B. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
- C. Determine connection locations and requirements.
- D. Sequence rough-in of electrical connections to coordinate with installation of equipment.
- E. Sequence electrical connections to coordinate with start-up of equipment.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS AND COMPONENTS

- A. General: For each electrical connection indicated, provide complete assembly of materials; including, but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, cable ties, solderless wirenuts, and other items and accessories as needed to complete splices and terminations of types indicated.
- B. Wire, Cables, and Connectors:  
General: Provide wires, cables, and connectors complying with Division 26.
- C. Connectors and Terminals: Provide electrical connectors and terminals that mate and match (including sizes and ratings) with equipment terminals, and are recommended by equipment manufacturer for intended applications.
- D. Manufacturers:
  - 1. Pass & Seymour.
  - 2. Hubbell.
  - 3. Cooper.
  - 4. Substitutions: Not Permitted.
- E. Attachment Plug Construction: Conform to NEMA WD 1.

- F. Configuration: NEMA WD 6; match receptacle configuration to outlet furnished for equipment.
- G. Cord Construction: Type SO multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations. Only allowed where shown on drawings.
- H. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Refer to Division 01: Coordination and project conditions.
- B. Verify equipment is ready for electrical connection, for wiring, and to be energized.

#### 3.2 EXISTING WORK

- A. Remove exposed abandoned equipment wiring connections, including abandoned connections above accessible ceiling finishes.
- B. Disconnect abandoned utilization equipment and remove wiring connections. Remove abandoned components when connected raceway is abandoned and removed. Install blank cover for abandoned boxes and enclosures not removed.
- C. Extend existing equipment connections using materials and methods as specified.

#### 3.3 INSTALLATION

- A. Install electrical connections as indicated; in accordance with equipment manufacturer's written instructions, with recognized industry practices, and complying with applicable requirements of UL and NEC to ensure that products fulfill requirements.
- B. Coordinate with other work, including wires/cables, raceway, and equipment installation as necessary to properly interface installation of electrical connections for equipment with other work.
- C. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.
- D. Make electrical connections.

- E. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in exterior, damp, wet, corrosive, oil and grease locations.
- F. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- G. Install receptacle outlet to accommodate connection with attachment plug.
- H. Install cord and cap for field-supplied attachment plug.
- I. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- J. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- K. Install terminal block jumpers to complete equipment wiring requirements.
- L. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

#### 3.4 ADJUSTING

- A. Refer to Division 01: Testing, adjusting, and balancing.
- B. Cooperate with utilization equipment installers and field service personnel during checkout and starting of equipment to allow testing and balancing and other startup operations. Provide personnel to operate electrical system and checkout wiring connection components and configurations.
- C. Field Quality Control: Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

END OF SECTION

## SECTION 26 12 19 – PAD-MOUNTED, LIQUID-FILLED, MEDIUM-VOLTAGE TRANSFORMERS

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. This section specifies the furnishing, installation and connection of padmounted transformers.
- B. Pad mounted transformers shall be complete, outdoor type, continuous duty, integral assembly, grounded, tamper-resistant and weatherproof with liquid-immersed transformers.
- C. Shall be radial feed, deadfront type.

#### 1.2 RELATED WORK

- A. Section 26 05 00 – Common Work Results for Electrical: General electrical requirements that are common to more than one section of Division 26.
- B. Section 26 05 13 - Medium-Voltage Cables.
- C. Section 26 05 43 - Underground Ducts and Raceways for Electrical Systems: Manholes, handholes and duct lines for underground raceway systems.
- D. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.
- E. Section 26 05 26 - Grounding and Bonding for Electrical Systems: Requirements for personnel safety and to provide a low impedance path to ground for possible ground currents.

#### 1.3 SUBMITTALS

- A. In accordance with Section 26 05 00, Basic Methods and Requirements, submit the following:
- B. Shop Drawings:
  - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
  - 2. Include electrical ratings, nameplate data, impedance, dimensions, weight, mounting details, decibel rating, termination information, temperature rise, no load and full load losses, regulation, overcurrent protection, connection diagrams, and accessories.
  - 3. Complete nameplate data including manufacturer's name and catalog number.
  - 4. Pad and anchoring details.
- C. Manuals:
  - 1. Submit simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering replacement parts.

- a. Identify terminals on wiring diagrams to facilitate installation, maintenance and operation.
- b. Indicate, on wiring diagrams, the internal wiring for each item of equipment and interconnections between the items of equipment.
- c. Approvals will be based on complete submissions of manuals together with shop drawings.
- d. Show all terminal identification.
- e. Include information for testing, repair, trouble shooting, assembly, disassembly, and recommended maintenance intervals.
- f. Provide a list of recommended spare parts, tools, and instruments for testing and maintenance purposes.
- g. Furnish manuals in loose leaf binder or manufacturer's standard binder.

#### 1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American Concrete Institute (ACI):
  1. 318 - Building Code Requirements for Structural Concrete
- C. American National Standards Institute (ANSI), Institute of Electrical and Electronic Engineers (IEEE), National Electrical Manufacturer's Association (NEMA):
  1. 48 - Standard Test Procedures and Requirements for Alternating Current Cable Terminations 2.5 kV through 765 kV
  2. 386 - Standard for Separable Insulated Connector Systems for Power Distribution Systems above 600 V (ANSI/IEEE)
  3. 592 - Standard for Exposed Semiconducting Shields on High Voltage Cable Joints and Separable Insulated Connectors
  4. C37.47 - High Voltage Current-Limiting Type Distribution Class Fuses and Fuse Disconnecting Switches
  5. C57.12.00 - IEEE Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
  6. C57.12.28 - Pad-Mounted Equipment Enclosure Integrity
  7. C57.12.34 - IEEE Standard Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers (2500 kVA and Smaller) – High Voltage: 34500GrdY/19920 Volts and Below; Low-Voltage: 480 Volt 2500 kVA and Smaller. (Issued in March 2005 – combines C57.12.22 and C57.12.26)
  8. C57.12.90 - IEEE Standard Test Code for Liquid
- D. National Fire Protection Association (NFPA):
  1. 70 - National Electrical Code (NEC)
  2. 70E – Electrical Safety in the Workplace
- E. Underwriters Laboratories Inc. (UL):
  1. 467 - UL Standard for Safety Grounding and Bonding Equipment

1.5 APPROVED MANUFACTURERS

- A. Cooper
- B. Culter-Hammer
- C. ABB
- D. GE

PART 2 - PRODUCTS

2.1 EQUIPMENT, GENERAL

- A. Equipment shall be in accordance with ANSI, ASTM, IEEE, NEMA, NFPA, UL, as shown on the drawings and as hereinafter specified.
- B. Voltages, windings, and ratings shall be as shown on the drawings.
- C. Provide units designed to withstand the mechanical stresses caused by rough handling during shipment in addition to the electrical and mechanical stresses that may occur during operation.
- D. Completely fabricate units at the factory so that only the external cable connections are required at the job site.
- E. The enclosure including base and supports, etc. shall be steel. Thoroughly clean, and finish all the metal surfaces at the factory with a rust resistant primer and dark green enamel finish coat.
- F. Secondary voltage BIL rating shall be minimum 95 kV.
- G. The transformer shall be furnished with full capacity high-voltage taps. The taps shall be +/- 2 – 2½% above and below nominal voltage. The tap changer switch shall be an externally operated switch with a hotstick-operable handle. The tap changer shall be clearly labeled to reflect that the transformer must be de-energized before operating the tap changer as required in Section 3.3 of ANSI C57.12.34. Taps shall be provided on the higher voltage of dual voltage primary units.
- H. The Kilovolt-ampere (kVA) ratings are continuous and are based on not exceeding either a 65°C average winding temperature rise or an 80°C hot-spot conductor temperature rise. The temperature rise of the insulating oil shall not exceed 65°C when measured near the top of the tank.
- I. The percent impedance voltage, as measured on the rated voltage connection, shall be per Table 2. For target impedances, the tolerance on the impedance shall be +/- 7.5% of nominal value for impedance values greater than 2.5%. The tolerance on the impedance shall be +/- 10.0% for impedance values less than or equal to 2.5%.

2.2 TABLE 2 PERCENT IMPEDANCE VOLTAGE

<b>kVA Rating (Low voltage , 700 V)</b>	<b>Impedance</b>
75	1.10 – 5.75
112.5-300	1.40 – 5.75
500	1.70 – 5.75
750-3750	5.75 nominal

- A. The primary switching scheme provided with the transformer shall be one (1) on-off under oil load-break switch.
- B. Shall be 60 Hz. Voltages as shown on drawings.

### 2.3 COMPARTMENTS

- A. Construction:
  1. The high and low voltage compartments and the transformer compartment shall be fabricated by a single manufacturer. The compartments and the transformer tank shall be assembled as an integral unit by a single manufacturer. Enclosures shall be in accordance with ANSI C57.12.28.
  2. The high and low voltage compartments shall be dead front type and separated with a steel barrier.
  3. The compartments shall be constructed of sheet steel (gage to meet ANSI requirements) with bracing, reinforcing gussets and jig-welding to assure rectangular rigidity.
  4. Use cadmium or zinc plated bolts, nuts and washers.

### 2.4 MEDIUM VOLTAGE BUSHINGS AND TERMINALS

- A. Bushing Style:
  1. For 15/25 kV Deadfront, for Currents Below 200 AMPS: The high voltage bushing shall be 15/25 kV 200 A bushing wells with bushing well inserts installed. The bushings shall be externally removable and be supplied with a removable stud. (Examples: Cooper Power Systems catalog sections 800-32, 500-12, and 500-26).
- B. Bushing Configuration:
  1. 15/25 kV Radial Feed Deadfront: The transformer shall be provided with three (3) high voltage bushings in accordance with minimum dimensions of ANSI C57.12.34 for radial feed configurations. The bushing heights shall be in accordance with minimum dimensions of ANSI C57.12.34.

### 2.5 SECONDARY VOLTAGE BUSHING AND TERMINALS

- A. Bushing Style:
  1. For voltage less than 700 Volts: The transformer shall be provided with tin-plated spade-type bushings. The spacing of the connection holes shall be 1.75” on center, per ANSI



C57.12.34 figure 13. The quantity of connection holes shall be twelve (12) if 500 kVA and below and twenty (20) for 750 kVA and larger.

2. Bushings supports shall be provided. Bushing supports shall be attached to the cabinet sidewalls; tank-mounted support mountings are not acceptable.

B. Bushing Configuration:

1. The transformer shall be provided with bushings in a staggered arrangement in accordance with ANSI C 57.12.34.
2. Sufficient space shall be provided for equipment, cabling and terminations in the compartments.
3. Affix the transformer instruction nameplate permanently to the unit within the low voltage compartment. Voltage ratings, kVA rating, connection configuration, impedance, date of manufacture and serial number shall be shown on the nameplate.

2.6 DOORS:

- A. Provide a separate door for each compartment with provision for a single padlock to secure the compartment area. The high voltage compartment door shall be prevented mechanically from opening, unless the low voltage door is opened.
- B. The secondary compartment door shall have a one-piece steel handle and incorporate three point locking mechanisms to assure a secure and tight door closing. Provide each compartment door with open position doorstops and tamperproof hinges. The hinge assembly shall be made of corrosion resistant material welded in place.
- C. Provide a 50mm (2 inch) size padlock for each assembly. Padlocks shall be keyed to the established key set. Firmly attach the padlock to the door assembly by a chain.

2.7 BIL RATING

- A. 15 kV class equipment shall have a minimum 95 kV BIL rating.

2.8 TRANSFORMER FUSE ASSEMBLY

- A. The transformer primary fuse assembly shall be load break combination fuse and dry well fuse holder rated for system voltage, for 10 load makes and 10 load breaks with rated 200 amp load current at 75 percent lower power factor, 10,000 symmetrical amperes close in on fault duty. The entire fuse assembly shall be removable through the use of hot stick.
  1. The fuses shall be concealed, hot stick removable, 50,000 ampere symmetrical interrupting. The fuses shall operate within the fuse holder as a unit disconnecting means. Fuses shall be in accordance with ANSI C37.47.
  2. Transformers shall not have internal "weak link" fuses requiring transformer tank cover removal for replacement.
- B. Overcurrent Protection:
  1. Bayonet with back-up current limiting fuses: shall be sized per manufacturer's recommendations. The high-voltage overcurrent protection scheme provided with the

transformer shall be an extremely removable loadbreak expulsion Bay-O-Net fuse assembly with a flapper valve to minimize oil spillage. The bayonet fuses shall be in series ELSP under-oil partial-range current-limiting back-up fuses with an interrupting rating of 50,000 AIC. An interlock shall be required between the load-break switch scheme specified and the bayonet fuses, such that the fuses may not be removed unless the transformer has been de-energized via the load-break switch scheme.

- C. Overvoltage Protection:
  - 1. The overvoltage protection scheme provided with the transformer shall protect the high-voltage winding.
  - 2. With DEADFRONT bushings: Externally mounted, Distribution Class M.O.V.E. Deadfront elbow arresters shall be supplied.

## 2.9 PRIMARY CONNECTIONS

- A. Transformer primary connections shall be 200A deadfront load break wells and inserts for cable sizes shown on the drawings.
- B. Surge Arresters: Distribution class, one for each primary phase, complying with IEEE C62.11 and NEMA LA 1, supported from tank wall.

## 2.10 MEDIUM VOLTAGE SWITCHING

- A. The transformer primary disconnect switch shall be an oil-immersed, internal, gang-operated, load-interrupter type, rated at ampacity and system voltage as shown on the drawings, with a minimum momentary withstand rating of not less than the calculated available fault current shown on the drawings.
  - 1. For radial feeds, switch shall be a two-position, on-off, manual switch located in the medium-voltage compartment and hot-stick-operated.
  - 2. For loop feeds, switch shall be a four-position, T-blade manual switch located in the medium-voltage compartment and hot-stick-operated.

## 2.11 MEDIUM VOLTAGE PREFORMED TERMINATIONS

- A. Terminate the high voltage cables in the high voltage compartment with load break premolded rubber elbow connectors. Elbow connectors shall have a minimum of 3mm (0.125 inch) semi-conductive shield material covering the housing. Each connector shall be tested - prior to shipment from the factory. The separable connector system shall include the loadbreak elbow, the bushing insert, and the bushing well. Separable connectors shall comply with the requirements of IEEE 386, and shall be interchangeable between suppliers. Allow sufficient slack in medium-voltage cable, ground, and drain wires to permit elbow connectors to be moved to their respective parking stands.
- B. Ground metallic cable shields with a device designed for the purpose. It shall consist of a solderless connector enclosed in watertight rubber housing covering the entire assembly. The grounding device and elbow connector are to be of the same manufacturer to insure electrical integrity of shielded parts.

- C. Premolded parts shall be suitable for submersible applications.
- D. Elbow connectors shall be rated as follows:
  - 1. Voltage: as shown on drawings
  - 2. BIL: match transformer
  - 3. AC withstands: 34 kV, 60 Hz for 1 minute.
  - 4. Corona voltage: 11 kV minimum.
  - 5. Continuous current: 600 amperes RMS.
  - 6. Short time current: 10,000 amperes for 12 cycles.
    - a. Fault closure: 10,000 amperes RMS symmetrical for 10 cycles (after 10 loadmake/loadbreak operations at 200 amperes and 14.4 kV contact voltage).
  - 1. Switching: 10 loadmake/loadbreak operations at 200 amperes, 70-80 percent power factor, and 14.4 kV maximum recovery voltage between contacts.
- E. Interchangeability: The separable connector system shall include the loadbreak elbow, the bushing insert, and bushing well. Separable connectors shall comply with the requirements of IEEE 386, and shall be interchangeable between suppliers. Loadbreak elbow and bushing insert shall be from the same manufacturer.
- F. Allow sufficient slack in high voltage cable, ground, and drain wires to permit elbow connectors to be moved to their respective parking stands.
- G. Provide insulated cable supports to relieve any strain imposed by cable weight or movement.

## 2.12 LOW VOLTAGE EQUIPMENT

- A. Mount the low voltage bushings, and hot stick in the low voltage compartment.
- B. The low voltage leads shall be brought out of the tank by epoxy, pressure tight bushings, and shall be standard arrangement per ANSI
- C. Tin plate the low voltage neutral terminal and isolate from the transformer tank. Provide a removable ground strap sized in accordance with the NEC and connect between the neutral and ground pad.

## 2.13 TRANSFORMERS

- A. Transformers shall be three-phase, liquid-immersed, isolated winding, and self-cooled by natural convection.
- B. The kVA ratings shown on the drawings are for continuous duty without the use of cooling fans.
- C. Temperature rises shall not exceed the NEMA TR1 standards of 65 degrees C by resistance, and 80 degrees C hot spot at rated kVA.
- D. Sound levels shall conform to NEMA TR1 standards.

## PART 3 - GENERAL DESIGN

### 3.1 CORE AND COIL ASSEMBLIES

- A. Cores shall be grain oriented, non-aging, and silicon steel to minimize losses.
- B. Core and coil assemblies shall be rigidly braced to withstand the stresses caused by rough handling during shipment, and stresses caused by any possible short circuit currents.
- C. Coils shall be continuous winding type without splices except for taps.
- D. Coil and core losses shall be optimum for the most efficient operation.
- E. Primary, secondary and tap connections shall be brazed or pressure type.
- F. Provide end fillers or tie downs for coil windings.
- G. The core and coil vacuum shall be processed to ensure maximum penetration of insulating fluid into the coil insulation system. While under vacuum, the windings will be energized to heat the coils and drive out moisture, and the transformer will be filled with preheated filtered degasses insulating fluid. The core shall be manufactured from burr-free, grain-oriented silicon steel and shall be precisely assembled to reduce gaps in the joints.
  - 1. Coil shall be insulated with B-stage, epoxy coated, diamond pattern, insulating paper, which shall be thermally cured to ensure proper bonding of conductor and paper.
  - 2. Windings must be completely dried before filling unit with pre-heated, filtered and degasses insulating fluid.
  - 3. Insulating fluid filling process must be done under vacuum to ensure maximum penetration of insulating fluid into the coil insulating system.
- H. The dielectric coolant shall be listed less-flammable fluid meeting the requirements of National Electrical Code® Section 450-23 and the requirements of the National Electrical Safety Code (IEEE C2-1997), Section 15. The dielectric coolant shall be readily and completely biodegradable per EPA OPPTS 835.3100. The base fluid shall be 100% derived from edible seed oils with performance enhancing additives. The fluid shall result in zero mortality when tested on trout fry per OECD G.L. 203 and be non-bioaccumulating. The fluid shall be published under US EPA Environmental Technology Verification (ETV) requirements, and tested for compatibility with transformer components. The fluid shall be Factory Mutual Approve, UL® Classified Dielectric Medium (UL-EOUV) and UL Classified Transformer Fluid (UL-EOVK), Envirotemp® FR3® fluid or equivalent.

### 3.2 TANK AND CABINET ENCLOSURE

- A. The high-voltage and low-voltage compartments, separated by a metal barrier, shall be located side-by-side on one side of the transformer tank. When viewed from the front, the low-voltage compartment shall be on the right. Each compartment shall have a door that is constructed so as to provide access to the high-voltage compartment only after the door to the low-voltage compartment has been opened. There shall be one or more additional fastening devices that must be removed before the high-voltage door can be opened. Where the low-voltage

compartment door is of a flat panel design, the compartment door shall have three-point latching with a handle provided for a locking device. Hinge pins and associated barrels shall be constructed of corrosion-resistant material, passivated AISI Type 304 or the equivalent.

- B. A recessed, captive, penta-head bolt that meets the dimensions per ANSI C57.12.28 shall secure all access doors.
- C. The enclosure integrity of the tank and cabinet shall meet the requirements for tamper resistance set forth in ANSI C57.12.28 including but not limited to the pry test, pull test, and wire probe test,
- D. The compartment depth shall be in accordance with C57.12.34, unless additional depth is specified.
- E. The tank base must be designed to allow skidding or rolling in any direction. Lifting provisions shall consist of four lifting lugs welded to the tank.
- F. The tank shall be constructed to withstand 7 psi without permanent deformation, and 15 psi without rupture. The tank shall include a 15 psig pressure relief valve with a minimum flow rate of 35 SCFM.
- G. The tank and cabinet coating shall meet all requirements of ANSI C57.12.28 including:
  - 1. Salt Spray Test
  - 2. Crosshatch Adhesion Test
  - 3. Humidity Test
  - 4. Impact Test
  - 5. Oil Resistance Test
  - 6. Ultraviolet Accelerated Weathering Test
  - 7. Abrasion Resistance – Taber Abraser
  - 8. The transformer tank, cover, and radiator gage thickness shall not be less than that outlined in ANSI.

### 3.3 ACCESSORIES:

- A. Provide standard NEMA features, accessories, and the following:
  - 1. No-load tap changer (Provide warning sign).
  - 2. Lifting, pulling and jacking facilities.
  - 3. Globe-type valve for oil filtering and draining, including sampling device.
  - 4. Pressure relief valve.
  - 5. Liquid level gage and filling plug.
  - 6. A grounding pad in the high and low voltage compartments.
  - 7. A diagrammatic nameplate and operating instructions enclosed by a transparent cover located in the low voltage compartment.
  - 8. Dial type liquid thermometer with a maximum reading pointer and an external reset.
  - 9. Hot stick. Securely fasten hot stick within low voltage compartment.
  - 10. Upper fill valve
  - 11. Pressure vacuum bleeder
  - 12. Spare bayonet fusing
  - 13. Fault indicator provisions

- 14. Ground connectors
  - 15. Danger high voltage warning signs
  - 16. Non-PCB decal
  - 17. Liquid level gauge with auxiliary contacts
- B. The accessories shall be made accessible within the compartments without disassembling trims and covers.
- C. Liquid filled transformers shall meet the minimum energy efficiency values per NEMA TP1:

KVA	(%)
75	98.1
112.5	98.3
150	99.0
225	99.0
300	99.0
500	99.1
750	99.2
1000	99.2
1500	99.3
2000	99.4
2500	99.4

3.4 CABLE FAULT INDICATORS (Loop feed transformers only):

- A. Provide each incoming and outgoing cable within the high voltage compartment with a single-phase cable fault indicator. Mount the indicator on the cable support member.
  - 1. The sensor assembly shall have a split-core for easy installation over the incoming and outgoing cable. Provide a clamp to secure the two coil halves around the cable.
    - a. The core shall be laminated, grain-oriented silicon steel, and encapsulated.
  - 2. The coil shall be encapsulated. Select the coil to pick up at the current setting shown on the drawings.
    - a. The coil setting shall be accurate to within 10 percent of pickup.
    - b. The coil current-time curve shall coordinate with the primary current-limiting fuse.
- B. Upon restoration of the system to normal operating conditions, the cable fault indicator shall automatically reset to normal and be ready to operate.

PART 4 - EXECUTION

4.1 INSTALLATION

- A. Install transformers as shown on the drawings, in accordance with the NEC and as recommended by the equipment manufacturer.

B. Foundation:

1. Provide foundation of reinforced concrete, Type C, 21mPa (3000 psi minimum, 28 day compressive strength), and comply with the ACI 318.
2. Locate the top of foundation pads 150mm (6-inches) above the adjacent finished grade, unless otherwise shown on the drawings. Refer to drawings for size, location, and structural steel reinforcing required.
3. Grade the adjacent terrain so that surface water will flow away from the foundation.
4. Anchor the transformers with cadmium or zinc plated bolts, nuts and washers. Bolts shall not be less than 12mm (1/2-inch) diameter.
5. Finished surface shall be < 2% slope.

C. Grounding:

1. Ground each padmounted transformer in accordance with the requirements of the NEC. Install 19mm (3/4-inch) diameter by 3m (10 feet) long copper-clad ground rods, driven 3m (10 feet) below grade to maintain a maximum resistance of five ohms to ground. Thermite weld the cable to the ground rods.
2. Connect the ground rod to the ground pads in the high and low voltage compartments, and to the secondary (and primary) neutral with not less than a 2/0 AWG bare copper conductor.
3. Refer to the section of the specifications describing GROUNDING for testing.
4. Independently connect cable shield grounding devices ground wires to ground with sufficient slack to permit elbow connector operation. Connect elbow connectors with a No. 14 AWG bare copper drain wire from its grounding eye to the related cable shield grounding device ground wire. Do not connect drain wires in any manner that will permit circulating currents, or cable fault currents, to pass through them.

#### 4.2 TESTING AND TOLERANCES

A. All units shall be tested at the factory and documentation submitted for the following:

1. No-load (20°C) losses at rated current
2. Total (85°C) losses at rated current
3. Percent Impedance (85°C) at rated current
4. Excitation current (100% voltage) test
5. Winding resistance measurement tests
6. Ratio tests using all tap settings
7. Polarity and phase relation tests
8. Induced potential tests
9. Full wave and reduced wave impulse test

B. In addition, the manufacturer shall provide certification upon request for all design and other tests listed in C57.12.00, including verification that the design has passed short circuit criteria per ANSI C57.12.00 and C57.12.90.

#### 4.3 SPARE PARTS

A. Deliver the following spare parts for the project to the Resident Engineer two weeks prior to final inspection:

1. Six stand-off insulators.

2. Six insulated protective caps.
3. One spare set of high voltage fuses for each size fuse used in the project.

END OF SECTION



## SECTION 26 13 26 – MEDIUM VOLTAGE METAL-CLAD SWITCHGEAR

### PART 1 - MEDIUM VOLTAGE, METAL CLAD, ARC RESISTANT SWITCHGEAR

#### 1.1 OVERVIEW

- A. This specification covers the basic design and functional requirements of medium voltage metal-clad switchgear with vacuum circuit breakers, arc resistance features, relaying, and Human Machine Interface (HMI), and Power Monitoring Software System. It is intended as a supplement to the single line diagram and other project requirements. No features described below in no way whatsoever, shall compromise the arc resistant nature of the switchgear.

#### 1.2 RELATED WORK

- A. Section 03 30 00, Cast-In-Place Concrete: Requirements for concrete equipment pads.
- B. Section 26 05 73 – Overcurrent Protective Device Coordination Study
- C. Section 26 05 13 – Medium-Voltage Cables
- D. Section 26 05 26 – Grounding and Bonding for Electrical Systems
- E. Section 26 05 33 – Raceways and Boxes for Electrical Systems
- F. Section 26 05 43 – Underground Ducts and Raceways for Electrical Systems

#### 1.3 SUBMITALS

- A. Submit six copies (hard copies in 3-ring binders, electronic versions will not be accepted) of the following:
  - 1. Shop Drawings:
    - a. Switchgear shop drawings shall be submitted simultaneously with the Overcurrent Protective Device Coordination Study.
    - b. Submit sufficient information to demonstrate compliance with drawings and specifications.
    - c. Prior to fabrication of switchgear, submit the following data for approval:
      - 1) Complete electrical ratings.
      - 2) Circuit breaker sizes.
      - 3) Interrupting ratings. (Prior to submitting the final submittal for review, the short circuit study shall be without comment to verify interrupting rating of switchgear.)
      - 4) Safety features.
      - 5) Accessories and nameplate data.
      - 6) Switchgear one line diagram, showing ampere rating, number of bars per phase and neutral in each bus run (horizontal and vertical), bus spacing, equipment ground bus, and bus material.

- 7) Elementary and interconnection wiring diagrams.
  - 8) Technical data for each component.
  - 9) Dimensioned exterior views of the switchgear.
  - 10) Dimensioned section views of the switchgear.
  - 11) Floor plan of the switchgear.
  - 12) Foundation plan for the switchgear.
  - 13) Provisions and required locations for external conduit and wiring entrances.
  - 14) Approximate design weights.
  - 15) Size batteries as required in this specification, design, and submit battery rack.
  - 16) Plenum box and shutter for arc-resistant controls.
2. Manuals:
- a. Submit within 120 days after final shop drawings, complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts. Include but not limited to:
    - 1) Three-line diagrams showing device terminal numbers.
    - 2) Schematic signal and control diagrams, with all terminals identified, matching terminal identification in the switchgear.
    - 3) Include information for testing, repair, troubleshooting, assembly, disassembly, and factory recommended/required periodic maintenance procedures and frequency.
    - 4) Provide a replacement and spare parts list. Include a list of tools and instruments for testing and maintenance purposes.
  - b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Test Reports:
- a. Submit certified factory design and production test reports.
  - b. Two weeks prior to the final inspection, submit certified field test reports and data sheets.
4. Certifications: Two weeks prior to final inspection, submit four copies of the following.
- a. Certification by the manufacturer that switchgear conforms to the requirements of the drawings and specifications.
  - b. Certification by the Contractor that switchgear has been properly installed, adjusted, and tested.

#### 1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. American National Standards Institute (ANSI):

C37.04	Standard Rating Structure for AC HV Circuit Breakers
C37.06	Preferred Rating for AC HV Circuit Breakers
C37.09	Standard Test Procedure for AC HV Circuit Breakers

- C37.010 Application Guide for AC HV Circuit Breakers
- C37.011 Application Guide for TRV for AC HV Circuit Breakers
- C37.012 Application Guide Capacitance Switching
- C37.11 Requirements for Electrical Control
- C37.20.2 Standard for Metal-Clad and Station Type Cubicle Switchgear
- C37.20.7 IEEE Guide for Testing Metal-Enclosed Switchgear Rated Up to 38kV for Internal Arcing Faults
- C37.54-10 Indoor Alternating Current High-Voltage Circuit Breakers Applied as Removable Elements in Metal-Enclosed Switchgear - Conformance Test Procedures
- C37.55 Conformance Testing Procedure of Metal-Clad Switchgear
- C37.55-10 Medium-Voltage Metal-Clad Assemblies - Conformance Test Procedures
- C57.13 Requirements for Instrument Transformers
- C. Institute of Electrical and Electronics Engineers (IEEE):
  - C37.04-09 Standard for Rating Structure for AC High-Voltage Circuit Breakers
  - C37.09-11 Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
  - C37.20.2-99 Standard for Metal-Clad Switchgear
  - C37.90-06 Standard for Relays and Relay Systems Associated with Electric Power Apparatus
  - C57.13-93 Standard Requirements for Instrument Transformers
- D. National Electrical Manufacturers Association (NEMA):
  - CC1 Electrical Power Connectors
  - LA 1-09 Surge Arrestors
  - SG-4 Standards for Power Circuit Breakers
  - SG 4-09 Alternating-Current High-Voltage Circuit Breakers
  - SG-5 Power Switchgear Assemblies NEC/NFPA
  - 250 Enclosures for Electrical Equipment

- E. National Fire Protection Association (NFPA):
  - 70 National Electrical Code (NEC)
  - 70E Electrical Safety in the Workplace

## PART 2 - GENERAL

### 2.1 INTRODUCTION

- A. This specification describes standard and optional features of arc-resistant metal-clad switchgear tested in accordance with IEEE C37.20.7 - 2007.
- B. Acceptable Manufacturers: ABB's SafeGear is the basis of design but the following list of manufactures is acceptable as long as they can show equivalence. All prospective manufactures shall manufacture their own circuit breakers, relays (ground-check relay excluded) as well as the switchgear.
  - 1. ABB
  - 2. Schneider
  - 3. Eaton
  - 4. Siemens
  - 5. General Electric (GE)

### 2.2 GENERAL DESCRIPTION

- A. SafeGear Indoor Metal-clad Switchgear shall consist of metal-clad freestanding vertical structures. Modules and provisions shall include: circuit breaker compartments and circuit breakers, primary bus system, ground bus system, auxiliary compartments and transformers, protection and control devices, control bus (as required) and connection provisions for primary, ground and control circuits.
- B. SafeGear Indoor Metal-clad switchgear shall be of modular construction and available in one-high and two-high arrangements. Design features shall include: a system allowing connection of circuit breaker and auxiliary modules with the door closed, fully automatic primary and secondary disconnects, and assembly and module grounding utilizing a solid ground bus system throughout the equipment.
- C. The lineup shall be extendable on either end by removal of the end dress panels and the main bus covers.
- D. The line-up shall have electrically interlocked main-tie-(maintenance) tie-main operation. Manual override shall be available of main and tie circuit breakers by maintenance personnel.
- E. The switchgear shall be open transition design with a "closed-transition" for up to five (5) seconds for the return.

## 2.3 SEQUENCE OF OPERATION

- A. The automatic transfer system is designed to seek out a good power source and transfer to it, and retransfer automatically or manually.
1. This switchgear line-up contains two main breakers, 52-1 and 52-2, which are normally closed and one tie breaker, 52-T, which is normally open (operational tie) (The maintenance tie is normally closed and the auto transfer will not work if it is open). The PLC control system shall be designed to automatically transfer to the tie breaker 52-T (given that the auto manual switch is in auto position), by opening one of the main breakers and closing the tie, should a phase-to-phase under voltage or phase imbalance occur on either utility source. An adjustable loss-of-source time delay is provided to allow the system to ride through transient voltage conditions.
  2. Control of the system is by PLC logic.
- B. Modes of Operation
1. **Manual Mode:** In the manual mode of operation, all breaker closure operations for 52-1, 52-2, and 52-T are via the breakers' respective manual control switches, opening can be either by protective relays or the breakers' respective control switches.
  2. **Automatic Mode:** In the automatic mode, all switch closure operations for 52-1, 52-2, and 52-T are by the Automatic Transfer System PLC. Opening will be by the PLC.
- C. Protective Interlocks: The following protective interlocks are provided in the manual and automatic mode.
1. **Paralleling of Sources:** Paralleling of sources is prevented in the automatic mode. In manual mode the customer cannot parallel sources.
  2. The following protective interlocks are provided in the automatic mode:
    - a. **Manual Switch Closures:** Manual switch closures of 52-1, 52-2, or 52-T via the breakers' respective manual control switches is prohibited via electrical interlocking when the system is in the automatic mode.
    - b. **Manual Breaker Opening:** Manual breaker opening of 52-1, 52-2, or 52-T via the breakers' respective manual control switches is possible when the system is in the automatic mode, but the system goes into auto mode failure.
- D. Sequence of Operations in Automatic Mode: Time settings are factory defaults.
1. **Loss of Power on One Source:**
    - a. If an under voltage/phase imbalance/phase sequence is detected by the 27/47 relay on either main breaker, that main breaker will open after an adjustable time delay (factory set to 5 seconds).
    - b. Once the main breaker for the failed source has opened, the tie breaker will close after an adjustable dead bus time delay (factory set to 2 seconds).
    - c. **Auto/Hold**
      - 1) If the auto/hold switch is in the hold position and the failed source returns, the system will not retransfer to the normal condition. The qualified system operator may retransfer to the normal condition (auto manual switch in manual position) by opening the tie breaker, and closing the main breaker for the restored source. If the source in use fails and if voltage to the other source has been restored, automatic transfer to the main now with power shall be initiated.
      - 2) If the auto/hold switch is in the auto position, the system will retransfer the load after the restored time delay (factory set to 10 minutes) by opening the

- tie breaker and then closing the main after the dead bus time delay.
2. Loss of Power on Second Source After Loss of Power on One Source and Transfer.
    - a. After the operations of 1 and 2 under the heading 'Loss of Power on One Source' (Above) have taken, loss of the second will result in opening of the closed main and tie.
    - b. The main breaker for the first source to return and remain stable for an adjustable time period (factory set to 5 seconds) will close.
  3. Simultaneous Loss of Power on Both Sources.
    - a. If both sources fail simultaneously, both breakers trip.
    - b. If both sources are restored within 1 seconds of each, both mains close.
    - c. If one source is restored, the main breaker for the restored source will close and the tie breaker will close. Further operation will be per 1 under the heading 'Loss of Power on One Source' (Above).
- E. Automatic Mode Failure.
1. Illumination of the red automatic mode failure pilot light indicates that the system is in the automatic mode failure condition. This can be caused by trying to enter the automatic mode under the following conditions:
    - a. Two of the three breakers (mains, tie) are not closed initially.
    - b. The maintenance tie is not closed or is racked out of the cell.
  2. In addition, the automatic mode failure condition can be caused by opening 52-1, 52-2, or 52-T, other than by the PLC, while in the automatic mode. Loss and subsequent restoration of control power will not cause automatic mode failure if the PLC battery is good.
  3. To clear the automatic mode failure condition, turn the auto/manual selector to the manual position and correct the cause of the failure. Once the cause of the failure is corrected, the green auto mode ready pilot light will be illuminated, indicating that the automatic mode can be initiated by turning the auto/manual selector to the auto position.

## 2.4 GENERAL DESIGN REQUIREMENTS

- A. The switchgear shall have a voltage rating of 15 kV. The switchgear will be One/Two high construction with indoor frame size of 36" wide x 95" high x 92" deep. End dress panels will be provided on each end of a lineup and can extend the width by approximately one inch on each end. The switchgear shall meet indoor standards as defined in ANSI C37.20.2. The switchgear will be used in a 13.2 kV, 3-phase, 60 Hz system. It shall be composed of factory assembled metal clad cubicles. The circuit breakers shall be designed with vacuum interrupter technology and shall incorporate a (spring operated or magnetically actuated) mechanism.

### 2.5 The switchgear will have the following rating:

- B. Rated Maximum Voltage 15 kV
- C. Operating Voltage 13.2 kV
- D. Main Bus Continuous Rating 2000 A
- E. Control bus DC Voltage (Nom.) 125 VDC

- F. Circuit Breaker Interrupting 50 kA
- G. Close and Latch 130 kA Peak
- H. Breaker Interrupting Time 3 cycles
- I. Rated Voltage 1.0 K
- J. Temperature rise of the switchgear will be in accordance with the latest revision of ANSI C.37.20 for metal clad switchgear.
- K. The equipment shall be completely factory assembled and tested prior to shipment.

## 2.6 ARC-RESISTANCE ACCESSIBILITY LEVEL

- A. The switchgear shall be tested in accordance with the requirements of C37.20.7-2007, IEEE Guide for Testing Metal-Enclosed Switchgear Rated Up to 38kV for Internal Arcing Faults for accessibility protection in conformance with Type 2 for the rear of the switchgear and Type 2BC for the front of the switchgear as indicated by these specifications.
  - 1. Switchgear “Rear” - Type 2 arc-resistant accessibility is designated for equipment where the degree of protection during an arcing event does not cause holes in the freely accessible front, sides, and rear of the enclosure. Smoke ingress, partial or total distortion of internal compartment walls, without signs of burning from a direct arc strike (i.e., a hole) or openings in the walls (i.e., torn seams) are acceptable. No door can be open during the arcing event.
  - 2. Switchgear “Front” - Type 2BC arc-resistant accessibility is the combination of types 2B and 2C and is designated for equipment where isolation from the effects of an internal arcing fault is desired between all adjacent compartments and the instrument compartment within a switchgear assembly where arcing does not cause holes in the freely accessible front, sides, and rear of the enclosure or in the walls isolating the low-voltage control or instrument compartment(s). Smoke ingress in the instrument compartment under evaluation is acceptable. Distortion of internal compartment walls, without signs of burning from a direct arc strike (i.e., a hole) or openings in the walls (i.e., torn seams) is not cause for failure. Meeting the requirements of this evaluation additionally qualifies the equipment for installation of instrument and control devices on the door or cover of the compartment tested without retesting the switchgear for the condition where the door or cover is present with devices mounted on it. Furthermore, the accessibility shall include the additional requirements of A.3.1 and A.3.2 of IEEE C37.20.7. It does not imply that the equipment may be operated with doors, covers, or panels opened or removed and maintain its intended degree of protection with the exception of the instrument compartment. Type 2BC is not applicable to equipment using open bus or open frame construction.
  - 3. When type 2BC two-high breaker construction is specified, the switchgear shall be designed in accordance with the requirements of IEEE C37.20.7 type 2BC in the front breaker, instrument and auxiliary compartments depending on the type designation and type 2 in the rear cable compartments.
  - 4. For one-high breaker construction, the switchgear shall be designed in accordance with the requirements of IEEE C37.20.7 type 2BC in both the front and rear compartments. This level of arc-resistance provides protection between the front and rear adjacent

vertical sections and between circuit breaker and auxiliary compartments within the same vertical section as well as isolation protection for the instrument compartment.

5. A flange shall extend along both sides and the top and bottom of each vertical section to maintain an arc-resistant seal. In case of an internal arc fault, all related exterior vents shall automatically close and pressure shall be directed through the roof exhaust vents into a horizontal plenum. The plenum shall successfully withstand the gas pressure and arcing by-products of the arcing event. The plenum shall exhaust the arcing event gasses and particles outside of the switchgear area. Connections between frames shall be made only at auxiliary compartments, or shall use fittings and materials to prevent propagation of damage due to an internal arc fault.

B. Standards for Arc Resistance Testing

Code	Title
IEEE C37.20.7	Guideline for Testing of Metal-Enclosed Switchgear Rated Up to 38kV for Internal Arcing Faults
EEMAC G14-1	Procedure for Testing the Resistance of Metal-clad Switchgear under Conditions of an Internal Fault

2.7 CIRCUIT BREAKER MODULE

A. Circuit Breaker

1. The circuit breaker shall be a 3-pole drawout type, vacuum circuit breaker, electrically operated, with either a magnetic actuator or spring charged mechanism. The breaker is a general-purpose device in accordance with applicable ANSI/IEEE standards in ratings of 1200 A or 2000 A.
2. The circuit breaker shall have an interruption clearing time of 50ms.
3. Opening and closing speed shall be independent of the operator or of control voltage within the rated control voltage range.
4. Circuit breakers of the same type, rating and control circuits shall be electrically and mechanically interchangeable.
5. Three independent sealed high-vacuum interrupters.
6. Interrupter contacts shall be protected from moisture and contaminated atmospheres.
7. Readily accessible contact wear indicator for each interrupter.
8. Maintenance free interrupter.
9. Contact surfaces to be of special alloys (such as copper chrome) to reduce effect of chopping.

2.8 POWER CIRCUIT BREAKERS

- A. The power circuit breakers shall be electrically operated, 3-pole, draw-out type, with vacuum interrupters and manual charging of a spring type stored energy operating mechanism. The power circuit breaker shall be provided with self-aligning line-side and load-side disconnecting devices. Circuit breakers to be ABB type ADVAC.
- B. The breaker racking system shall allow smooth, consistent breaker movement with the door closed and shall have three positions in addition to the fully withdrawn position; disconnect, test and connected. The circuit breaker shall stop and lock in all three positions, requiring operator action to move from one position to another. The circuit breaker door must be provided with



impact resistant poly carbonate viewing window of at least 86 square inches and ½” thick to determine breaker position, open/closed indicator, spring charge status, and operations counter.

- C. The circuit breaker will be provided with an integral racking mechanism. Circuit breakers utilizing switchgear mounted racking mechanisms separate from the circuit breaker are not acceptable.
- D. The draw-out mechanism shall hold the breakers rigidly in the CONNECTED (primaries and secondaries engaged), TEST (primary contacts disconnected and shutter closed, but control contacts engaged) and DISCONNECTED (both primary and secondary contacts disengaged) positions, with the door closed. The secondary contact plug shall automatically disconnect when the breaker is moved from the TEST to the DISCONNECTED position. A single (25 pin) fully automatic, self-aligning, secondary disconnecting device shall be provided to act as a disconnect for the secondary connections between the circuit breaker and the switchgear. The disconnecting device shall be positioned and constructed as to not expose the operator to live parts. The secondary disconnect shall connect automatically when the circuit breaker is racked into the test and connected positions. A double (50 pin) disconnect arrangement shall be available as an option and provided as shown on project data sheets. The female portion of the disconnect system shall reside in the breaker compartment, so that energized contacts are recessed and remain “touch safe”. To guarantee the integrity of operating personnel, it shall not be required to open or keep opened the door of the circuit breaker compartment after the breaker has been locked in the disconnected position to be able to rack the breaker or connect the secondary contacts, Circuit breakers that require manual connecting or disconnecting of the secondary contacts are unacceptable.
- E. The breakers in the upper compartment and lower compartment shall be held captive in the cubicle by means of a latching mechanism, even in the disconnected position. Removal of the circuit breaker shall be by means of unlatching the mechanism and pulling the circuit breaker onto a lift truck. Cell must have a minimum of a 1” lip for proper sealing of the door and to prevent ingress of dirt and other contaminants. Circuit breakers that require rail extensions for circuit breaker removal are not acceptable.
- F. Wheels shall be provided on the bottom of the circuit breaker for easy floor rolling after the breaker is removed from the frame. Circuit breakers that require a separately purchased floor rolling truck assembly are not acceptable.
- G. Interlocks shall be provided which will prevent connecting the breaker to, or disconnecting it from the bus stabs unless the breaker is OPEN (tripped), assuring proper sequencing and safe operation. The close springs of the circuit breaker will automatically discharge when the breaker is released from the cell by pulling in on the truck latch assembly. Provisions shall be made for the addition of optional KIRK KEY interlocks, as shown on project data sheets and the single line diagram.
- H. Control voltage and trip voltage shall be as follows:
  - 1. The breaker motor charging range shall be 125 VDC. The trip voltage shall be 125 VDC. The close voltage shall be 125 VDC. The direct current power source shall be as discussed in these specifications and shown on the drawings.
  - 2. Close and trip circuits for each breaker shall be separately fused. Fuse blocks shall be dead front, pull-out type, which provides the control power disconnecting means.

- I. The ADVAC circuit breaker shall be provided with a toroidal spring mechanism, which allows for the easiest manual charging in the industry. The mechanism shall rotate the main horizontal shaft in only one direction, in order to reduce wear and maintenance costs and eliminating mechanism binding. The breaker shall be equipped with the "stored energy operation" type, anti-pump-operating mechanism. It shall be possible to open and close the breakers manually. The circuit breaker shall be capable of operating in three cycles which means smaller power cables, lower construction costs, and improved system quality. The mechanism shall be completely front accessible and maintainable by removing the faceplate. Breakers that require lifting to access the mechanism under the carriage are unacceptable.
- J. The circuit breaker enclosure shall have interference blocking to prevent the insertion of improperly rated breakers. Note: Circuit breakers with a single secondary disconnect are not interchangeable with a dual secondary disconnect.
- K. The breaker shall include 8 available mechanism operated contacts (MOC) consisting of 4a and 4b contacts, wired through the secondary disconnect. Up to 9 additional MOC contacts (5a, 4b) can be installed on the breaker and wired through the secondary disconnect, for a total of 17 available MOC contacts. All breaker-mounted contacts shall operate in both connected and test positions. Mechanism operated contacts that are installed external to the circuit breaker requiring complex linkages and alignment procedures to the breaker are not acceptable.
- L. Provisions for padlocking breakers in any of the positions shall be included.
- M. Circuit breaker power draw-out contacts shall be silver-plated.
- N. The breaker shall have a mechanism device to indicate open or closed position, and spring charge status. Only the correct status flag for any single function shall be visible. Additionally, the breaker shall have a 5-digit, non-resettable operations counter.
- O. Circuit Breaker Enclosure
  - 1. The enclosure door shall be securely held with tamper resistant hinges and a manual fastening system.
  - 2. The enclosure doors shall be provided with a single handle, multi-point latching mechanism for interrupting ratings up to 36kA. For interrupting ratings of 40kA and above, the hinged front doors shall be held in place by captive bolts.
  - 3. The stationary support bushings and the primary contacts engage with an ADVAC circuit breaker.
  - 4. All bushings shall be porcelain.
  - 5. Auxiliary ring core type current transformer (CT) shall be located behind the shutters. They shall be bushing-mounted and accessible from the front. Bushings shall accommodate up to four standard accuracy CTs per phase for all ratings.
- P. Racking System and Interlocks
  - 1. The circuit breaker module shall include all necessary interlocks for proper sequencing and safe operation.
  - 2. The racking system shall allow movement of the breaker with the door closed and have three distinct positions, in addition to the withdrawn position (free movement):
    - a. Disconnected (both primary and secondary contacts disengaged),
    - b. Test (primary contacts disconnected and shutter closed, but control contacts engaged) and

- c. Connected (primary and secondary contacts engaged).
3. The circuit breaker shall stop and lock in all three positions, requiring deliberate operator action to continue insertion or withdrawal of the breaker. A racking padlock provision for all positive positions shall be provided. Padlocks not included.
4. It shall not be possible to insert or withdraw a closed breaker. The breaker shall not be allowed to close within a cell unless it is in a positive Connected, Test, or Disconnected position.
5. Interference blocking shall prevent insertion of a lower rated breaker into a higher rated compartment.
6. All drawout modules shall have manually actuated locking devices to prevent inadvertently withdrawing a module from a compartment.
7. Grounding shall occur in the test position and shall be continuous during racking and in the connected position. Grounding shall be made by solid copper contacts connecting to a solid copper ground bus.

Q. Shutters

1. Shutters shall cover primary contacts when the breaker is in the Disconnected or Withdrawn position. The motion of the circuit breaker truck or G&T device shall positively open or close the shutters independent of a gravity or spring return system.
2. Shutters shall be equipped with padlocking provisions in the closed position. Dedicated wires shall ground the shutters. Insulated shutters shall be standard on all designs with a BIL rating greater than 95 kV.
3. The shutters shall be made of transparent Lexan.

2.9 RELAYING

- A. All protective relays, auxiliary relays, indicating instruments, recording instruments, indicating lights, transducers, etc. shall be housed in the low voltage compartment unless specifically allowed by the project data sheets. The low voltage compartment shall isolate the above equipment so that additional arc flash protection is available. Relays and instruments shall be provided and wired as specified on the project single line diagram and data sheets. A multi-function, 3-phase microprocessor based relay and control package shall be used in 2-high breaker arrangements. Door-mounted protective relays will be draw-out type whenever practical.
- B. Protective relays and test devices shall be semi-flush mounted. The relays shall be so arranged that they can be tested in position on the panel and readily withdrawn from the panel for inspection or replacement.
- C. The relays shall be provided with targets with an external reset feature.
- D. Switchgear device function numbers shall be in accordance with ANSI C-37.20.
- E. An ABB type REF615 distribution protection relay with functions and features described in Item F below shall be provided. The protection relay shall include the following:
  1. Multi-shot reclosing
  2. Ammeter, demand and peak demand ammeters
  3. Event recording
  4. Accumulation of breaker interrupting duty
  5. Continuous self-checking

6. RS-232 and RS-485 communications ports for remote terminal connection.
- F. Protective Relay
1. General
    - a. Protective relays shall be of a microprocessor (numerical) communicating type design architecture offering extensive protection, control, monitoring, measuring and recording functions in one enclosed unit. The protection relay basic design and data modeling shall be based on the IEC 61850 standard with DNP3.0, and ModBus communication protocols also provided.
  2. Mechanical design
    - a. The relay design shall include "draw-out" and "draw-in" components where the draw-out unit can be withdrawn or inserted to a fixed mounted case. The withdrawal of the draw-out unit shall result in automatic shorting of the wired current transformer (CT) secondary circuits. The draw-in component shall engage and complete the insertion of the relay in its case.
  3. IEC61850 compliance and GOOSE messaging
    - a. The relay shall be compliant to the IEC61850-8-1 standard in all order codes and capable of utilizing GOOSE messages, as described in the IEC61850-8-1 standard, for horizontal level communication. The GOOSE signal performance has to be in accordance with type 1A and fulfill the requirements of class P1.
  4. Local Human Machine Interface (LHMI)
    - a. The LHMI shall support a freely programmable liquid crystal display (LCD) including graphical components as part of the LHMI. The graphic displays shall be linked to binary status to dynamically change appearance when the binary status changes state. For example, the breaker symbol will change depending on the open/close status of the breaker. The LHMI shall support local measurement, event and alarm views through its LCD display. The LHMI shall provide access to view and, with proper password authorization, edit protection settings. The LHMI shall support choosing either an SLD, main menu or metering view as the default LCD view.
  5. Circuit breaker control
    - a. It shall be possible to perform a circuit breaker control from designated control buttons on the relay LHMI.
  6. Indications and LEDs
    - a. The LHMI shall include at least eleven (11) freely programmable alarm LEDs for status indication. It shall be possible to remove the factory default LED description sheet and replace with a user-defined description sheet.
  7. Embedded web server
    - a. The relay shall be equipped with web server functionality for local or remote access to view LHMI LED status, view, edit, download and upload settings, perform controls, and retrieve event records and digital fault recording (DFR) data using commonly available web browser software such as Microsoft's Internet Explorer and Mozilla Firefox. The web server shall support real-time monitoring of all analog quantities. It shall also provide real-time phasor plotting of all phase currents and voltages as well as all sequence currents and voltages.
  8. Local/Remote switch
    - a. The LHMI shall be equipped with a Local/Remote (L/R) switch including status indication.
  9. Power supply input
    - a. The power supply shall be rated for 48-250 Vdc, 100-240 Vac 50/60 Hz

10. Current input channels
  - a. The relay hardware shall support both 5 A and 1 A nominal current transformer (CT) secondary ratings for the phase and ground CT analog input channels. Separate phase and ground CT secondary nominal ratings shall be available and their selections shall be made via software settings.
11. Voltage input channels
  - a. The relay hardware shall support nominal voltage transformer (VT) secondary ratings from 60 to 210 Vac. Separate phase, synchronism (where required) and ground VT secondary nominal ratings shall be available and their selections shall be made via software settings. The relay must support both phase-to-phase and phase-to-neutral voltage VT input connections.
12. Physical (binary) inputs
  - a. The inputs shall be fully isolated from the protection relay internal circuits. The turn-on threshold voltage of the binary inputs shall be settable using a dedicated parameter from 18...175 Vdc. It shall be possible via software to freely assign the physical inputs and outputs to the protection relay internal function logic.
13. Physical (binary) outputs
  - a. The relay binary outputs shall include a dedicated self-check alarm (IRF) output. At least four outputs shall be of a heavy-duty type.
14. Self-supervision and alarm (IRF) output
  - a. The relay shall be equipped with extensive self-supervision capabilities. In case of an internal failure, the relay shall disable protection to prevent a false trip and activate the alarm output. The failure code shall be visible on the protection relay LHMI display.
15. Breaker Condition monitoring
  - a. The relay shall include a freely programmable circuit breaker condition monitoring function. The monitoring shall include interrupted current ( $I^2t$ ) accumulators, operation counters, breaker operation and inactivity timing, SF6 gas pressure and spring charge status.
16. Communication interfaces
  - a. The front communication connection shall be RJ-45 type connector. DHCP server shall be available on the front communication port interface for easy connection of PC.
  - b. The following possibilities shall be available depending on order code: Galvanic RJ-45 Ethernet connection, optical LC Ethernet connection, ST-type glass fiber serial connection, EIA-485 serial connection, EIA-232 serial connection. The Ethernet connection shall support multiple remote simultaneous communication sessions for SCADA, Engineering and Maintenance and time synchronization (SNTP) including at least these communication protocols, Modbus over TCP/IP, DNP3.0 Level 2 over TCP/IP, IEC61850, SNTP.
17. Synchronism check (Tie Breaker Relay with Automatic Transfer Scheme Only)
  - a. The relay shall include a freely programmable synchronism check function. This function is necessary in validating synchronism between two separate systems, e.g., utility and local generation systems, separated by a breaker. The function shall include at least these setting options:

<u>Setting description</u>	<u>Setting range, step size</u>
Mode:	1=Both Dead
	2=Live L, Dead B
	3=Dead L, Live B
	4=Dead Bus, L Any

5=Dead L, Bus Any  
 6=One Live, Dead  
 7=Not Both Live

Voltage difference:  $0.01 - 0.50 \times V_n$ , step  $0.10 \times V_n$   
 Angle difference:  $5 - 90$  degrees, 1 degree  
 Frequency difference:  $0.001 - 0.100 \times F_n$ , step  $0.001 \times F_n$

- b. The function shall include digital input logic programmable for control purposes, e.g., blocking, and digital output logic programmable to the physical outputs and other programming logic.
- 18. User authorization
  - a. The relay shall support at least four independent user authorization levels. There shall be settable separate passwords for each user authorization level. The password shall be different for local and remote access.
- 19. Protective Devices
  - a. Each incoming main breaker shall be provided with (1) protective relay as defined in the section "Feeder Protection Relay" below. ABB REF615 relay style HAFCCCA33E1BNN1XE or approved equivalent.
  - b. Each tie breaker shall be provided with (1) protective relay as defined in the section "Tie Breaker Protection Relay" below. ABB REF620 relay style NAFBBABA33E1BNN1XF or approved equivalent.  
 Each Switchgear Bus Bar Arc Fault: ABB REA101 relay
- 20. Feeder Protection Relay
 

Protective functions	
Phase overcurrents	51P, 50P
Directional phase overcurrents	67P
Neutral overcurrents	51N, 50N
Ground overcurrents	51G, 50G
Negative sequence overcurrents	46
Underfrequencies, overfrequencies, rate-of-changes	81
Cable fault detection (CFD) for underground and overhead feeder cables (Optional)	CFD
Thermal overload	49F
Cold load inrush detection (seconds, minutes)	62CLD
Undercurrent	37
Phase undervoltages	27
Phase overvoltages	59
Directional power	32
Directional overcurrent	67
Directional overcurrent ground fault	G7N
Phase sequence overvoltages	47
Neutral overvoltage	59N
Circuit breaker failure	50BF, 50NBF
Electrically latched/self-resetting trip digital outputs	86/94-1, 86/94-2
- 21. Control
 

Circuit breaker control	52
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- 22. Monitoring and Supervision
 

Breaker condition monitoring	52CM
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	Trip circuit monitoring	TCM
	Fuse failure	60
	Open CT secondary monitoring	CCM
23.	Measurement	
	Three-phase currents	IA, IB, IC
	Sequence currents	I1, I2, I0
	Ground current	IG
	Demand phase currents	
	Maximum and minimum demand values	
	Three-phase voltages	VA, VB, VC
	Sequence voltages	V1, V2, V0
	Power and energy (1-phase, 3-phases) and power factor	P, E and PF
	Fault location	FLO
	Power quality	PQ
24.	Automation & Communications	
	Ethernet 100Base-TX (RJ45) + configurable RS232/RS485 + [RS485 or serial glass fiber (ST) + IRIG-B]	
25.	Records	
	Sequence of events recorder	SER
	Fault recorder	FLR
	Digital fault (waveform) recorder	DFR
	Load profile	LoadProf
26.	Analog inputs	
	Three phase currents:	5/1 A programmable
	Ground current:	5/1 A programmable or 0.2 A for SEF/HIZ option
	Rated frequency:	60/50 Hz programmable
	Three-phase and ground voltages:	programmable nominal secondary voltage (available as options)
27.	Binary inputs and outputs	
	Fourteen binary inputs standard	
	Four Power outputs	
	Three high speed outputs	
	Two signal outputs	
	One Form C self-check alarm output	
28.	Communication	
	IEC 61850-8-1 with GOOSE messaging	
	DNP3.0 Level 2+ over TCP/IP	
	Modbus over TCP/IP	
	Time synchronization via SNTP (primary and backup servers)	
29.	Main and Tie Breaker Protection Relay	
	Protective functions	
	Phase overcurrents	51P, 50P
	Directional phase overcurrents	67P
	Neutral overcurrents	51N, 50N

	Directional neutral overcurrents	67N
	Negative sequence overcurrents	46
	Underfrequencies, overfrequencies, rate-of-changes	81
	Phase undervoltages	27
	Phase overvoltages	59
	Phase sequence overvoltages	47
	Neutral overvoltage	59N
	Circuit breaker failure	50BF, 50NBF
	Three phase inrush detector	INR
	Electrically latched/self-resetting trip digital outputs	86/94-1, 86/94-2
	Phase current sets summing function	CSUM
	Three phase measurement switching	VSWI
30.	Control	
	Circuit breaker control	52
	Synchronism check	25
31.	Monitoring and Supervision	
	Breaker condition monitoring	52CM
	Trip circuit monitoring	TCM
	Fuse failure	60
32.	Measurement	
	Three-phase currents	IA, IB, IC
	Sequence currents	I1, I2, I0
	Demand phase currents	
	Maximum and minimum demand values	
	Three-phase voltages	VA, VB, VC
	Sequence voltages	V1, V2, V0
	Power and energy (1-phase, 3-phases) and power factor	P, E and PF
	Fault location	FLO
	Power quality	PQ
33.	Automation & Communications	
	Ethernet 100Base-TX (RJ45) + configurable RS232/RS485 + [RS485 or serial glass fiber (ST) + IRIG-B]2	
34.	Records	
	Sequence of events recorder	SER
	Fault recorder	FLR
	Digital fault (waveform) recorder	DFR
	Load profile	LoadProf
35.	Analog inputs	
	Three phase currents:	5/1 A programmable
	Ground current:	5/1 A programmable or 1/0.2 A
	Rated frequency:	60/50 Hz programmable
	Three-phase and ground voltages:	programmable nominal secondary voltage (available as options)
36.	Binary inputs and outputs	
	Sixteen binary inputs including VT inputs	
	Two NO outputs with trip circuit monitoring	



Three NO outputs  
One Form C output  
One Form C self-check alarm output

37. Communication

IEC 61850-8-1 with GOOSE messaging  
DNP3.0 Level 2+ over TCP/IP  
Modbus over TCP/IP  
Time synchronization via SNTP (primary and backup servers)  
Serial RS-485 port programmable for DNP3.0 Level 2+ or Modbus RTU  
IRIG-B time synchronization

38. Control voltage

48 - 250 V dc

G. ETHERNET SWITCH

1. Ethernet switch shall be ABB style AFS650.

H. COMMUNICATING GATEWAY

1. General
  - a. The Gateway device provides functions for mapping signals between protection and control relays with Local Human Machine Interface (HMI) screen showing real-time data and information of the MV switchgear and electric power system.
2. Communication Protocols and Human Machine Interface (HMI)
  - a. The Gateway device shall be capable of processing different communication protocols including, but not limited to, IEC61850, DNP3.0, and ModBus over TCP/IP. It is utilized for MV switchgear visualization, monitoring, and control via web HMI, i.e. MS Internet Explorer, Mozilla Firefox, and Google Chrome. Measured values from metering devices and protective relays are displayed on the HMI. Single-line diagrams are used to view any available measured values from the metering and relays.
3. Events and Alarms
  - a. Events and alarms shall be identified by date, time, bay, device, object description and status and shall be automatically filtered according to voltage level or bay criteria. The event list shall be in .csv file format that can be exported for further analysis.
4. Disturbance and Fault Record Handling
  - a. Disturbance records from the connected protective relays shall be automatically downloaded and stored in the Gateway device for further analysis. The disturbance records shall be saved in the standard COMTRADE format.
5. Data Historian
  - a. The Gateway's data historian function shall be a real-time database designed and optimized for process information management, extensive history recording, and power system dynamic trending purposes.
  - b. The Gateway device shall be ABB type COM600, style number COM600HNNH32PPNNND.

I. Ground Check Relay and Monitor

1. A separate ground check monitor and relay (Littlefuse S E-135 or equivalent) shall be installed at every crane feeder circuit breaker. The relay shall continuously monitor the ground check conductor and have thresholds that can be visually and audibly alarmed as

well as tripping the circuit breaker. Alarm shall be integral into switchgear and be minimum 10 db above ambient, LED indicator on feeder breaker door and/or trip circuit breaker. Coordinate with crane supplier for installation of SE-TA12A series termination assemblies. SE-TA12A by contractor, installation and crane termination by crane supplier.

J. Arc-Flash Relay and System

1. Install an early detection arc flash relay and system that extends the length of the switchgear. Relay opens circuit breaker(s) extremely quick to limit let-through energy.

2.10 BUS AND CABLE COMPARTMENTS

- A. The main bus enclosure shall be separated from the other enclosures by an 11 gauge steel barrier or equivalent and shall fully enclose the main bus.
- B. The main bus enclosure shall be accessible from the rear through the cable compartment. Main bus ratings shall match the highest rated circuit breaker continuous current ratings and comply with ANSI temperature rise requirements.
- C. Split rear panels shall be bolted to the frame with standard grade 5 hardware.
- D. The primary cable-entry plates shall be easily removable and shall be manufactured from non-magnetic stainless steel.
- E. Current transformers, lighting arrestors, surge capacitors, stationary control power transformers, ground sensors, or other stationary auxiliary equipment shall be mounted in the cable compartments as shown on the single line diagram and project data sheets.
- F. Bus Bars and Supports
  1. Bus bars shall be made of copper. The bus bars shall have full rounded edges. The main bus shall not be tapered. The main bus shall be in accordance with applicable ANSI self-cooled bus ratings.
  2. Connection joints shall be silver plated.
  3. Primary bus conductors shall be epoxy insulated, except at bolted joints. Bus joint covers shall be reusable for field inspection and maintenance.
  4. Bus bar connections shall be mechanically secured with reusable fasteners that shall maintain adequate pressures within the operating temperature range of the switchgear.
  5. Standard supports for 1200 A and 2000 A units shall be either porcelain or glass-reinforced polyester.
- G. Termination Bus
  1. A termination bus shall be provided from the circuit breaker or switchgear primary disconnects to a location that allows cable connections to other equipment. Bus connections to cables shall be rigid. Termination bus arrangement shall allow at least 36 inches for primary cable terminations and stress cones. The self-cooled rating of the termination bus shall be in accordance with ANSI C37.20.2, Table 4 at 45C.
  2. The equipment shall be adaptable for bottom primary entrance arrangements, as specified on project data sheets.
  3. The switchgear shall be supplied with cable lug boots.

H. Ground Bus

1. A copper ground bus, to which the entire metallic enclosure is solidly connected, shall extend through the length of the switchgear. The ground bus shall be accessible in the cable compartment and shall have connection points in each switchgear section. Connect to ground grid as shown on the drawings.

2.11 AUXILIARY MODULE

- A. Auxiliary enclosures shall be provided where necessary for mounting of auxiliary units such as potential transformers (PT), control power transformers (CPT) or primary current-limiting fuses for CPT.

B. Racking System

1. Drawout units shall use the same racking system, accessories and solid grounding as the circuit breakers but without a Test position. Primary fuses shall be grounded in the Disconnect position and when withdrawn.

C. Arc-quenching Snuffer

1. All primary contacts of auxiliary draw-out units shall be of the arc-extinguishing probe type. This contact shall minimize and suppress arcing at the primary contacts.
2. Terminal blocks for customer connections shall be provided in the auxiliary or the low voltage module.
3. The auxiliary enclosure bushings shall be glass filled polyester.
4. The bushings shall be porcelain.
5. A window shall be provided on the door to allow observation of drawout unit position with the door closed.

2.12 CONTROL AND PROTECTION

A. Low Voltage Module

1. In general all protective relays, auxiliary relays, indicating instruments, recording instruments, indicating lights, transducers and all other secondary equipment shall be housed in a low-voltage module. Relays and instruments shall be provided and wired as specified on the project single line diagram and data sheets.
2. A multi-function, 3-phase microprocessor based relay and control package shall be used in two-high arrangements. Alternative relay types may be used in one-high configurations to the extent allowed by mounting space in the low-voltage enclosure.
3. Electromechanical meters, when used, shall be the flush-mount 1% accuracy taut-band switchboard type, with a minimum 250 degree scale.

B. Current Transformers

1. CT ratings and accuracy shall be in accordance with ANSI/IEEE, C57.13 and C37.20.2. The CT winding shall terminate in a screw type terminal on the CT housing and shall be wired to shorting terminal blocks.

C. Potential Transformers

1. Potential transformers shall be drawout type with ratings and accuracy in accordance with ANSI C57.13. PT's shall be fused.

D. Interconnection

1. Control wiring shall be enclosed in a grounded metal wireway when routed through a high voltage compartment.
2. Control circuits shall incorporate all necessary switching and protective devices. Charge circuits and close and trip circuits shall be separately fused. Dead-front pullout fuse blocks shall be used for circuit protection and disconnect.
3. Sleeve type wire markers shall be provided at both ends of each wire.
4. Ends shall terminate with non-insulated ring-tongue terminals on screw-type terminal blocks, unless prohibited by the design of connection points on control devices. Terminal block screws shall use vibration-resistant hardware.
5. Ends shall terminate with insulated ring-tongue terminals.

#### 2.13 GENERAL CONTROL AND METERING

- A. Instruments and meters shall be rectangular and anti-fungi, black finish, dust proof and semi-flush mounted digital switchboard type.
- B. Meter potential coils shall be 120 volts and current coils shall be five (5) amperes.
- C. The equipment panel shall be arranged symmetrically and when possible shall allow for possible future additions.
- D. Instrument switches shall have black knurled non-removable handles. The circuit breaker controls shall have non-removable pistol grip handles.

#### 2.14 METERING

- A. As necessary, provide vertical structure with a front hinged door to provide safe isolated access to meters and all associated terminal and fuse blocks for maintenance, calibration or testing.
- B. Provide current transformers for each meter. Current transformers shall be wired to shorting-type terminal blocks.
- C. Provide voltage transformers including primary fuses and secondary protective devices for metering as shown on the drawings.
- D. Each main circuit breaker and feeder circuit breaker shall have a PowerLogic ION 7650 meter
  1. Meters shall be fully functional, connected, and retrieve and store all data that is capable for an ION 7650.
  2. Connect ION 7650s to the facility Ethernet LAN. Coordinate with PortOwner IT for requirements.
  3. Furnish and install a complete and fully operational “Power Monitoring Expert Software System” as manufactured by Schneider or equivalent. Include all functions and capabilities including all hardware, software, web enabled applications, graphical monitoring and analysis, dashboards, tables, alarm viewers, reports, data storage, and system integration. Minimum of four screens. Include on-site training and start-up and server. The system shall be complete and turn-key.
- E. Switchgear spaces shall have space and provisions for future meters.
- F. All meters shall include all wiring and terminations for fully operable metering systems. Meters

shall be fully visible and accessible without the need of opening a door.

#### 2.15 HUMAN MACHINE INTERFACE (HMI)

- A. A minimum 32" color, LED touch screen shall be provided and installed at a remote location in switchgear room. HMI shall show a 'dashboard' and shall show system one-line diagram including cranes and future equipment. Colors shall be used to indicate normal, abnormal, or emergency conditions. kWh, kW, kVA, PF, voltage, amps, and power flow shall be shown on power one-line diagram in real time. Touch screen shall also toggle from main power one-line diagram to front elevations of switchgear and then into individual main and feeder breaker sections where similar status and functions can be viewed in detail.
- B. The HMI is read-only, no switchgear control commands can be initiated from it.
- C. HMI data and views shall be exported through gateway and cabling and a web portal to authorized computers and mobile devices.
- D. Contractor shall provide all components, produce all software, and make all connections within the switchgear building for a fully complete and operable HMI system.

#### 2.16 CONTROL DEVICES AND WIRING

- A. Control devices, control buses, local control, instrument cables and wiring on the equipment shall be installed at the factory. Low voltage cables shall be enclosed in grounded metal flexible conduit when routed through a high voltage compartment. Control wiring shall be neatly bundled and tie wrapped where applicable. Wiring shall be protected from rubbing against door flanges or other parts of the enclosure.
- B. Control relays, auxiliary contacts and small mechanisms shall be enclosed, protected and accessible for maintenance.
- C. Fuses shall be provided in each closing circuit of each circuit breaker. These fuses shall be respectively located in the low voltage compartment of the circuit breaker frame. Only the closing circuit shall be fused; there shall be no fuses in the tripping circuit
- D. Control wire shall be fourteen (14) gauge SIS stranded, extra-flexible, 600V flame retardant, gray color and UL-listed wire except where larger sizes are needed for current carrying requirements. Current transformers shall be provided with a minimum of twelve (12) gauge. The conductors shall be stranded copper for fixed wiring and extra flexible stranded copper for hinge wiring. The conductors shall be 90 degrees Celsius normal operating temperature, flameproof 600-volt switchboard cable and shall meet ICEA S-66-524 NEMA publication No. WC-7 Standards for cross-linked thermosetting polyethylene insulated wire and cable. Flexible connections between stationary and hinged panels or doors shall be made between terminal blocks or clamped in such a manner as to afford flexibility without damage to the wires. The wires shall be neatly bundled and tie wrapped.
- E. The assembled control equipment and wiring connections shall be insulated for 600-volts and shall be subjected to a one (1) minute test of 1500-volts AC at the factory after fabrication and assembly is complete.

- F. Terminal blocks shall be provided for terminating all power and control wiring. Terminal blocks shall be rated at 600-volts, strap screw terminals with white marking strips showing terminal numbers.
- G. Terminal blocks shall be conveniently located for external connection without accessing the high voltage compartments and shall be marked appropriately. A wire label at both ends will identify each internal connecting wire.

## 2.17 BATTERY SYSTEM

### A. Batteries:

- 1. Provide high discharge rate type maintenance-free nickel-cadmium batteries. Battery voltage shall be 125 volts nominal. Calculate the battery capacity based on the lowest ambient temperature in the room where it is to be installed. Include a safety margin of 50 percent for reserve capacity.
  - a. Provide sufficient battery capacity to carry all continuous loads (lamps, relays, etc.) for 8 hours and then perform the greater of the following duties, with the charger de-energized.
    - 1) Trip all circuit breakers simultaneously and
    - 2) Be able to cycle every circuit breaker at least 2 cycles. Breaker closing current shall include both the spring release coil current and the starting current of the spring charging motor.
- 2. Provide battery connector covers for protection against external short circuits.
- 3. Provide corrosion-resistant steel battery racks.
- 4. Shall have integral disconnecting means with shunt trip capability for emergency power off (EPO). Refer also to drawings.

### B. Battery Charger:

- 1. Provide a charger of the full-wave rectifier type utilizing silicon controlled rectifiers as the power-control elements. Construction shall be modular with plug-in control units for easy replacement.
- 2. The charger shall maintain 1/2 of one percent voltage regulation from no load to full load for line voltage variation of 10 percent, and frequency variation of 3 Hz from 60 Hz.
- 3. The charger shall maintain a nominal float voltage of 1.4 vpc, and a nominal equalizing voltage of 1.5 vpc.
- 4. The charger shall be capable of continuous operation in an ambient temperature of 40 degrees C (104 degrees F) without derating. The charger shall be installed in a convection cooled NEMA Type 1 ventilated enclosure. The housing is to have a hinged front door with all equipment accessible from the front.
- 5. Provide both AC and DC transient protection. Charger shall be able to recharge a fully discharged battery without tripping AC protective devices. AC circuit breaker shall not trip under any DC load condition, including short circuit on output terminals.
- 6. The charger shall be capable of supplying the following demand simultaneously:
  - a. Recharging a fully discharged battery in 12 hours.
  - b. Supervisory panel and control panel.
  - c. Steady loads (indicating lamps, relays, etc.).
- 7. The charger shall have fused AC input and DC output protection.
- 8. The charger shall not discharge the batteries when AC power fails.
- 9. The charger shall have the following accessories:
  - a. On-off control switch with pilot light.

- b. AC power failure alarm light.
- c. High DC voltage alarm light.
- d. Low DC voltage alarm light.
- e. Ground detection switch and alarm light.
- f. DC ammeter - 2 percent accuracy.
- g. DC voltmeter - 2 percent accuracy: Float/equalize voltage marked in red on voltmeter.
- h. Provisions for activation of remote annunciation of trouble for the above conditions.

#### 2.18 NAMEPLATES

- A. Nameplates shall be laminated orange plastic with black lettering identifying circuit breaker cubicle; white plastic with black lettering for relaying, metering, and control devices.
- B. Nameplates shall be provided on all relaying, metering, and control devices.
- C. Circuit identification nameplates shall be placed on the front and back of each switchgear frame.

#### 2.19 FINISH

- A. All non-galvanic steel within the switchgear and metal-enclosed bus enclosures shall be cleaned, iron phosphated and painted in accordance with the manufacturer's standard practice for the environmental conditions specified. The enclosure final exterior color paint coat shall be ANSI No. 61 gray.
- B. The interior shall utilize galvanic steel for internal construction. The galvanic steel shall provide inherent reflective properties to its surface and shall not peel, scratch, rust or corrode. Painted interiors are subject to scratching during racking of the circuit breakers and normal maintenance of the switchgear and are therefore unacceptable.
  - 1. Manufacturer shall supply paint, matching each color used, for field "touch up" after installation of the equipment.

#### 2.20 OTHER EQUIPMENT

- A. Furnish tools and accessories required for circuit breaker and switchgear test, inspection, maintenance, and proper operation.
- B. Cable terminations:
  - 1. Cable terminations shall conform to the requirements in Section 26 05 13, MEDIUM-VOLTAGE CABLES.
  - 2. Coordinate cable terminations with the switchgear being furnished.
- C. Medium-voltage surge arresters:
  - 1. Distribution class, metal-oxide-varistor type. Comply with NEMA LA 1.
  - 2. Provide each ungrounded conductor of each incoming and outgoing circuit with an appropriate arrester for the application voltage.
  - 3. Provide each phase of each circuit breaker with appropriate surge arrester for application voltage.

4. Locate surge arrestors so they can be easily accessed by maintenance personnel for testing and replacement. Show locations on shop drawings.
- D. Circuit breaker removal equipment: Furnish a permanent circuit breaker transport and removal device mounted on top of enclosure for installation and removal of circuit breakers, PT or CPT.
- E. Kirk Key
  1. A Kirk Key interlock system shall be provided in accordance with the single line diagram.
- F. Mimic Bus
  1. A mimic bus applied to the front of the switchgear shall functionally represent the primary circuits. Mimic bus shall be a phenolic label screwed to the front.

#### 2.21 OPTIONAL ACCESSORIES

- A. An electrical test jumper shall connect the breaker to the switchgear control circuit while the breaker is completely out of the cell.
- B. An electrical test cabinet with door-mounted open and close pushbuttons shall be supplied for testing the circuit breaker away from the switchgear.
- C. Vendor's standard, manually operated, Ground & Test device shall be supplied for main bus and system grounding during maintenance. The G&T device shall be equipped with 6 terminals.
- D. Relay/test plug for each type of device, as applicable.

#### 2.22 TESTING AND CERTIFICATION

- A. Design tests, to verify ANSI/IEEE ratings as identified in this specification, shall be documented as required by ISO 9001-2000 and available for review and inspection.
- B. The switchgear shall be UL certified.

#### 2.23 FACTORY TESTS

- A. Switchgear shall be thoroughly tested at the factory, with the circuit breakers in the connected position in their cubicles. Tests shall be in accordance with ANSI C37.54 and C37.55, and IEEE C37.09. Factory tests shall be certified, and shall include the following tests:
  1. Design tests.
  2. Production tests.
  3. Conformance tests.
- B. The following additional tests shall be performed:
  1. Verify that circuit breaker sizes and types correspond to drawings, and the Overcurrent Protective Device Coordination Study.
  2. Verify that current and voltage transformer ratios correspond to drawings.
  3. Verify tightness of bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
  4. Confirm correct operation and sequencing of interlock systems for multiple circuit



breakers by attempting closure on locked-open devices, and attempting to open locked-closed devices, and making key exchange with devices operated in off-normal positions.

5. Verify correct barrier and shutter installation and operation.
6. Exercise all active components.
7. Inspect indicating devices for correct operation.
8. Perform an insulation-resistance test, phase to ground, on each bus section, with phases not under test grounded, in accordance with manufacturer's published data.
9. Perform insulation-resistance tests on control wiring with respect to ground.
10. If applicable, verify correct function of control transfer relays located in the switchgear with multiple control power sources.
11. Perform phasing checks on double-ended or dual-source switchgear to ensure correct bus phasing from each source.

- C. Submit four (4) copies of certified manufacturer's factory test.

#### 2.24 ON-SITE TESTING

- A. The control circuits shall be operated at the normal voltage and current for proper operation of circuit breakers, circuit breaker simulators, switches, contactors, interlocks, etc.
- B. Instruments shall be energized from the low voltage winding of the potential transformers and the low current winding of current transformers. Where practical, each instrument shall be operated through its range of voltage, current and/or phase angle and frequency to produce deflections over the entire scale.
- C. The ratio and interconnections of all potential transformers shall be functionally checked to verify conformance to the electrical drawings and electrical bills of material.
- D. Relays shall be tested by applying rated current and/or voltage as required to determine proper performance characteristics. Each relay shall be tested to determine its proper operation in itself and also in the total overall circuit performance.
- E. A static circuit check shall be performed for auxiliary switches, external circuit connections and parts of circuitry that have not been checked or cannot be checked functionally. The devices shall be checked for mechanical function and for conformance to the schematic and wiring diagrams.
- F. After all electrical tests and mechanical checks have been completed and corrections have been signed off, the following dielectric tests shall be performed:
  1. Each power bus shall be given a high voltage withstand test from phase to phase and phase to ground at the specified voltage, frequency and time duration indicated in the Standard C37.20.
  2. Control wire shall be given a high voltage withstand test from wire to ground at the specified voltage, frequency and time duration with reference to the proper standard.

#### 2.25 ENGINEERING DATA REQUIREMENTS

- A. All engineering data provided for the equipment shall show equipment as specified and ordered. Engineering data, as listed below, shall be supplied in the quantities shown on the supplier's quotation.

- B. Standard Class I drawings shall consist of a system single line drawing; front view; floor plan and section view drawing. Standard Class II drawings shall consist of Class I drawings plus 3-phase elementary and schematic diagrams, nameplate drawing, instrument layout and bills of material.
- C. Drawings shall indicate all equipment, but only such equipment, as is actually in the switchgear scope of supply. All user connection and interface points shall be clearly marked, including primary and secondary cable entrances and connection points, installation details, generic interframe assembly and generic connection details for shipping splits.
- D. Drawing Requirements
  - 1. AutoCad Version 2010 or greater supplied for all drawings.
  - 2. Electronic drawing PDF format files for approval shall be supplied. Where possible, typical drawings shall be supplied as PDF files for class 1 and either PDF files or AutoCAD files for class 2.
    - a. Structural Drawings, with critical dimensions, showing:
      - 1) Arrangement.
      - 2) Plan, front view, and elevation section views.
      - 3) Required clearances for opening doors and for removing breakers.
      - 4) Conduit or cable trays entrance locations and dimensions for both top and bottom entrance including low voltage conduit locations for entering top.
      - 5) Bus bar locations and configurations.
      - 6) Incoming and outgoing power cable terminator positions.
      - 7) Anchor bolt locations.
      - 8) Grounding connections.
      - 9) Weight of equipment.
    - b. Elementary Three-Line Diagrams
      - 1) Three line diagrams, with ANSI device function numbers used throughout, shall show all:
        - a) Instrument transformers.
        - b) Relays.
        - c) Meters and meter switches.
        - d) Breakers and other pertinent devices.
    - c. Schematic Diagrams
      - 1) Schematic diagrams shall be furnished for the electrically-operated breaker / relay control scheme.
      - 2) Each schematic diagram shall show all control devices and device contact, each of which shall be labeled with its proper ANSI device function number.
      - 3) Each schematic diagram shall show device and terminal block terminal numbers for customer connections.
      - 4) Provide control switch development tables.
    - d. Detailed Connection (Wiring) Diagrams showing, submitted for record only:
      - 1) Approximate physical location of all items in each unit.
      - 2) All wiring within each unit.
      - 3) All interconnecting wiring between units.
      - 4) Identification of all terminals, terminal blocks, and wires.
    - e. Provide one set of drawings shipped with the switchgear for start-up use.

E. Material List

1. An electrical bill of material list shall be furnished listing the quantity, rating, type, and manufacturer's catalog number of all equipment on each unit.
- F. Installation, Operating, and Maintenance Instructions
1. Installation, operating, and maintenance instructions shall cover switchgear, breakers, relays, meters and devices requiring installation, programming and / or maintenance.
  2. The breaker operating mechanism shall be front-accessible, and all routine maintenance shall be performed with the breaker in an upright position. The interrupters shall be completely sealed requiring no interphase barriers. Breakers shall be designed for easy insertion, removal and transport on flat indoor surfaces. A breaker lift truck shall be furnished with each switchgear assembly.
- G. Instruction and Maintenance Literature
1. Instruction books shall show the customer step by step installation instructions.
  2. Reassembly of shipping splits.
  3. Instructions on how to install shipped loose items.
  4. Methods of attaching skid to foundation.
  5. Recommended testing.
  6. Recommended cleaning and touch up of the building.
  7. A video showing all of the above

## 2.26 PREPARATION FOR SHIPMENT

- A. Preparation for Shipment shall be in accordance with manufacturer's standards, unless otherwise noted on the Request for Quotation and/or Purchase Order. The manufacturer shall be solely responsible for the adequacy of the Preparation for Shipment provision employed in respect of materials and application, to provide materials and their destination in ex-works condition when handled by commercial carrier systems.

## 2.27 SHIPPING

- A. Instructions for receiving, handling, and storage shall be provided with the switchgear shipment.
- B. Circuit breakers shall not be shipped installed in the switchgear assembly to avoid damage.
- C. Each "shipping section" of stationary structures shall be provided with a permanently-attached, readily-visible identification tag bearing the equipment number of the assembly of which it is a part.
- D. The switchgear shall be split in the most efficient manner for shipping.
- E. If shipped in sections the wiring between the units shall be terminated on terminal blocks on each side of the shipping split. Jumpers shall be provided and marked for convenient connection in the field.
- F. All accessory items shall be shipped with the switchgear. Boxes and crates containing accessories shall be clearly marked with the contents.
1. Accessories include:
    - a. A breaker lifting truck device to allow a circuit breaker, or auxiliary draw-out unit to be elevated and then inserted or withdrawn from upper or lower compartments.

- b. Circuit breaker accessories, including a hand crank for manually operating the breaker, PT/CPT/draw-out fuse racking system and/or a handle for manually charging the stored energy system on circuit breakers.
  - c. An electrical test jumper for connecting the breaker to the switchgear control circuit while the breaker is completely out of the cell.
- G. After shipping from the factory, switchgear shall not be stored in an unconditioned space. Coordinate optimal delivery time.

## 2.28 PROVISIONS FOR HANDLING AND FIELD ERECTION

- A. Each assembly order shall be furnished with one set of channel base extensions suitable for crane hooks or slings.
- B. Each shipping split shall be furnished with removable steel shipping channels that permit the use of pipe rollers or dollies without damaging the frame steel of the equipment.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install switchgear in accordance with the NEC, as shown on the drawings, and as recommended by the manufacturer.
- B. Anchor switchgear with rustproof bolts, nuts, and washers not less than 12 mm (1/2 inch) diameter, in accordance with manufacturer's instructions, and as shown on drawings.
- C. Interior Location. Mount switchgear on concrete slab. Unless otherwise indicated, the slab shall be at least 100 mm (4 inches) thick. The top of the concrete slab shall be approximately 100 mm (4 inches) above finished floor. Edges above floor shall have 12.5 mm (1/2 inch) chamfer. The slab shall be of adequate size to project at least 100 mm (8 inches) beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits 75mm (3 inches) above slab surface. Concrete work shall be as specified in Section 03 30 00, Cast-In-Place Concrete.

### 3.2 TEMPORARY HEATING

- A. Prior to delivery to job site, apply temporary heat to switchgear, according to manufacturer's written instructions, throughout periods when switchgear environment is not controlled for temperature and humidity within manufacturer's stipulated service conditions.

### 3.3 ONE LINE DIAGRAM AND SEQUENCE OF OPERATION

- A. At final inspection, an as-built 13.2 kV system one line diagram shall be laminated or mounted under acrylic glass, and installed in a frame mounted in the switchgear room or in the outdoor switchgear enclosure.

- B. Furnish a written sequence of operation for the switchgear and connected line side/load side electrical distribution equipment. The sequence of operation shall be laminated or mounted under acrylic glass, and installed in a frame mounted in the switchgear room or in the outdoor switchgear enclosure.
- C. Mount on wall adjacent to HMI.
- D. Deliver an additional four copies of the as-built one line diagram and sequence of operation to the owner

### 3.4 SWITCHGEAR START-UP AND COMMISSIONING

- A. Provide full switchgear start-up and commissioning services to fully check-out and commission new switchgear, communications, HMI, relays, interlocking, breakers, metering, etc. Provide minimum on-site 2 persons for 7 days. (Relays shall be tested, checked, and settings installed at the factory and field verified during the commissioning phase.) Develop test procedures and checklists and document start-up and commissioning activities. Commissioning shall be in the presence of the owner and Engineer and contractor shall provide minimum 21 days of advanced notice.
- B. Contractor is responsible for successful start-up and commissioning and shall make all necessary adjustments and corrections during this time window for a fully functional and operational switchgear.

### 3.5 SYSEM START-UP AND COMMISSIONING

- A. After the cranes arrive and are connected to the 13.2 kV distribution system, provide system start-up and commissioning services to fully check-out and commission new switchgear, communications, HMI, relays, interlocking, breakers, metering, cables, connectors, ground-check, etc. when connected to the cranes and the cranes are operating. During system check-out, testing, and commissioning, provide minimum on-site 2 persons for 7 days. Develop test procedures and checklists and document start-up and commissioning. Coordinate with the owner for dates.
- B. Contractor is responsible for successful system start-up and commissioning and shall make all necessary adjustments and corrections during this time window for a fully functional and operational system.
- C. The switchgear warranty shall start after the approval and acceptance of the system start-up and commissioning.

### 3.6 AS-LEFT RELAY SETTINGS, AND FUSE RATINGS for control equipment

- A. The relay settings shall be set in the field by an authorized representative of the switchgear manufacturer per the approved Overcurrent Protective Device Coordination Study in accordance with Section 26 05 73, Overcurrent Protective Device Coordination Study.
- B. Post a durable copy of the "as-left" relay settings, and fuse ratings for control equipment in a

convenient location in the switchgear room. Deliver four additional copies of the settings and fuse ratings to the owner. Furnish this information prior to the activation of the switchgear.

3.7 INSTRUCTION

- A. Furnish the services of a factory-trained technician for one 4-hour training period for instructing personnel in the maintenance and operation of the switchgear, on the dates requested by the owner.

END OF SECTION

## SECTION 26 22 00 – LOW-VOLTAGE TRANSFORMERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes two-winding transformers; shielded transformers; autotransformers; and buck-and-boost transformers.
- B. Related Sections:
  - 1. Section 26 05 26 – Grounding and Bonding.

#### 1.2 REFERENCES

- A. National Electrical Manufacturers Association:
  - 1. NEMA ST 1 - Specialty Transformers (Except General Purpose Type).
  - 2. NEMA ST 20 - Dry Type Transformers for General Applications.
- B. International Electrical Testing Association:
  - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. National Fire Protection Association:
  - 1. National Electrical Code (NEC).

#### 1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures : Submittal procedures.
- B. Product Data: Submit and outline and support point dimensions of enclosures and accessories if mounted above floor, unit weight, voltage, kVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.
- C. Test Reports: Indicate loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.
- D. Complete nameplate data including manufacturer's name and catalog number.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of transformers.

## 1.5 QUALIFICATIONS

- A. Manufacturers:
  - 1. Square D.
  - 2. Cutler-Hammer
  - 3. G.E.
  - 4. Siemens.
- B. Substitutions: Not Permitted.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

## PART 2 - PRODUCTS

### 2.1 GENERAL PURPOSE DRY TYPE TWO-WINDING TRANSFORMERS

- A. Transformers shall be UL listed or labeled.
- B. Product Description: TP-1 rated, NEMA ST 20, factory-assembled, air-cooled, dry type transformers.
- C. Primary and secondary voltages as shown on drawings. Delta-Wye grounded configuration unless shown otherwise.
- D. Case temperature: Do not exceed 35 degrees C rise above ambient at warmest point at full load.
- E. Sound Levels: Maximum sound levels are as follows:
  - 1. 1-9 kVA: 40 dB.
  - 2. 10-50 kVA: 45 dB.
  - 3. 51-150 kVA: 50 dB.
  - 4. 151-300 kVA: 55 dB.
  - 5. 301-500 kVA: 60 dB.
- F. Enclosure: NEMA ST 20, Type 1. Furnish lifting eyes or brackets.
- G. Isolate core and coil from enclosure using vibration-absorbing mounts.
- H. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.



- I. Dry type transformers shall have the following features:
  1. Self-cooled by natural convection, isolating windings, indoor, dry type. Autotransformers will not be accepted.
  2. Rating and winding connections shall be as shown on the drawings.
  3. Transformers shall have copper windings.
  4. Ratings shown on the drawings are for continuous-duty without the use of cooling fans.
  5. Insulation systems:
    - a. Transformers 30 KVA and larger: UL rated 220 degrees C system having an average maximum rise by resistance of 150 degrees C in a maximum ambient of 40 degrees C.
    - b. Transformers below 30 KVA: Same as for 30 KVA and larger or UL rated 185 degrees C system having an average maximum rise by resistance of 115 degrees C in a maximum ambient of 40 degrees C.
  6. Core and coil assemblies:
    - a. Rigidly braced to withstand the stresses caused by short circuit currents and rough handling during shipment.
    - b. Cores shall be grain oriented, non-aging, and silicon steel.
    - c. Coils shall be continuous windings without splices except for taps.
    - d. Coil loss and core loss shall be minimum for efficient operation.
    - e. Primary and secondary tap connections shall be brazed or pressure type.
    - f. Coil windings shall have end fillers or tie downs for maximum strength.
  7. Nominal impedance shall be as shown on the drawings. If not shown on drawings, nominal impedance shall be as permitted by NEMA.
  8. Single phase transformers rated 15 KVA through 25 KVA shall have two, 5 percent full capacity taps below normal rated primary voltage. All transformers rated 30 KVA and larger shall have two, 2 ½ percent full capacity taps above, and four, 2 ½ percent full capacity taps below normal rated primary voltage.
  9. Core assemblies shall be grounded to their enclosures by adequate flexible ground straps.
  10. Enclosures:
    - a. Not less than code gage steel.
    - b. Outdoor enclosures shall be NEMA 3R and stainless steel Type 316.
    - c. Temperature rise at hottest spot shall conform to NEMA Standards, and shall not bake and peel off the enclosure paint after the transformer has been placed in service.
    - d. Ventilation openings shall prevent accidental access to live components.
    - e. Thoroughly clean and paint enclosure at the factory with manufacturer's prime coat and standard finish.
  11. Standard NEMA features and accessories including ground pad, lifting provisions and nameplate with the wiring diagrams and sound level indicated on it.
  12. Dimensions and configurations shall conform to the spaces designated for their installations.
  13. Transformers shall meet the minimum energy efficiency values per NEMA TP1 as listed below:

KVA Rating	Output efficiency (%)
15	97
30	97.5

45	97.7
75	98
112.5	98.2
150	98.3
225	98.5
300	98.6
500	98.7
750	98.8

## 2.2 SOURCE QUALITY CONTROL

- A. Production test each unit according to NEMA ST20.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify mounting supports are properly sized and located including concealed bracing in walls.

### 3.2 EXISTING WORK

### 3.3 INSTALLATION

- A. Set transformer plumb and level.
- B. Use flexible conduit, in accordance with Section 26 05 33, 2 feet Minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- C. Support transformers in accordance with Section 26 05 29.
  - 1. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by manufacturer. Coordinate exact requirements with architect and structural engineer.
  - 2. Mount floor-mounted transformers on vibration isolating pads suitable for isolating transformer noise from building structure.
  - 3. Mount trapeze-mounted transformers as indicated on Drawings. Coordinate exact requirements with architect and structural engineer.
  - 4. Stacked transformers: Construct and anchor painted angled steel frame suitable for weight and size of transformer. Ground frame with min. #8AWG
- D. Installation of transformers shall be in accordance with the NEC, as recommended by the equipment manufacturer and as shown on the drawings.

- E. Install the transformers with adequate clearance at a minimum of 100 mm (4 inches) from wall and adjacent equipment for air circulation to remove the heat produced by transformers.
- F. Provide seismic restraints if installed in a seismic zone.
- G. Install grounding and bonding in accordance with Section 26 05 26 .

#### 3.4 FIELD QUALITY CONTROL

- A. Section [01 70 00 - Execution and Closeout Requirements]: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.2.1.

#### 3.5 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION

## SECTION 26 24 16 – PANELBOARDS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes distribution and branch circuit panelboards.
- B. Related Sections:
  - 1. Section 26 05 00 – Common Work Results for Electrical.
  - 2. Section 26 05 19 – Low Voltage Electrical Power Conductors and Cables.
  - 3. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
  - 4. Section 26 05 29 – Hangers and Supports for Electrical Systems.
  - 5. Section 26 05 33 – Raceway and Boxes for Electrical Systems.
  - 6. Section 26 05 53 - Identification for Electrical Systems.

#### 1.2 REFERENCES – latest adopted editions of:

- A. Institute of Electrical and Electronics Engineers:
  - 1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- B. National Electrical Manufacturers Association:
  - 1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
  - 2. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
  - 3. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
  - 4. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
  - 5. NEMA PB 1 - Panelboards.
  - 6. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
- C. International Electrical Testing Association:
  - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- D. National Fire Protection Association:
  - 1. NFPA 70 - National Electrical Code.
  - 2. NFPA70E – Electrical Safety in the Workplace.
- E. Underwriters Laboratories Inc.:
  - 1. UL 67 - Safety for Panelboards.
  - 2. UL 1283 - Electromagnetic Interference Filters.
  - 3. UL 1449 - Transient Voltage Surge Suppressors.

### 1.3 SUBMITTALS

- A. Refer to Division 01: Requirements for submittals.
- B. Shop Drawings: Indicate as a minimum outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating and circuit breaker arrangement and sizes.
- C. Product Data: Submit catalog data showing specified features of standard products.
- D. Complete nameplate data including manufacturer's name and catalog number.

### 1.4 CLOSEOUT SUBMITTALS

- A. Refer to Division 01: Requirements for submittals.
- B. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.
- C. Operation and Maintenance Data: Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

### 1.5 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in the manufacture of panelboards and enclosures, of types, sizes and ratings required; whose products have been in satisfactory use in similar service for not less than (5) five years.
- B. Installer's Qualifications: A firm with at least three (3) years of successful installation experience on projects utilizing panelboards similar to those required for this project.
- C. Codes and Standards:
  - 1. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC Article 384 as applicable to the installation and construction of electrical panelboards and enclosures.
  - 2. UL Compliance: Comply with applicable requirements of UL 67, "Electric Panelboards", and UL Codes 50, 869 and 1053 pertaining to panelboards, accessories and enclosures. Provide panelboard units that are UL listed and labeled.

### 1.6 MAINTENANCE MATERIALS

- A. Refer to Division 01: Requirements for maintenance products.
- B. Furnish two of each panelboard key. Panelboards keyed alike to Owner's current keying system.

## PART 2 - PRODUCTS

### 2.1 PANELBOARDS

- A. Panelboards shall be in accordance with UL, NEMA, NEC, and as shown on the drawings.
- B. Panelboards shall be standard manufactured products. All components of the panelboards shall be the product and assembly of the same manufacturer. All similar units of all panelboards to be of the same manufacturer.
- C. All panelboards shall be dead front safety type. Arrange sections for easy removal without disturbing other sections.
- D. All panelboards shall be completely factory assembled with molded case circuit breakers.
- E. Main circuit breaker shall have vertical mounting position.
- F. Panelboards shall have main breaker or main lugs, bus size, voltage, phase, top or bottom feed, and flush or surface mounting as shown on scheduled and on the drawings.
- G. Provide circuit breaker type panelboards as indicated on drawings and as specified hereinafter.
- H. Power Distribution Panelboards shall be Square D type 'I Line', General Electric type 'Spectra', Cutler Hammer type 'PRL3a' or Siemens equivalent. Voltage shall be indicated.
- I. Lighting and Appliance: Panelboards shall be Square D type 'NQOD' or 'NF', General Electric A-series or 'S2', Cutler-Hammer type PRL2 or Siemens equivalent. Panelboard boxes shall be five and three-fourths (5  $\frac{3}{4}$ ") deep. Voltage shall be as indicated.
- J. Panelboards shall have the following features:
  - 1. Non-reduced size copper bus bars, and connection straps bolted together and rigidly supported on molded insulators. Bus bar taps for panels with single pole branches shall be arranged for sequence phasing of branch circuit devices.
  - 2. Full size, copper neutral bar (unless shown otherwise on drawings), mounted on insulated supports. [Neutral bar shall be factory installed and electrically isolated.]
  - 3. Copper ground bar with sufficient terminals for all grounding wires. Buses braced for the available short circuit current, but not less than 10,000 amperes symmetrical for 120/208 volt panelboards, and 14,000 amperes symmetrical for 277/480 volt panelboards.
  - 4. All breakers and phase bus connections shall be arranged so that it will be possible to substitute a 2-pole breaker for two single pole breakers, and a 3-pole breaker for three single pole breakers, when trip is 30 Amps or less and frame size is 100 amperes or less, without having to drill and tap the main bus bars at bus straps.
  - 5. Minimum Circuit breaker lugs shall be 75°C.
  - 6. Design interior so that protective devices can be replaced without removing adjacent units, main bus connectors, and without drilling or tapping. Panel phase bus connections to protective devices shall not be riveted to the panel bus and shall be field removable by means of a screw driver.
  - 7. Where designated on panel schedule as "space", include all necessary bussing, device support and connections. Provide blank cover for each space.

8. In two section panelboards, the main bus in each section shall be full size. The first section shall be furnished with subfeed or feed-through lugs as shown on drawings on the line side with cable connections to the second section. Panelboard sections with tapped bus or crossover bus are not acceptable.
9. Series rated panelboards are not permitted.
10. Provide keyed alike system for all panelboards. In existing buildings where new panels are installed, provide keyed alike locks as directed by owner.
11. Provide a type written directory card, metal holder, and transparent cover. Permanently mount holders on inside of doors.

K. Painting: Factory primed and painted.

L. Fusible Switch Assemblies: NEMA KS 1, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Furnish interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: Designed to accommodate NEMA FU 1, Class R fuses.

M. Exterior panelboards and dead fronts shall be stainless steel Type 316. Refer also to drawings.

## 2.2 MOLDED CASE CIRCUIT BREAKERS FOR PANELBOARDS

A. Breakers shall be UL listed and labeled, in accordance with the NEC, as shown on the drawings, and as specified.

B. Circuit breakers in panelboards shall be bolt on type on phase bus bar or branch circuit bar.

C. Molded case circuit breakers shall have minimum interrupting rating and not less than shown above.

1. 120/208 volt Panelboard: 10,000 amperes symmetrical.
2. 277/480 volt Panelboard: 14,000 amperes symmetrical.

D. Breaker features shall be as follows.

1. A rugged, integral housing of molded insulating material.
2. Silver alloy contacts.
3. Arc quenches and phase barriers for each pole.
4. Over-center, trip-free, toggle-type, quick-make, quick-break, operating mechanisms.
5. A trip element for each pole, thermal magnetic type with long time delay and instantaneous characteristics, a common trip bar for all poles and a single operator.
6. Electrically and mechanically trip free.
7. An operating handle which indicates ON, TRIPPED, and OFF positions.
  - a. Line connections shall be bolted.
  - b. Interrupting rating shall not be less than the maximum short circuit current available at the line terminals as indicated on the drawings.
8. An overload on one pole of a multipole breaker shall automatically cause all the poles of the breaker to open.
9. For circuit breakers being added to existing panelboards, coordinate the breaker type with existing panelboards. Modify the panel directory.
10. Factory assembled.

11. Construct breakers for mounting and operating in any physical position and operating in ambient temperature of 40°C.
  12. Provide breakers with mechanical screw type removable connector lugs; /CU rated.
- E. Circuit Breakers shall be UL Listed for air conditioning branch circuits.

### 2.3 SEPARATELY ENCLOSED MOLDED CASE CIRCUIT BREAKERS

- A. Where separately enclosed molded case circuit breakers are shown on the drawings, provide circuit breakers in accordance with the applicable requirements of those specified for panelboards.
- B. Enclosures are to be of the NEMA types shown on the drawings. Where the types are not shown, they are to be the NEMA type most suitable for the environmental conditions where the breakers are being installed.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install panelboards in accordance with NEMA PB 1.1.
- B. Install panelboards plumb.
- C. Install recessed panelboards flush with wall finishes.
- D. Installation shall be in accordance with NEC, as shown on the drawings, and as specified.
- E. Locate panelboards so that the present and future conduits can be conveniently connected. Coordinate the sizes of the cabinets with designated closet space.
- F. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque-tightening values for equipment connectors.
- G. Fasten enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically anchored.
- H. Install a typewritten schedule of circuits in each. Schedules shall be typed on the panel directory cards and installed in the appropriate panelboards, incorporating all applicable contract changes pertaining to that schedule. Include the room numbers and items served on the cards.
- I. Mount top of panelboard at 6'- 6". If panelboard length is longer than standard, then mount panelboard so that maximum height of the top circuit breaker above finished floor shall not exceed 1980 mm (78 inches). For panelboards, which are too high, mount panelboard so that the bottom of the cabinets will not be less than 150 mm (6 inches) above the finished floor.



- J. For panelboards located in the areas accessible to the public, paint the exposed surfaces of the trims, doors, and boxes with finishes to match surrounding surfaces after the panelboards have been installed.
- K. Circuit numbers indicated on the drawings are shown for the purpose of clarifying the grouping of outlets. The actual number assigned to the circuit in the panelboard shall suit the bussing and branch circuiting of the panel. Provide owner as-built drawings showing the actual circuit numbers being used for each device on each brand circuit.
- L. Panelboards shall be installed complete with connectors and associated hardware for all circuit breakers and circuit breaker spaces listed in the panelboard schedule.
- M. When connecting equipment to existing panelboards, the new and existing circuit breakers shall be identified. A new circuit directory card shall be provided.
- N. Provide equipment grounding connections for panelboard enclosures as indicated.
- O. Prior to energization, check panelboards for electrical continuity of circuits and for short-circuits.
- P. Install filler plates for unused spaces in panelboards.
- Q. Install engraved plastic nameplates in accordance with Section 26 05 53{16075}.
- R. Install spare conduits out of each recessed panelboard to accessible location. Minimum spare conduits: 5 empty  $\frac{3}{4}$  inch. Identify each as SPARE.
- S. Ground and bond panelboard enclosure according to Section 26 05 26. Connect equipment ground bars of panels in accordance with NFPA 70.
- T. Torque mechanical and electrical connections to manufacturer's specifications/recommendations.

### 3.2 FIELD QUALITY CONTROL

- A. Refer to Division 01: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS.

### 3.3 ADJUSTING

- A. Refer to Division 01: Requirements for starting and adjusting.
- B. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.
- C. Adjust operating mechanisms for free mechanical movement.

- D. Touch-up scratched or marred surfaces to match original finishes.

END OF SECTION

## SECTION 26 29 21 – DISCONNECT SWITCHES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes fusible and nonfusible switches.
- B. Related Sections:
  1. Section 26 05 00 – Basic Methods and Requirements.
  2. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.
  3. Section 26 05 26 – Grounding and Bonding for Electrical Systems.
  4. Section 26 05 29 – Hangers and Supports for Electrical Systems.
  5. Section 26 05 33 – Raceways and Boxes for Electrical Systems.
  6. Section 26 05 53 – Identification for Electrical Systems.

#### 1.2 REFERENCES

- A. National Electrical Manufacturers Association:
  1. NEMA FU 1 - Low Voltage Cartridge Fuses.
  2. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
  3. ICS 1-00 – Industrial Control and Systems General Requirements.
  4. ICS 1.1-03 – Safety Guidelines for the Application, Installation and Maintenance of Solid State Control.
  5. ICS 2-00 – Industrial Control and Systems, Controllers, Contractors and Overload Relays Rated 600 Volts DC.
  6. ICS 6-01 – Industrial Control and Systems Enclosures.
  7. ICS 7-00 – Industrial Control and Systems Adjustable-Speed Drives
  8. ICS 7.1-00 – Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems.
- B. International Electrical Testing Association:
  1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. National Fire Protection Association (NFPA):

70	National Electrical Code (NEC)
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- D. Underwriters Laboratories, Inc (UL):

98	Enclosed and Dead-Front Switches
198C	High-Interrupting-Capacity Fuses, Current Limiting Types
198E	Class R Fuses

977	Fused Power-Circuit Devices
508	Industrial Control Equipment

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit switch ratings and enclosure dimensions.
- C. Shall label each switch/starter with its associated equipment tag (i.e. AHU-1).

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of enclosed switches and ratings of installed fuses.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCH ASSEMBLIES

- A. Manufacturers:
  - 1. Square D.
  - 2. Cutler-Hammer.
  - 3. G.E.
  - 4. Siemens.
  - 5. Substitutions: Not Permitted.
- B. Product Description: Enclosed load interrupter knife switch.
- C. Fuse clips: Designed to accommodate NEMA FU 1, Class R fuses.
- D. Fuses shall be class RK1 or Class L.
- E. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray. Stainless steel if marine application.
  - 1. Interior Dry Locations: Type 1.
  - 2. Exterior Locations: Type 4X, stainless steel, Type 316.

- F. Furnish switches with entirely copper current carrying parts.
- G. Shall be quick-make, quick-break type in accordance with UL 98, NEMA KS 1 and NEC.
- H. Shall have a minimum duty rating, NEMA Heavy Duty (HD) classification for voltage required.
- I. Shall be horsepower rated.
- J. Shall have the following features:
  - 1. Switch mechanism shall be the quick-make, quick-break type.
  - 2. Copper blades, visible in the OFF position.
  - 3. An arc chute for each pole.
  - 4. External operating handle shall indicate ON and OFF position and shall have lock-open padlocking provisions.
  - 5. Mechanical interlock shall permit opening of the door only when the switch is in the OFF position, defeatable by a special tool to permit inspection.
  - 6. Fuse holders for the sizes and types of fuses specified.
  - 7. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
  - 8. Ground Lugs: One for each ground conductor.
  - 9. Handle lockable in OFF position.
  - 10. Entirely copper current carrying parts.
- K. Where switch is located on the load side of a VFD, provide one (1) normally open (NO) auxiliary contact to interlock the VFD run permissive circuit. Disconnecting on-line motor shall shut down VFD. When the switch is closed, a permissive run signal shall restart the VFD at low voltage and frequency. Interlock equipment with two (2) #12 AWG in 3/4 inch conduit.

## 2.2 NONFUSIBLE SWITCH ASSEMBLIES

- A. Shall be same as fusible switch assembly (2.1 above) except it shall not accept fuse.

## 2.3 SWITCH RATINGS

- A. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.
- B. Short Circuit Current Rating: UL listed for 10,000 rms symmetrical amperes minimum without fuses. 200,000 rms symmetrical amperes when used with or protected by Class R fuses (30-600 ampere switches employing appropriate fuse rejection schemes).

## PART 3 - EXECUTION

### 3.1 EXISTING WORK

- A. Disconnect and remove abandoned enclosed switches.

- B. Maintain access to existing enclosed switches and other installations remaining active and requiring access. Modify installation or provide access panel.
- C. Clean and repair existing enclosed switches to remain or to be reinstalled.

### 3.2 INSTALLATION

- A. Install disconnect switches in accordance with the NEC.
- B. Install enclosed switches plumb. Provide supports in accordance with Section 26 05 29.
- C. Height: 5 feet (1500 mm) to operating handle.
- D. Install fuses for fusible disconnect switches.
- E. Install engraved plastic nameplates in accordance with Section 26 05 53.
- F. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.
- G. Install motor control equipment in accordance with manufacturer's recommendations, the NEC, NEMA and as shown on the drawings.
- H. Install Variable Speed Motor Controllers in accordance with manufacturer's recommendations, the NEC, as shown on the drawings and in accordance with NEMA ICS 7.1.C.
- I. Ensure proper direction of rotation of each motor.
- J. Two weeks prior to the final inspection, provide one complete set of spare fuses for each fusible disconnect installed on this project.
- K. Electrical equipment located in smoke or fire rated walls shall be mounted on Unistrut channels. Channels shall be supported from floor and structure above the ceiling. There shall be no penetrations of the fire rated assembly pursuant to the equipment installation.
- L. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors.

### 3.3 IDENTIFICATION SIGNS

- A. Install nameplate identification signs on each disconnect switch to identify the equipment controlled.
- B. Nameplates shall be laminated black phenolic resin with a white core, with engraved lettering, a minimum of 1/4 inch high. Secure nameplates with screws.

### 3.4 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.5.

END OF SECTION

SECTION 26 31 00 – FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes fire alarm control panels, manual fire alarm stations, automatic smoke and heat detectors, fire alarm signaling appliances, and auxiliary fire alarm equipment and power and signal wire and cable.
- B. Related Sections:
  - 1. Section 26 05 19 – Low-Voltage Electrical Power Conductors And Cables.
  - 2. Section 26 05 26 – Grounding For Electronic Safety And Security.

1.2 REFERENCES

- A. National Fire Protection Association:

NFPA 70	National Electrical Code
NFPA 72	National Fire Alarm Code
NFPA 262	Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

1.3 WORK INCLUDED

- A. Provide labor, materials, equipment and items of service required for completion of a functionally operative fire alarm system as described in subsequent parts of this section.
- B. Installer shall coordinate and work fully with project commissioning agent.
- C. Provide signed and sealed fire alarm plans.

1.4 TEMPORARY SYSTEM REQUIREMENTS

- A. Provide temporary fire alarm system coverage for the project area, new and demolition areas, as described herein. Install equipment before construction commences in any area and leave in service until construction is complete or until permanent fire alarm system is in place and operational.
- B. Coordinate with owner the extension of existing fire alarm system for temporary coverage in renovated areas. In new construction, provide complete system with connection into existing building fire alarm system for reporting purposes.



- C. Provide manual stations, heat detector or other fire alarm devices for temporary system as follows:
  - 1. One (1) 135 degree heat detector for every 900 square feet (30 feet on center).
  - 2. Locate manual stations, at least one per area, such that the distance from any point within a construction area does not exceed 100 feet. Locate stations in readily accessible areas with preference given to the means of egress from the construction area. Relocate stations during the duration of construction as required to maintain ready access.
- D. Remove all fire alarm devices, wiring and raceways at the completion of construction. Heat detectors and other fire alarm devices shall be turned over to the owner in good condition.

## 1.5 SYSTEM DESCRIPTION

- A. Fire Alarm System: NFPA 72, manual and automatic with connections to 24/7 central station.
- B. Alarm Sequence of Operation: Actuation of initiating device causes the following system operations:
  - 1. Local fire alarm signaling devices sound and display with signal.
  - 2. Signal transmits to central station.
  - 3. Location of alarm indicates on fire alarm control panel and on remote annunciator panel.
  - 4. Signal transmits to building elevator control panel, initiating return to main floor or alternate floor and lockout for fire service.
  - 5. Signal transmits to building mechanical controls, shutting down fans and operating dampers.
  - 6. Signal releases electric door locks.
- C. Immediately perform the following alarm sequence when an alarm condition is activated on the system:
  - 1. Annunciate on the fire alarm system identifying the floor level, smoke compartment, room number and specific device(s) in alarm. (The room number used for identification shall be the room number assigned by the owner and not necessarily the room number indicated on the floor plans. Coordinate the device description with the owner.)
  - 2. Initiate a general fire alarm activating all audio/visual appliances.
  - 3. Unlock all egress doors that are electrically locked via a security or other system.
- D. Interface fire alarm system with the HVAC system such that when any device except a manual pull station activates an alarm condition, the following occurs in addition to the actions listed above:
  - 1. Shutdown systems greater than 2000 cfm.
- E. Initiate a trouble tone and illuminate LED light on the FACP to indicate a trouble condition under the following conditions:
  - 1. System wiring short circuit, open circuit or short to ground condition.
  - 2. Failure of tone-generating equipment.
  - 3. Failure of primary or secondary power supply.
  - 4. Missing or failed initiating device.

- F. Provide a Digital Alarm Communicator Transmitter (DACT) for signaling the central monitoring service that an alarm, trouble or supervisory alert condition exists at the facility. Provide equipment with the following:
  - 1. UL listing for fire reporting to a Central Station and meet performance requirements of NFPA 72.
  - 2. Battery backup.
  - 3. Supervise wiring from the FACP to DACT.
- G. Drill Sequence of Operation: Manual drill function causes alarm mode sequence of operation.
- H. Trouble Sequence of Operation: System or circuit trouble causes the following system operations:
  - 1. Visual and audible trouble alarm indicates at fire alarm control panel.
  - 2. Visual and audible trouble alarm indicates at remote annunciator panel.
  - 3. Trouble signal transmits to central station.
- I. Provide a complete, non-coded, addressable, intelligent, microprocessor-based, reporting fire alarm system as indicated on the drawings and as specified herein.
- J. Wiring for the system shall conform to the following criteria:
  - 1. Provide Class A, Style 7 signaling line circuits (SLC) for initiating devices. Design the system with the appropriate number of SLC's so that on any floor, the quantity of initiating devices can be increased by 25% without adding a circuit.
  - 2. Provide Class B, Style Y notification appliance circuits (NAC) for speakers and visual strobe units as follows:
    - a. Wire horns and strobes such that the horns are capable of being silenced while the strobes continue to flash. Wire speakers and strobes on separate circuits if necessary to achieve this functionality.
    - b. Dedicate each NAC to the floor it serves (except in stairwells).
    - c. Design the system so that the number of notification appliances can be increased by 25% on each floor without adding a circuit.
    - d. Provide "survivability" of circuits per NFPA 72 by protecting circuits that serve multiple evacuation signaling zones. The evacuation signaling zones match the building smoke compartment zones. Methods considered acceptable as meeting the survivability requirements include using a 2-hour rated cable or cable system or by installing circuits in a 2-hour rated chase. Circuits, or portions of circuits, that serve a single evacuation signaling zone do not have to meet this requirement.
- K. Provide secondary power supply with battery backup in accordance with NFPA 72:
  - 1. Provide sufficient capacity to operate the fire alarm system under quiescent load (system operating in nonalarm condition) for a minimum 24 hours and at the end of that period be capable of operating all alarm notification appliances for 5 minutes.

## 1.6 SUBMITTALS

- A. Manufacturers:
  - 1. Simplex.
  - 2. Edwards EST.

3. Siemens

- B. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- C. Shop Drawings: Indicate system wiring diagram showing each device and wiring connection; indicate annunciator layout, and design calculations, including battery sizing.
- D. Product Data: Submit catalog data showing electrical characteristics and connection requirements.
- E. Test Reports: Indicate procedures and results for specified field testing and inspection.
- F. Manufacturer's Field Reports: Indicate activities on site, adverse findings, and recommendations.

1.7 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of fire alarm equipment.
- C. Operation and Maintenance Data: Submit manufacturer's standard operating and maintenance instructions.

1.8 QUALITY ASSURANCE

- A. Comply with applicable sections of NFPA 72; locally enforced code requirements and NEC article 760 for equipment and installation.
- B. Provide all materials for the fire alarm systems listed as a product of a SINGLE fire alarm system manufacturer, bearing the UL label. Provide all control equipment listed under UL category UOJZ as a single control unit. Partial listing is NOT acceptable.
- C. Provide transient voltage protection for all control equipment to comply with UL 864.
- D. Perform Work in accordance with AHJ's standard.
- E. Maintain one copy of each document on site.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of project.
- B. Installer: Certified fire alarm installer with service facilities within 50 miles of Project.

1.10 MAINTENANCE SERVICE

- A. Section 01 70 00 - Execution and Closeout Requirements: Maintenance service.
- B. Furnish service and maintenance of fire alarm equipment for one year from Date of Substantial Completion.

1.11 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish three of each type of automatic smoke detector.

PART 2 - PRODUCTS

2.1 CONTROL PANEL

- A. Manufacturers:
  - 1. Simplex Model 4010.
  - 2. Edwards EST Model QS1.
  - 3. Siemens Model Firefinder XLS.
  - 4. Substitutions: Not Permitted.
- B. Product Description: Modular fire alarm control panel with surface wall-mounted enclosure.
- C. Power supply: Adequate to serve control panel modules, remote detectors, remote annunciators, relays, and alarm signaling devices. Include battery-operated emergency power supply with capacity for operating system in standby mode for 24 hours followed by alarm mode for 5 minutes.
- D. System Supervision: Component or power supply failure places system in trouble mode.
- E. Initiating Device Circuits: Supervised zone module with alarm and trouble indication; occurrence of single ground or open condition places circuit in trouble mode but does not disable circuit from initiating alarm.
- F. Indicating Appliance Circuits: Supervised signal module, sufficient for signal devices connected to system; occurrence of single ground or open condition places circuit in trouble mode but does not disable circuit from signaling alarm.
- G. Remote Station Signal Transmitter: Electrically supervised digital alarm communicator transmitter, capable of transmitting alarm and trouble signals over telephone lines to central station receiver.
- H. Auxiliary Relays: Sufficient SPDT auxiliary relay contacts for each detection zone to provide accessory functions specified.

## 2.2 MANUAL FIRE ALARM STATIONS

- A. Manual Pull Stations:
1. Double action operation.
  2. Red LEXAN or metal finished in red with molded, raised-letter operating instructions of contrasting color. Use metal pull stations where subject to damage.
  3. Station to mechanically latch upon operation and remain so until manually reset with a key common with the control units.
  4. Provide a tamperproof, clear LEXAN shield and red frame that easily fits over manual pull stations where called for on drawings. Include a battery powered piercing warning horn to activate when shield is lifted to gain access to the station. Lowering and realigning the shield will silence the horn. Provide horn with 85dB at 10 feet and 9V battery operation.

## 2.3 SPOT HEAT DETECTOR

- A. Heat detectors: intelligent (analog) and addressable, rated for 135 degrees Fahrenheit or 200 degrees Fahrenheit with a rate-of-rise element rated at 15 degrees Fahrenheit per minute. Furnish with the following:
1. Automatic reset.
  2. Ability to operating a remote alarm LED, an auxiliary relay or an audible base.
  3. Utilize 200 degree heat detectors in spaces with high ambient temperatures such as boiler rooms. Provide a remote module located where ambient temperature is lower and within recommended operating range of the addressable module.

## 2.4 CEILING SMOKE DETECTOR

- A. Smoke Detectors:
1. Photoelectric smoke detectors: intelligent (analog) and addressable, utilizing the photoelectric light-scattering principle to measure smoke density. Furnish with the following:
    - a. LED's that provide dual alarm and power indication. LED's flash green under normal conditions, indicating that the detector is operational and in regular communication with the FACP. LED's produce a steady red light when an alarm condition has been detected.
    - b. Ability to operate a remote alarm LED, an auxiliary relay or an audible base.
    - c. Magnetically actuated test switch to provide for easy alarm testing at the detector location.
    - d. Where called for on drawings, provide detector with an integral, resettable, thermistor-based, 135 degree Fahrenheit fixed-temperature heat detector.
  2. Duct mounted smoke detectors: intelligent (analog) and addressable, utilizing the photoelectric light-scattering principle to measure smoke density. Furnish with the following:
    - a. Sampling tubes of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied.

- b. Air duct housing designed for detection of smoke in HVAC ducts in accordance with NFPA 90. Provide with two test ports for measuring airflow and for testing. These ports will allow aerosol injection in order to test activation of the duct smoke detector.
- c. A supervised relay driver circuit for driving up to 15 relays with a single "Form C" contact rated at 7A @ 28 VDC or 1/2A @ 120VAC. This auxiliary relay operates when the detector reaches its alarm threshold. Mount relay within 3 feet of the HVAC control circuit.
- d. LED's that provide dual alarm and power indication. LED's flash green under normal conditions, indicating that the detector is operational and in regular communication with the FACP. LED's produce a steady red light when an alarm condition has been detected.
- e. A remote test station with an alarm LED and test switch.
- f. UV stabilized plastic weatherproof duct housing with a NEMA 4X rating for use where detectors are installed on ducts located outside on the roof or otherwise. Housing shall circulate conditioned air from duct to maintain detector housing at rated temperature range. Install duct housing per manufacturer's instructions, providing additional ventilated, sheet metal canopy where the housing is mounted in direct sunlight.

B. Mounting: 4 inch (102 mm) outlet box.

## 2.5 CIRCUIT INTERFACE MODULES

- A. Addressable Circuit Interface Modules: individually addressable, utilized to monitor and/or control system components that are not otherwise equipped for addressable communication.
  - 1. Monitor modules shall supervise and monitor the status of non-addressable devices with normally open dry contacts. Module shall communicate device status (normal, alarm, trouble) to the FACP.
  - 2. Control modules shall supervise and control the operation of auxiliary devices. Module shall provide double pole, double throw relay switching for 2 Amp @ 30 VDC resistive power limited and at 1/2 Amp @ 120 VAC resistive, non-power limited. It shall contain easily replaceable 2 Amp fuses, one on each common leg of the relay.
  - 3. Modules to be capable of mounting in a standard electric outlet box with cover plates to allow surface or flush mounting.
  - 4. Modules shall receive their operating power from the signaling line or a separate two wire pair running from and appropriate power supply as required.
  - 5. All circuit interface modules shall be supervised and uniquely identified by the control panel. Modules shall have an on board LED to provide indication that the module is powered and communicating with the FACP.
- B. Alarm Notification Appliances
  - 1. Visual Only Strobes. Provide UL 1971 listed device with the following:
    - a. Xenon flash tube and associated lens/reflector system.
    - b. Provide with different flash intensities of 15, 15/75, 30, 75 and 110 candela.
    - c. Provide a visible label inside the lens to indicate the listed candela rating.
    - d. Mount with red, impact resistant and flame retardant thermoplastic cover.
    - e. Wall or ceiling mounted as shown on drawings with the "FIRE" lettering oriented for easy reading.

2. Combination Horn/Visual Devices. Provide UL 1480 listed device with the following:
  - a. Red, impact resistant and flame retardant thermoplastic covers.
  - b. Electric horn with loud, penetrating output. Sound output @ 24 VDC equal to 85 dBA @ 10 ft. for reverberant room test and 93 dBA @ 10 ft. for anechoic chamber test.
  - c. Xenon flash tube and associated lens/reflector system with different flash intensities of 15, 15/75, 30, 75 and 110 candela. Furnish with visible label inside the lens to indicate listed candela rating.

## 2.6 REMOTE ANNUNCIATOR

- A. Remote LCD Annunciator:
  1. Primary Acknowledge, Silence, Reset Keys, Status LEDs and LCD display similar to the FACP.
  2. Minimum two lines of 40 characters each and four programmable control switches and associated LEDs.
  3. Operator keys shall be keyed switch enabled to prevent unauthorized use.
- B. Mounting: Factory mounted in flush wall-mounted enclosure.

## 2.7 WIRE AND CABLE

- A. Fire alarm circuit conductors have insulation color or code as follows:
  1. Power Branch Circuit Conductors: Black, red, white.
  2. Initiating Device Circuit: Black, red.
  3. Detector Power Supply: Violet, brown.
  4. Signal Device Circuit: Blue (positive), white (negative).
  5. Door Release: Gray, gray.
  6. Municipal Trip Circuit: Orange, orange.
  7. Municipal Fire Alarm Loop: Black, white.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify products and systems receiving devices are ready for installation.

### 3.2 INSTALLATION

- A. Install manual station with operating handle 4 feet above floor.
- B. Install 14 AWG minimum size conductors for fire alarm detection and signal circuit conductors in conduit.

- C. Mount end-of-line device in box with last device or separate box adjacent to last device in circuit.
- D. Mount outlet box for electric door holder to withstand 80 pounds (36.4 kg) pulling force.
- E. Connect conduit and wire to door release devices, sprinkler flow switches, sprinkler valve tamper switches, fire suppression system control panels, and duct smoke detectors.
- F. Automatic Detector Installation: Conform to NFPA 72.
- G. Install engraved plastic nameplates in accordance with Section 28 05 53.
- H. Ground and bond fire alarm equipment and circuits in accordance with Section 26 05 26.
- I. Provide services of a factory authorized service representative to supervise the field assembly and connection of components and the pre-testing, testing and adjustment of the system. Manufacturer's representatives to be available on a 24-hour basis within 150 miles of this project.
- J. Provide system complete, in accordance with drawings, specifications and with manufacturer's instructions, including conduit boxes, wiring and accessories.
- K. Maintain the existing system fully operational at all times while the addition to the system is being constructed.
- L. Device labeling:
  - 1. Coordinate all system programming, including device descriptors, with owner in advance. Submit final programming for approval prior to implementation.
  - 2. Label all initiating and notification appliances with 3/8" high letters.
- M. Wiring:
  - 1. Install wiring in conduit and tag wires at junction points..
  - 2. Obtain from Fire Alarm System Manufacturer written instruction regarding the appropriate wire/cable to be used for this installation. Make no deviation from the written instructions without prior written approval from the Fire Alarm System manufacturer and engineer of record.
  - 3. Color-code fire alarm conductors differently from normal building power wiring. Use one color code for alarm initiating circuit wiring and a different color code for supervisory circuits. Color code notification appliance circuits differently from alarm initiating circuits.
  - 4. Install at least 2 vertical cable risers to serve the fire alarm system. Separate risers that are in close proximity to each other, in accordance with NFPA 72, with a minimum 2-hour rated cable assembly, 2-hour rated shaft or enclosure or 2-hour rated stairwell so that the loss of one riser does not prevent the receipt or transmission of signal from other floors or zones.
  - 5. Install wiring to central station transmitter in a 1 inch conduit from FACP to the central station transmitter connection. Install the quantity of conductors and electrical supervision for connecting wiring as required to suit the central station monitoring function.



6. For each exterior circuit, in addition to the number of panel wires required, provide a green grounding conductor for operation of transient protection cube. Obtain ground at panel nearest to the point of cube application, but in no case exceed 28 feet of wire length.
  7. Provide a dedicated “life Safety” branch, 120 Volt circuit to power the FACP and DACT. Provide a red marking on the circuit breakers for these circuits and identify them as “Fire Alarm Circuit”.
- N. Provide on-premise warranty service during normal working hours at no cost for a period of twelve months from date of completion and acceptance.
- O. Smoke Detectors:
1. For addressable smoke detectors, permanently write the address in the base so that it is visible with the smoke head removed, where the address is contained in the smoke head.
  2. Mount ceiling smoke detectors no less than 3 feet from a supply, return or exhaust air diffusers, and 3 feet from electronic ballasts. Coordinate with Division 23 for diffuser locations.
- P. Duct mounted smoke detectors:
1. Provide duct smoke detectors as specified on Division 23 drawings for HVAC supply, return and exhaust fans and ducts. Refer to Division 23 drawings for location and quantities.
  2. Install duct smoke detectors in the supply air stream of an air handling unit downstream of filters and at least 6 feet from humidifier, preferably upstream.
  3. Install duct smoke detectors within 5 feet of smoke dampers where required.
  4. Install duct smoke detectors in the return air stream of an air handling unit on upstream side of outside air inlet.
  5. Furnish and connect duct detectors under this Division but install them under Division 23.
  6. Support sampling tube within the duct and extend at least  $\frac{3}{4}$  of the distance across the duct.
  7. Mount detectors the appropriate distance from ells, turns, etc. as required by the detector manufacturer.
  8. Where duct detectors are mounted above ceilings or above 6 feet in mechanical rooms, provide remote LED alarm light and test switch in ceiling close to detector to surface mounted on an adjacent wall of mechanical room.
- Q. Alarm Devices:
1. Wire flashing lights separately from audible alarms. When alarm signal is silenced, lights shall continue to flash until the condition responsible for the system alarm has been cleared and reset.
  2. Provide synchronized visual devices throughout the project.
  3. Comply with ADA regulations for mounting of strobe units. Depending upon the configuration of the strobe unit, utilize mounting requirements as follows:
    - a. Mount strobe unit 80 inches to bottom of the device faceplate, measured from the highest floor level of area served, and
    - b. Entire lens shall not be less than 80 inches or greater than 96 inches above the finished floor.

- R. System is to automatically actuate certain control functions and monitor or supervise points. Electrically supervise wiring to auxiliary fire alarm relays used to activate such functions or monitor/supervise points. Locate relays within 3 feet of the device controlled, such as a motor starter. Functions for which circuits are to be supervised include, but are not limited to, the following:
1. Shutdown of selected HVAC systems.

### 3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Provide a 10 day minimum notice in writing when the system is ready for final acceptance testing. Send notice after pre-testing has been completed to confirm that the system conforms to the drawings and specifications and malfunctioning or damaged devices have been replaced.
- C. Test completed fire alarm system in the presence of owner's representative and the AHJ. After test, certify test was completed, deficiencies were corrected and system performs as specified.
- D. Upon completion of smoke detector installations, test each detector's sensitivity and compare the installed sensitivity with that recorded at the factory when the detector was manufactured and shipped. Replace detectors that out of limits. Prepare a typewritten tabulation of these tests along with name and signature of tester. Include the following information:
1. Smoke detector descriptor.
  2. Smoke detector location in the project.
  3. Sensitivity value – field test.
  4. Sensitivity value – factory test.
  5. Within limits – “yes” or “no”.
- E. Provide the services of a factory authorized service representative to demonstrate the system and train the owner's maintenance personnel. Include procedures and schedules involved in operating, troubleshooting, servicing and preventative maintenance of the system in the training. Provide a minimum of 16 hours of training. Schedule training with the owner at least 14 days in advance.
- F. Test system in accordance with the procedures outlined in NFPA 72.
- G. Completion Documents
1. Furnish a written record of inspections, tests, and detailed test results in the form of a test log.
  2. Prepare the “Fire Alarm System Record of Completion” document per NFPA 72.
  3. Upon final acceptance furnish the following to the owner's representative:
    - a. “Record of Completion” document.
    - b. Owner's manual and installation instructions covering all system equipment.
    - c. Record drawings.

3.4 MANUFACTURER'S FIELD SERVICES

- A. Section 01 40 00 - Quality Requirements: Manufacturer's field services.
- B. Include services of certified technician to supervise installation, adjustments, final connections, and system testing.

END OF SECTION

SECTION 26 41 00 – LIGHTNING PROTECTION SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, complete installation of a complete master labeled lightning protection system, complying with NFPA 780, UL 96 and UL 96A.

1.2 RELATED WORK

- A. Section 26 05 00, Common Work Results For Electrical: General electrical requirements and items that are common to more than one section of Division 16.
- B. Section 26 05 26, Grounding: Requirements for personnel safety and to provide a low impedance path to ground for possible ground faults.

1.3 SUBMITTALS

- A. Submit in accordance with Section 26 05 00, Basic Methods and Requirements (Electrical).
- B. Shop Drawings:
  - 1. Isometric and plan views showing layout and connections to the required metal surfaces.
  - 2. Show the methods of mounting the system to the adjacent construction.
- C. Qualifications: Submit proof that the installer of the lightning protection system has had suitable and adequate experience installing other lightning protection systems, and is capable of installing the system as recommended by the manufacturer of the equipment.
- D. Certification that the lightning protection system has been inspected by a UL representative and has been approved by UL without variation.

1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. National Fire Protection Association (NFPA):

70	National Electric Code (NEC)
780	Standard for the Installation of Lightning Protection Systems

- C. Underwriters Laboratories, Inc. (UL):

90	Lightning Protection Components
96A	Installation Requirements for Lightning Protection Systems

- D. LPI Compliance: Comply with requirements of Lightning Protection Institute (LPI) Standards 175, 176, and 177, pertaining to lightning protection system material, components, installation, and testing procedures.

## 1.5 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in the manufacture of lightning protection system components of types, sizes, and ratings required; whose products have been in satisfactory use in similar service for not less than three (3) years, and who are Class I manufacturer - members of Lightning Protection Institute.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Attach master labels "A" or "B" to each item by its manufacturer as evidence that the materials have been manufactured in conformance with the UL Standards for master label lightning protection materials.
- B. In addition to conformance to UL 96, the component material requirements are as follows:
1. Conductors: Electrical grade copper.
  2. Air terminals: Solid copper, not less than 9 mm (3/8 inch) diameter, with sharp nickel-plated points.
  3. Ground rods: Copper clad steel, not less than 13 mm (1/2 inch) diameter by 2400 mm (8 feet) long..
  4. Ground plates: Solid copper, not less than 2 mm (1/16 inch) thick.
  5. Tubing: Stiff copper or brass.
- C. Anchors and fasteners: Bolt type which are most suitable for the specific anchor and fastener installations.
- D. Ground rods shall be copper clad, size as shown on drawings.
- E. See drawings for additional information and requirements.

## PART 3 - EXECUTION

### 3.1 INSTALLATION:

- A. Install the conductors as inconspicuously as practical and with the proper bends.

- B. Install the vertical conductors within the concealed cavity of exterior walls. Run the conductors to the exterior at elevations below the finished grade and make the ground connections to the earth outside of the building or stack perimeter.
- C. Make connections of dissimilar metal with bimetallic type fittings to prevent electrolytic action.
- D. Use the exothermic welding type connections that form solid metal joints in the main vertical and horizontal conductors, and for connections that are not exposed in the finish work.
- E. Protect copper conductors with stiff copper or brass tubing, which enclose the conductors from the top to the bottom of the tubing, between 300 mm (one foot) below and 2100 mm (seven feet) above the finished grade.
- F. Sheath copper conductors, which pass over cast stone, cut stone, architectural concrete and masonry surfaces, with not less than a 2 mm (1/16 inch) thickness of lead to prevent staining of the exterior finish surfaces.
- G. For the earth connections, install ground rods and ground plates, and the conductor connections to them and the main water pipes in the presence of the owner's representative. For the conductors located outside of the building or stack, install the conductors not less than 600 mm (two feet) below the finished grade.
- H. For structural steel buildings, connect the steel framework of the buildings to the main water pipe near the water system entrance to the building.
- I. Connect exterior metal surfaces, located within 900 mm (three feet) of the lightning protection system conductors, to the lightning protection system conductors to prevent flashovers.
- J. Grounding: Test the ground resistance to earth by standard methods and conform to the ground resistance requirements specified in Section, Grounding.
- K. Where shown, use the structural steel framework or reinforcing steel as the main conductor:
  - 1. Weld or bond the non-electrically-continuous sections together and make them electrically continuous.
  - 2. Verify the electrical continuity by measuring the ground resistances to earth at the ground level, at the top of the building or stack, and at intermediate points with a sensitive ohmmeter. Compare the resistance readings.
  - 3. Connect the air terminals together with an exterior conductor connected to the structural steel framework at not more than 18000 mm (60 foot) intervals.
  - 4. Install ground connections to earth at not more than 18000 mm (60 foot) intervals around the perimeter of the building.
  - 5. Weld or braze bonding plates, not less than 200 mm (eight inches) square, to cleaned sections of the steel and connect the conductors to the plates.
  - 6. Do not pierce the structural steel in any manner. Connections to the structural steel shall conform to UL Publication No. 96A.
- L. Coordinate with other work, including electrical wiring and roofing work, as necessary to interface installation of lightning protection system with other work.

- M. Install conductors with direct paths from air terminals to ground connections avoiding sharp bends and narrow loops. Install arresters as close as practical to equipment which they are to protect.
- N. When the lightning protection systems have been installed, have the systems inspected by a UL representative. Obtain and install a UL numbered master label "C" for each of the lightning protection systems at the location directed by the UL representative.
- O. Where the drawings show the new lightning protection system connected to an existing lightning protection system without a UL master label, the new portion of the lightning system still requires inspection and labels as specified above for new work.
- P. Provide equipment grounding and bonding connections, sufficiently tight to assure permanent and effective grounds and bonds, for lightning protection connection devices as indicated.

END OF SECTION

SECTION 26 43 00 – SURGE PROTECTIVE DEVICES (SPDs)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions Divisions 00 and 01 Specification sections, apply to work of this Section.
- B. The Section is Division 26 Basic Electrical Materials and Methods section, and is a part of each Division 26 section making reference to electrical surge suppression specified herein.

1.2 DESCRIPTION OF WORK

- A. The work required under this division shall include all materials, labor, and auxiliaries required to furnish and install complete surge suppression for the protection of building electrical and electronics systems from the effects of line-induced transient voltage surge and lightning discharge, as indicated on drawings or specified in this section.
- B. Types of surge suppression specified in this section include the following:
  - 1. Distribution and branch circuit panels.
  - 2. Fire alarm control panel.

1.3 QUALITY ASSURANCE

- A. All surge suppression devices shall be manufactured by a company normally engaged in the design, development, and manufacture of such devices for electrical and electronics systems equipment.
- B. The surge suppressor manufacturer shall offer technical assistance through support by a factory representative and local stocking distributor.
- C. Submittals: Surge suppression submittal shall include:
  - 1. Manufacturer's performance data on each suppressor type.
  - 2. Dimensioned drawing of each suppressor type.
- D. Equipment Certification: Items shall be listed by Underwriters' Laboratories, shall bear the UL seal, and be marked in accordance with referenced standard.
- E. Surge suppression devices shall be installed and located in accordance with requirements of all applicable National Fire Protection Association (NFPA) Codes.



1.4 WARRANTY

- A. All surge suppression devices shall be warranted to be free from defects in materials and workmanship under normal use in accordance with the instructions provided for a period of five (5) years.
- B. Any suppressor which shows evidence of failure or incorrect operating during the warranty period shall be repaired or replaced by the manufacturer and installer.

1.5 CODES AND STANDARDS

- A. The following standards and publications are referenced in various parts of this specification and shall apply:

UL 1449, 3 <sup>rd</sup> Edition	Standard for Safety, Transient Voltage Surge Suppressors.
ANSI/IEEE C62.41 (IEEE 587)	Guide for Surge Voltages in Low-Voltage AC Power Circuits.
ANSI/IEEE C62.33	Standard Test Specifications for Varistor Surge Protection Devices.
ANSI/IEEE C62.45	IEEE Guide for Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.

1.6 REQUIRED SUPPRESSORS

- A. Provide surge suppression for the equipment described herein:
  - 1. On distribution and branch circuit panels as shown in the project drawings.
  - 2. On 120 volt power connections for the fire alarm control panel.
  - 3. On all equipment identified in the project drawings.

PART 2 - PRODUCTS

2.1 SUPPRESSORS

- A. The surge suppressor manufacturer shall offer a complete line of surge suppression products to support the required suppressors listed in Part 1.
- B. The service entrance surge suppressors shall be designed with replaceable modules for purposes of in-service replacement. The unit suppressor shall be designed with redundant back-up surge protection in the event of a module failure.
- C. Module status indicators shall be provided to indicate individual module status. When a module has failed, the module LED status indicator shall indicate said failure.

- D. Unit status indicators shall be provided to indicate the status of the complete unit suppressor. The LED status indicators shall be located on the hinged front cover to redundantly indicate module or unit failure. The unit suppressor shall include alarm contacts (one N.O. and one N.C.) for remote annunciation of unit status.
- E. Suppressors shall be designed for the specific type and voltage of electrical service and shall provide clamping action for both normal (L-N) and common (L-N-G) mode protection.
- F. Service entrance suppressors shall utilize normal and common modes of protection - each phase line to neutral, each phase line to ground and neutral to ground.
- G. Distribution and branch circuit panel suppressors shall utilize protection of each phase line to ground and neutral to ground (if neutral conductor present).
- H. Suppressors shall be of a hybrid design and include circuitry with tight, wave-tracking clamping characteristics.
- I. Suppressors shall be designed to withstand a maximum continuous operating voltage of not less than 115% of nominal RMS line voltage.
- J. Suppressors shall utilize internal safety fusing or a UL/IEEE approved method to disconnect the suppressor from the electrical source if the suppressor fails. The suppressor shall be internally protected from fault current damage as a result of a suppressor failure.
- K. Each suppressor shall have an internal disconnect switch when not connected to a separate circuit breaker or fused disconnect switch which is dedicated specifically for the suppressor.
- L. Suppressors shall be failsafe, shall allow no follow-through current, shall have repeated surge capability, shall be solid state, shall be self-restoring, and shall be fully automatic.
- M. Suppressors shall be UL 1449, 3<sup>rd</sup> Edition listed and shall be approved for the location in which they are installed.
- N. Suppressors shall have an operating temperature range of -40°C to +85°C.

## 2.2 SUPPRESSOR CRITERIA

- A. Shall be equivalent to the basis-of-design shown on drawings.
- B. Alternate manufacturers: Atlantic Scientific.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF SUPPRESSORS:

- A. Suppressors shall be installed as close as practical to the electric panel or electronic equipment to be protected, consistent with available space. Suppressors shall be close nipped to the device being protected in a position near the point of connections, which will minimize lead length between the suppressor connects. Suppressor leads shall not extend beyond the suppressor manufacturer's recommended maximum lead length without specific approval of the engineer.
- B. Suppressors shall be installed in a neat, workmanlike manner. Lead dress shall be as short and as straight as possible and be consistent with recommended industry practices for the system on which these devices are installed.
- C. Supplementary grounding and bonding connections required between the bonding bus or ground plane for each equipment cluster and other locations as indicated herein shall be accomplished using #6 AWG core copper conductor and approved connections, unless otherwise noted. Referenced to a common earth ground.
- D. Suppressors shall be installed in a manner that allows simple replacement within short periods of downtime.
- E. Service entrance and panel type suppressors shall be installed with a means of disconnecting the suppressor. If no dedicated circuit breaker is included in panel, manufacturer shall provide an integral fused disconnect.
- F. The surge suppression equipment shall be UL listed and installed per the NEC and the manufacturer's specifications.

END OF SECTION

SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes interior luminaires, lamps, ballasts, and accessories.
- B. Related Sections:
  - 1. Section 26 05 26 – Grounding and Bonding For Electrical Systems.
  - 2. Section 26 05 33 – Raceways and Boxes for Electrical Systems.

1.2 REFERENCES - Latest Editions of:

- A. American National Standards Institute:

ANSI C82.1	American National Standard for Lamp Ballast-Line Frequency Fluorescent Lamp Ballast.
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- B. National Fire Protection Association (NFPA):

70	National Electrical Code (NEC)
101	Life Safety Code

- C. National Electrical Manufacturer's Association (NEMA):

C82.1	Ballasts for Fluorescent Lamps – Specifications
C82.2	Method of Measurement of Fluorescent Lamp Ballasts

- D. Underwriters Laboratories, Inc. (UL):

542	Lampholders, Starters, and Starter Holders for Fluorescent Lamps
924	Emergency Lighting and Power Equipment
935	Fluorescent-Lamp Ballasts
1598	Luminaires

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures.
- B. Shop Drawings: Indicate dimensions and components for each luminaire not standard product of manufacturer.

- C. Product Data: Submit dimensions, ratings, and performance data.
- D. Samples: When requested, submit two color chips 3 x 3 inch (75 x 75 mm) in size illustrating luminaire finish color where indicated in luminaire schedule.
- E. Product Data: Submit manufacturer's product data and installation instructions on each type building lighting fixture, lamp type and ballast.
- F. Shop Drawings: Submit fixture shop drawings in booklet form, with separate sheet for each fixture assembled in "luminaire type" alphabetical or numerical order, with proposed fixture and accessories clearly indicated on each sheet. Submit details indicating compatibility with ceiling grid system.
  - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
  - 2. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, wiring and connection diagrams, photometric data, ballasts, lenses, louvers, lamps, and controls.

#### 1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

### PART 2 - PRODUCTS

#### 2.1 INTERIOR LUMINAIRES

- A. Product Description: Complete interior luminaire assemblies, with features, options, and accessories as scheduled.
- B. Refer to Section 01 60 00 - Product Requirements for product options. Substitutions are not permitted.
- C. Shall be in accordance with NFPA 70, UL 1598 and shall be as shown on drawings and as specified.
- D. Sheet Metal:
  - 1. Shall be formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved) and parallel to each other as designed.
  - 2. Wireways and fittings shall be free of burrs and sharp edges and shall accommodate internal and branch circuit wiring without damage to the wiring.
  - 3. Where lighting fixtures are detailed with minimum 20 gauge housing, minimum 22 gauge housings will be acceptable provided they have strengthening embossed rib and break formations, which give the equivalent rigidity of a 20 gauge housing.
  - 4. When installed, any exposed fixture housing surface, trim frame, door frame and lens frame shall be free of light leaks; lens doors shall close in a light tight manner.

5. Hinged door closure frames shall operate smoothly without binding when the fixture is in the installed position, and latches shall function easily by finger action without the use of tools.
- E. Ballasts shall be serviceable while the fixture is in its normally installed position, and shall not be mounted to removable reflectors or wireway covers unless so specified.
- F. Lamp Sockets:
  1. Fluorescent: Lampholder contacts shall be the biting edge type or phosphorous-bronze with silver flash contact surface type and shall conform to the applicable requirements of UL 542. Contacts for recessed double contact Lampholders and for slimline Lampholders shall be silver plated. Lampholders for bi-pin lamps, with the exception of those for "U" type lamps, shall be of the telescoping compression type, or of the single slot entry type requiring a one-quarter turn of the lamp after insertion.
- G. Fluorescent fixtures with louvers or light transmitting panels shall have hinges, latches and safety catches to facilitate safe, convenient cleaning and relamping. Vapor tight fixtures shall have pressure clamping devices in lieu of the latches.
- H. Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive hinges or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.
- I. Metal Finishes:
  1. The manufacturer shall apply his standard finish (unless otherwise specified) over a corrosion resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface (s). Fixture finish shall be free of stains or evidence of rusting, blistering, or flaking. All metal parts shall be painted after fabrication.
  2. Interior light reflecting finishes shall be white with not less than 85 percent reflectance, except where otherwise shown on the drawing.
  3. Exterior finishes shall be as shown on the drawings.
- J. Provide all lighting fixtures with a specific means for grounding their metallic wireways and housings to an equipment grounding conductor.
- K. Light Transmitting Components for Fluorescent Fixtures:
  1. Lenses: Plastic lenses where specified for enclosed fluorescent lighting fixtures shall be acrylic and have minimum overall thickness including prism of 0.125 inches.
  2. Unless otherwise specified, lenses, diffusers and louvers shall be retained firmly in a metal frame by clips or clamping ring in such a manner as to allow expansion and contraction of the lens without distortion or cracking.
- L. Compact fluorescent fixtures shall be manufactured specifically for compact fluorescent lamps with ballasts integral to the fixture. Assemblies designed to retrofit incandescent fixtures are prohibited except when specifically indicated for renovation of existing fixtures. Fixtures shall be designed for lamps as specified.

## 2.2 FLUORESCENT BALLASTS

- A. Ballasts (Electronic):
1. Ballasts for fluorescent lamps shall be high frequency electronic for use with Octic type (265mA) lamps. The total harmonic distortion (%THD) shall be less than 10%. The power factor shall be .95 or higher.
  2. Non-dimming electronic ballasts for fluorescent lamps shall be General Electric (Magnetek), Osram Sylvania Quicktronic, Advance or Motorola.
  3. All ballasts shall be individually fused on the line side of the ballast.
  4. All ballasts shall bear the ETL/CBM and UL labels.
  5. Shop drawings shall be submitted for ballast types.
  6. Instant start ballast shall be used with non-occupancy sensor controlled luminaries; programmed rapid start ballast shall be used for occupancy sensor controlled luminaries.

## 2.3 FLUORESCENT DIMMING BALLASTS AND CONTROLS

- A. Product Description: Electrical assembly of control unit and ballast to furnish smooth dimming of fluorescent lamps.

## 2.4 LAMPS

- A. Manufacturers:
1. Sylvania.
  2. Phillips.
  3. G.E.
  4. Substitutions: Not Permitted.
- B. Lamps: Fluorescent lamps shall be rapid start with a minimum 85 CRI, 4100K, unless otherwise noted on drawings, all lamps shall be 'TCLP' compliant as manufactured by General Electric, Sylvania or Phillips. T-8, U-shaped lamps shall have 6" spacing between ends. Shop drawings shall be submitted for all lamp types.
- C. LED: Minimum 50,000 hour expected life, minimum CRI 85, 4000K temperature.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Installation shall be in accordance with NEC
- B. Install suspended luminaires using pendants supported from swivel hangers. Install pendant length required to suspend luminaire at indicated height.
- C. Support luminaires 2 x 4 foot size and larger independent of ceiling framing.
- D. Locate recessed ceiling luminaires as indicated on Drawings.

- E. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- F. Install recessed luminaires to permit removal from below.
- G. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- H. Install wall-mounted luminaires at height as indicated on Drawings.
- I. Install accessories furnished with each luminaire.
- J. Connect luminaires to branch circuit outlets provided under Section 26 05 33 using flexible conduit.
- K. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- L. Install specified lamps in each luminaire.
- M. Ground and bond interior luminaires in accordance with Section 26 05 26.
- N. Examination: Examine areas and conditions under which lighting fixtures are to be installed and substrate for supporting lighting fixtures, including architectural elevations and sections. Notify owner in writing of condition detrimental to installation of fixtures or completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to installer.
- O. Align, mount and level the lighting fixtures uniformly.
- P. Provide fixtures and/or fixture outlet boxes with hangers to properly support fixture weight. Submit design of hangers, method of fastening, other than indicated or specified herein, for review by owner.
- Q. Install flush-mounted fixtures properly to eliminate light leakage between fixture frame and finished surface.
- R. Provide plaster frames for recessed fixtures installed in other than suspended grid type acoustical ceiling systems. Brace frames temporarily to prevent distortion during handling.
- S. Fasten fixtures securely to indicate structural supports and ensure that pendant fixtures are plumb and level.
- T. Recessed fixtures shall be centered in the ceiling tile, structural pan, or other visually controlling feature, unless otherwise noted on drawings. Fixtures installed in sloped ceilings shall be furnished with manufacturer's standard adapters for mounting lamps vertical to floor. Verify architectural drawings for applicable notes and details.
- U. Lay-in fixtures shall have T-bar clips installed.



- V. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors.
- W. Support surface mounted fixtures greater than two feet (2') in length at a point in addition to the outlet box fixture stud.
- X. Avoid interference with and provide clearance for equipment. Where the indicated locations for the lighting fixtures conflict with the locations for equipment, change the locations for the lighting fixtures by the minimum distances necessary as approved by the owner.
- Y. For suspended lighting fixtures, the mounting heights shall provide the clearances between the bottoms of the fixtures and the finished floors as shown on the drawings.
- Z. Lighting Fixture Supports:
  - 1. Shall provide support for all of the fixtures. Supports may be anchored to channels of the ceiling construction, to the structural slab or to structural members within a partition, or above a suspended ceiling.
  - 2. Shall maintain the fixture positions after cleaning and relamping.
  - 3. Shall support the lighting fixtures without causing the ceiling or partition to deflect.
  - 4. Hardware for recessed fluorescent fixtures:
    - a. Where the suspended ceiling system is supported at the four corners of the fixture opening, hardware devices shall clamp the fixture to the ceiling system structural members, or plaster frame at not less than four points in such a manner as to resist spreading of the support members and safely lock the fixture into the ceiling system.
    - b. Where the suspended ceiling system is not supported at the four corners of the fixture opening, hardware devices shall independently support the fixture from the building structure at four points.
  - 5. Hardware for surface mounting fluorescent fixtures to suspended ceilings:
    - a. In addition to being secured to any required outlet box, fixtures shall be bolted to a grid ceiling system at four points spaced near the corners of each fixture. The bolts shall be not less than 6 mm (1/4 inch) secured to channel members attached to and spanning the tops of the ceiling structural grid members. Non-turning studs may be attached to the ceiling structural grid members or spanning channels by special clips designed for the purpose, provided they lock into place and require simple tools for removal.
    - b. In addition to being secured to any required outlet box, fixtures shall be bolted to a plaster ceiling at four points spaced near the corners of each fixture. Pre-positioned 6 mm (1/4 inch) studs or threaded plaster inserts secured to ceiling structural members shall be used to bolt the fixtures to the ceiling. In lieu of the above, 6 mm (1/4 inch) toggle bolts may be used on new or existing ceiling provided the plaster and lath can safely support the fixtures without sagging or cracking.
- AA. Furnish and install the specified lamps for all lighting fixtures installed and all existing lighting fixtures reinstalled under this project.
- BB. Coordinate between the electrical and ceiling trades to ascertain that approved lighting fixtures are furnished in the proper sizes and installed with the proper devices (hangers, clips, trim frames, flanges), to match the ceiling system being installed.

- CC. At completion of project, relamp all fixtures which have failed/burned-out lamps. Clean all fixtures, lenses, diffusers and louvers that have accumulated dust/dirt during construction.
- DD. Protect installed fixtures for damage during remainder of construction period.

### 3.2 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

### 3.3 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Aim and adjust luminaires as directed by owner/architect/engineer.

### 3.4 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements. Remove dirt and debris from enclosures.
- B. Clean photometric control surfaces as recommended by manufacturer.
- C. Clean finishes and touch up damage.

### 3.5 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 - Execution and Closeout Requirements. Relamp luminaires having failed lamps at Substantial Completion.

END OF SECTION

## SECTION 31 09 19 – AUGER PILE LOAD TESTS

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Pile load testing.
  - 2. Documented test results.
- B. Related Sections:
  - 1. Section 31 23 16 - Excavation: Excavating to working and test equipment level.
  - 2. Section 31 63 16 - Auger Cast Grout Piles.

#### 1.2 REFERENCES

- A. ASTM International:
  - 1. ASTM D1143 - Standard Test Method for Piles Under Static Axial Compressive Load.
  - 2. ASTM D3689 - Standard Test Methods for Deep Foundations Under Static Axial Tensile Load.
  - 3. ASTM D3966 - Standard Test Method of Testing Piles under Lateral Loads.

#### 1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate test method and equipment, load type, calibration equipment.

#### 1.4 QUALITY ASSURANCE

- A. Tierra South Florida, Inc. is the Geotechnical Engineer for the project and will inspect the pile load tests.
- B. Perform Work in accordance with the following:
  - 1. Compressive Load Tests: ASTM D1143.
  - 2. Uplift Load Tests: ASTM D3689.
  - 3. Lateral load test: ASTM D3966.

### PART 2 PRODUCTS

#### 2.1 MATERIAL

- A. Reinforcement: Specified in Section 03 20 00; spiral wound.

- B. Portland cement, aggregates, admixtures: Specified in Section 03 00 00.

## 2.2 GROUT

- A. The grout used shall consist of a mixture of Portland Cement, fluidifier, retarder, fine aggregate and water so proportioned and mixed as to produce a grout mix capable of being pumped. The auger cast pile grout for the 16-inch diameter, 18-inch diameter, and 24-inch diameter piles shall have a minimum 28-day compressive strength of 4,000 lbs/in<sup>2</sup>, 6,500 lbs/in<sup>2</sup>, and 5,500 lbs/in<sup>2</sup>, respectively. Mixing time after adding the fluidifier at the site shall be no less than 3 minutes. The grout shall be mixed in accordance with the applicable requirements of ASTM C94.
- B. During hot weather or under conditions contributing to rapid setting of grout, a shorter mixing time than specified in ASTM C94 may be required. If agitated continuously, the grout may be held in the mixer or agitator for a period not exceeding two and one-half hours at grout temperatures below 70 degrees F and for a period not exceeding two hours at temperatures not exceeding 90 degrees F. Grout temperatures above 90 degrees F may be held in the mixer for a maximum of 90 minutes. Grout shall not be placed when its temperature exceeds 100 degrees F. If the pre-approved maximum limits are in excess of the aforementioned limits, the grout supplier shall provide adequate documentation that the grout does not become detrimentally affected beyond this general local industry accepted standard limits. The Contractor shall coordinate his grout delivery to meet the above requirement and to assure continuity of the work.
- C. The Contractor shall not add water to the grout batch unless authorized and supervised by a qualified technical representative from the grout supplier.
- D. The grout shall be sampled and tested by the Testing Laboratory retained by the Owner. During test pile installation, sampling and casting of a set of six 6-inch cylinders shall be made from each truck of grout delivered to the site. During the production pile installation, grout samples shall be taken for every 50 yd<sup>3</sup> of grout delivered to the site.
- E. For each set, one cylinder shall be tested at 7 days, two at 14 days, and two at 28 days. One cylinder shall be kept as a reserve in case of low grout strength results. If the 28-day cylinder breaks at strength greater than or equal to the required, then the last cylinder shall also be tested at 28 days. If not, the last cylinder shall be tested at 56 days.
- F. Grout cubes shall be made and tested in accordance with ASTM C31, C109 and C469. The test results shall be submitted to the Owner, the Structural Engineer, the Geotechnical Engineer, and the Piling Contractor for review within 3 days of completion of the testing.

## 2.3 EQUIPMENT

- A. The grout pump shall be a positive displacement piston pump capable of developing sufficient displacement pressures to assure the continuous and complete filling of the augered pile shafts. Before any pile installation work is done, the Contractor shall field-calibrate the pump discharge capacity in strokes per cubic foot utilizing the pre-approved electronic control system. In addition, the pump discharge capacity shall also be calibrated by measuring the required number of pump strokes to fill a known volume container. All field calibration procedures are subject to the approval of the Geotechnical Engineer.
- B. The equipment shall be capable of advancing and withdrawing the auger in a slow and steady continuous motion, and shall have sufficient torque and weight to advance the auger to the required depths specified herein.
- C. The auger shall have continuous flights that are uniform 16-inch diameter for the 16-inch diameter pile, 18-inch-diameter for the 18-inch diameter pile, and 24-inch-diameter for the 24-inch-diameter pile, throughout its length with no reduction or sweep at any point along the length. The auger shall have a 3-inch minimum I.D, hollow stem to facilitate grout injection. The 16-inch diameter auger shall be capable of installing up to 45-ft-long piles, and the 18-inch-diameter and 24-inch-diameter auger shall be capable of installing up to 95-ft-long piles.
- D. The piling leads shall be clearly marked at all times in at least two locations specified by the Geotechnical Engineer in foot increments, and numbered at 5 foot intervals, such that the Geotechnical Engineer can easily infer the pile tip depth or elevation. The auger shall contain a middle guide.
- E. The same augering rig shall be used for test pile and production pile installation.
- F. Substitution of material and equipment shall be made only with the Geotechnical and Structural Engineer's approval.
- G. Quantity: Provide one test crib for pile load testing.

## PART 3 EXECUTION

### 3.1 TEST PILE INSTALLATION

- A. The test pile program shall consist of installing the 16-inch-diameter compression, 18-inch-diameter compression, and 24-inch-diameter compression, and lateral test piles, and associated reaction piles at locations designated by the Geotechnical Engineer after discussions with the Owner, the Structural Engineer, and the Contractor. Deviations of the reaction piles from the designated locations are allowed based on the Contractor's discretion and after approval by the Geotechnical Engineer. The layout and location of the test piles shall be further discussed with the Owner, the Structural Engineer, and the Contractor. At this time it is anticipated that the 24-inch-diameter lateral test pile will be installed to a depth of 40 feet below existing grade.

### 3.2 LOAD TEST

- A. A total of four (4) load tests shall be performed. One (1) 16-inch-diameter test pile shall be load tested in compression, one (1) 18-inch-diameter pile shall be load tested in compression, one (1) 24-inch-diameter test pile shall be load tested in compression, and one (1) 24-inch-diameter test pile shall be laterally load tested. Load tests shall be performed as follows:
1. The load tests shall be performed by the Contractor, and will be monitored by the Geotechnical Engineer with the assistance of the full-time experienced personnel and equipment provided by the Contractor.
  2. The compression load test shall be performed in accordance with ASTM D1143. The 16-inch-diameter pile shall be load tested to at least 150 tons in compression under standard loading procedure. The 18-inch-diameter pile shall be load tested to at least 480 tons in compression under standard loading procedure. The 24-inch-diameter pile shall be load tested to at least 800 tons in compression under standard loading procedure.
  3. The lateral load tests shall be performed in general accordance with ASTM D 3966 "Standard Method of Testing Piles under Lateral Loads." The loading schedule shall be the standard cyclic loading as shown in paragraph 6.3 of ASTM D 3966. The maximum lateral test load shall be 40 tons. However, the Contractor shall provide a jack capable of applying a load of 50 tons. A calibrated load Cell or a gauge calibrated and graduated to clearly define the loads being applied shall be used after approval by the Geotechnical Engineer. The piles shall be instrumented with dial gauges to clearly determine the lateral movement of the pile butt and the rotation of the butt of the pile as described in section 5.3 of the above mentioned ASTM standard. The load shall be applied by utilizing a pile/piles as shown in section 2, figure 2 of the above mentioned ASTM standard or other pre-approved system as a reaction. Both the test pile and the reaction pile/piles shall be instrumented and monitored during testing. The Contractor shall excavate a pit around the test and reaction piles to allow test load application at about 6 feet below existing ground surface, as directed by the Geotechnical Engineer. Depending on the results of the load test, the Geotechnical Engineer may direct the Contractor to perform additional loading cycles to higher load levels.
  4. Test loads shall not be applied to the test piles until the pile grout has attained sufficient strength, as determined by the Structural and Geotechnical Engineers, based on their review of the grout strength test results.
  5. Gauges accurate and readable to 0.001 inch shall be provided to determine the amount of movement during testing. An independent and stable reference frame shall be provided.
- B. All reaction systems for all load tests shall be designed by the Contractor. Reaction piles shall be installed to sufficient depths and shall have proper reinforcement or anchors to provide sustained sufficient resistance during pile load testing and to permit proper load transfer without loss of support or excessive deflection. Reaction piles, mats, stands, or any other necessary means of support shall be provided to provide the necessary reaction to perform the compression, tension, and lateral load tests.
- C. Strain gauges shall be installed in the test piles as specified herein.

1. The strain gauges installed within the test piles shall be vibrating wire sister bar gauges, Model 4911-4 as manufactured by Geokon, Inc. Each strain gauge shall be installed onto the reinforcement cage as recommended by the manufacturer. The strain gauge wires shall be securely attached to the reinforcing cage to prevent movement and damage during installation.
  2. Nine pairs of sister bar gauges shall be used in the 24-inch-diameter, and 18-inch-diameter compression test piles as designated by the Geotechnical Engineer. Five sister bar gauges shall be used in the 16-inch-diameter compression test pile. The working condition of the strain gauges shall be verified at the site prior to insertion into the grouted shaft.
  3. The Contractor shall provide a portable vibrating wire readout box, model GK-403 as manufactured by Geokon, Inc. for the Geotechnical Engineer to monitor the strain gauges. The Contractor shall be responsible for keeping the readout box in working order at all times. The Contractor shall also provide at least three dial gauges, a scale, and wireline for each test pile, and their locations shall be approved by the Engineer.
- D. The Contractor shall be responsible for any instrumentation damage, and for any necessary corrective measures, including, if necessary replacement test piles and instrumentation.

### 3.3 POST INSTALLATION

- A. Installed piles shall be periodically checked by the Contractor to determine if the grout in the piles has settled. If the grout level drops more than about 1 ft, the top of the pile shall be purged and fresh grout shall be added to the top of the pile prior to the grout reaching its initial set so as to maintain the proper elevation. At no time shall the Contractor allow the grout to settle below the cutoff elevation.
- B. Accepted piles shall be cut-off no earlier than 7 days after installation, unless otherwise approved by the Structural Engineer.
- C. Any damage to the pile during excavation or pile cutting shall be the responsibility of the Contractor unless otherwise indicated by the Owner. If the Structural Engineer determines that a damaged pile can be repaired, the Contractor shall do so at his own expense and in accordance with the Structural Engineer's recommendations. If replacement piles are required as determined by the Structural Engineer, the Contractor shall install the replacement piles at no additional cost to the Owner.
- D. The Contractor shall remove all materials excavated by augering and any excess grout from within the foundation area and dispose of the materials as directed by the Construction Manager or Owner.
- E. The Contractor shall not demobilize his equipment from the project site until all piles necessary for the testing phase are installed and accepted by the Geotechnical Engineer and Structural Engineer or until directed to do so by the General Contractor or Owner. During the production phase, again the Contractor shall not demobilize his equipment from the project site until all piles are installed and accepted.

### 3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspecting, and testing.
- B. Tierra South Florida, Inc. will be engaged to observe and document test method and results.
- C. Document test equipment used, method of calibration and recording, test results, recommendations or modification of piling method used.
- D. Accurately record actual dimensions and locations of tested piles and movement or distortion caused by testing.

3.5 EQUIPMENT REMOVAL

- A. Remove test and temporary load equipment from site.

END OF SECTION



## SECTION 31 10 00 - SITE CLEARING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Removing above- and below-grade site improvements.
2. Disconnecting, capping or sealing, and removing or abandoning site utilities in place.
3. Temporary erosion- and sedimentation-control measures.

- B. Related Sections: (See Applicable Sections)

- C. Work Included:

1. Provide all labor, materials, necessary equipment and services to complete the clearing work, as indicated on the drawings, as specified herein or both, except as for items specifically indicated as "By Other Contractor" for Berth 30 Extension.
2. Under this section, the Contractor shall do all clearing, relocation of storage containers, and necessary clean-up operations in connection with the construction of the work and its related sitework.
3. The work shall consist of the removal and disposal of chain link fences, existing foundation, pavement, etc. from all project areas as designated on the drawings as specified herein, and as directed by the Engineer on the site. Fencing and walls removed shall be neatly placed on adjacent property if requested by County or property owner. Otherwise, the Contractor shall dispose of them offsite.
4. The Contractor shall remove all refuse, asphalt pavement, concrete pavement, and any and all trash found in clearing and adjacent areas as directed by the Engineer.
5. The Contractor shall furnish all services, labor, transportation, materials, and equipment necessary for the performance of these operations. All clearing and cleanup operations shall be accomplished to the complete satisfaction of the Engineer.

#### 1.3 DEFINITIONS

- A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

- B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow.

#### 1.4 MATERIAL OWNERSHIP

- A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Existing Conditions: Documentation of existing site conditions, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
  - 1. Use sufficiently detailed photographs or videotape.
  - 2. Include plans and notations to indicate specific damage conditions of each area designated to remain.
- B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

#### 1.6 QUALITY ASSURANCE

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.7 PROJECT CONDITIONS

- A. Traffic: Minimize interference with terminal traffic, adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
  - 1. Do not close or obstruct terminal traffic, streets, walks, or other adjacent occupied or used facilities without permission from the Owner and authorities having jurisdiction.
  - 2. Provide alternate routes around closed or obstructed traffic ways if required by the Owner or authorities having jurisdiction.
- B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- C. Utility Locator Service: Notify utility locator service for area where Project is located prior to site clearing.

- D. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place.
- E. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.
- F. Contractor shall verify existing grades prior to performing work under this section. If existing grades are at variance with the drawings, notify the Owner and receive instructions prior to proceeding. No additional compensation will be considered resulting from grade variances once site clearing has commenced.
- G. All benchmarks and monuments shall be protected during construction. If disturbed or destroyed, they shall be replaced in original position by a licensed surveyor at the Contractor's expense.
- H. Protect areas outside limits of disturbance from encroachment by construction personnel or equipment, regardless of property Ownership. Access shall be by specific, written permission or easement only.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."
  - 1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.
- B. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer complying with MPI #79, Alkyd Anticorrosive Metal Primer.
  - 1. Use coating with a VOC content of 420 g/L (3.5 lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Protect existing site improvements to remain from damage during construction.
  - 1. Restore damaged improvements to their original condition, as acceptable to the Owner.
- C. Limit of clearing is to be staked in accordance with Section 017123, Field Engineering, and verified by the Owner prior to removal of any trees.

### 3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

### 3.3 EXISTING UTILITIES

- A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.
  - 1. Verify that utilities have been disconnected and capped before proceeding with site clearing.
- B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
  - 1. Arrange with utility companies to shut off indicated utilities.
  - 2. Owner will arrange to shut off indicated utilities when requested by Contractor.
- C. Locate, identify, and disconnect utilities indicated to be abandoned in place.
- D. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify Engineer not less than two days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without Engineer's written permission.
- E. Excavate for and remove underground utilities indicated to be removed.
- F. Removal of underground utilities is included in earthwork sections and with applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security and utilities sections and Section 024119 "Selective Demolition."

### 3.4 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated on drawings and necessary to facilitate new construction.

- B. Remove slabs, paving, existing crane girder footing, curbs, gutters, and aggregate base as indicated.
  - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement and existing crane girder footing to remain before removing adjacent existing pavement and concrete. Saw-cut faces vertically.
  - 2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

### 3.5 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION

## SECTION 31 20 00 - EARTH MOVING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

##### A. Section Includes:

1. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses and plants.
2. Excavating and backfilling for buildings, structures, and crane girders.
3. Drainage course for concrete slabs-on-grade.
4. Subbase course for concrete walks and pavements.
5. Subbase course and base course for asphalt paving.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling trenches for utilities and pits for buried utility structures.

##### B. Related Sections: (see applicable sections)

#### 1.3 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
  1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
  2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.
- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices or changes in the Work.
  2. Bulk Excavation: Excavation more than 10 feet (3 m) in width and more than 30 feet (9 m) in length.
  3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 2 cu. yd. for bulk excavation or 2 cu. yd. for footing, trench, and pit excavation that exceed a standard penetration resistance of 30 blows per foot when tested by a geotechnical testing agency, according to ASTM D 1586 and exceeding 1000 psi from an Unconfined Compression Strength Test (ASTM D-2938) and that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,700 lbf and stick-crowd force of not less than 18,400 lbf with extra-long reach boom; measured according to SAE J-1179.
  2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp flywheel power and developing a minimum of 47,992-lbf breakout force with a general-purpose bare bucket; measured according to SAE J-732.
- I. Structures: Buildings, crane girders, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- J. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

#### 1.4 WORK INCLUDED

- A. Provide all labor, materials, necessary equipment and services to complete the Earthwork, as indicated on the drawings, as specified herein or both, except as for items specifically indicated as "By other contractor" at Berth 30 Extension.
- B. Including but not necessarily limited to the following:
  - 1. Excavation, including demucking.
  - 2. Backfilling.
  - 3. Filling.
  - 4. Grading, general site and building pads.
  - 5. Compaction.
  - 6. Coordination with Engineer for offsite disposal of all excess materials and stock piling of suitable materials to be used as fill or backfill.
- C. Cutting, proofrolling, filling and grading to required lines, dimensions, contours and elevations for proposed improvements as shown and implied on the drawings and required by these specifications.
- D. Scarifying, compaction, moisture content conditioning and control, and removal of unsuitable material to ensure proper preparation of areas for the proposed improvements.
- E. Undertake any special construction procedures for the site recommended in the geotechnical report for preparation of building and pavement areas.
- F. There shall be no classification of excavation for measurement of payment regardless of materials encountered.
- G. The work of this Section includes all earthwork required for construction of the Work. Such earthwork shall include, but not be limited to, the loosening, removing, loading, transporting, depositing, and compacting in its final location of all materials wet and dry, as required for the purposes of completing the work specified in the Contract Documents, which shall include, but not be limited to, the furnishing, placing, and removing of sheeting and bracing necessary to safely support the sides of all excavation; all pumping, ditching, draining, and other required measures for the removal or exclusion of water from the excavation; the supporting of structures above and below the ground; all backfilling around structures and all backfilling of trenches and pits; the disposal of excess excavated materials; borrow of materials to makeup deficiencies for fills; and all other incidental earthwork, all in accordance with the requirement of the Contract Documents.

#### 1.5 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Codes: All codes, as referenced herein, "Reference Standards."



B. American Society for Testing and Materials (ASTM) – latest edition

ASTM D 422 - Method for Particle-Size Analysis of Soils.

ASTM D 698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-lb (2.49-kg) Rammer and 12-in (304.8-mm) Drop.

ASTM D 1556 - Test Method for Density of Soil in Place by the Sand Cone Method.

ASTM D 1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in (457-mm) Drop.

ASTM D 1633 - Test Method for Compressive Strength of Molded Soil-Cement Cylinders.

ASTM D 2216 - Laboratory Determination of Moisture content of Soil.

ASTM D 2419 - Test Method for Sand Equivalent Value of Soils and Fine Aggregate.

ASTM D 2487 - Classification of Soils for Engineering Purposes.

ASTM D 2901 - Test Method for Cement Content of Freshly-Mixed Soil-Cement.

ASTM D 2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

ASTM D 3017 - Test for Water Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

ASTM D 4253 - Test Methods for Maximum Index Density of Soils Using a Vibratory Table.

ASTM D 4254 - Test Methods for Minimum Index Density of Soils and Calculation of Relative Density.

ASTM D 4318 - Test for Plastic Limit, Liquid Limit, and Plasticity Index of Soils.

ASTM D 4429 - Standard Test Method for CBR (California Bearing Ratio) of Soils in Place.

C. American Association of State Highway and Transportation Officials (AASHTO) - latest edition

1. T 88 Particle Size Analysis of Soils.

1.6 SITE INSPECTION

A. The Contractor shall visit the site and acquaint himself with all existing conditions. Make his own subsurface investigation to satisfy himself as to site and subsurface conditions, but such subsurface investigations shall be performed only under time schedules and arrangements approved in advance by the Owner and Engineer.

1.7 TOPOGRAPHIC INFORMATION

- A. The existing grades shown on the drawings are approximate only and no representation is made as to their accuracy or consistency. The Contractor shall verify all existing grades to the extent necessary to insure completion of the job to the proposed grades indicated on the drawings.

#### 1.8 DISPOSAL OF SURPLUS OR UNSUITABLE MATERIAL

- A. Unsuitable material encountered during the course of construction shall be removed from the construction site at the expense of the Contractor. Unsuitable material shall not be stockpiled on-site. All suitable material shall be stockpiled at areas approved by the Engineer.

#### 1.9 BENCH MARKS AND MONUMENTS

- A. Contractor shall employ a registered Professional Surveyor and Mapper to lay out lines and grades as indicated. Benchmarks shall be established by a Professional Surveyor and Mapper registered in the State of Florida. Benchmarks shall be permanent and easily accessible and maintained and replaced if disturbed or destroyed. All benchmarks shall be North American Vertical Datum of 1988 (NAVD).

#### 1.10 UTILITIES

- A. Before starting site operations, disconnect or arrange for the disconnection of all utility services designated to be removed.
- B. Locate all existing active utility lines traversing the site and determine the requirements for their protection. Preserve in operating condition all active utilities adjacent to or traversing the site and/or designated to remain.
- C. Observe rules and regulations governing respective utilities in working under requirements of this section. Adequately protect utilities from damage, remove or replace as indicated, specified or required. Remove, plug or cap inactive or abandoned utilities encountered in excavation. Record location of all utilities.

#### 1.11 SUBMITTALS

- A. Within 10 days after award of the contract, the Contractor shall submit to the Owner, with his bid package, a schedule detailing the sequence, and time of completion of all phases of work under this section.
- B. At least 2 weeks in advance of imported fill use, the Contractor shall submit the following laboratory test data to the Engineer for each type of imported soil/gravel material to be used as compacted fill.
  - 1. Moisture and Density Relationship: ASTM D1557 or D698 as required by project geotechnical engineering study.
  - 2. Mechanical Analysis: AASHTO T-88.
  - 3. Plasticity Index: ASTM D 4318.

- C. Together with the above test data, the Contractor shall submit a 5 pound sample of each type of off-site fill material in an air tight container for the approval of the Engineer and the Owner.
- D. Submit the name of each material supplier and specific type and source of each material. Any change in source or soil type throughout the job requires approval of the Owner and the Engineer.

#### 1.12 QUALITY ASSURANCE

- A. A geotechnical engineer may be retained by the Owner to observe performance of work in connection with excavating, filling, grading, and compaction. This inspection will not relieve the Contractor from his responsibility to complete the work in accordance with the drawings and specifications. The Contractor shall re-adjust all work performed that does not meet technical or design requirements but make no deviations from the Contract documents without specific and written acceptance of the Engineer.
- B. Visual field confirmation and density testing of subgrade preparation and fill placement procedures shall be performed by the field geotechnical engineer as part of the construction testing requirements. The Contractor shall be informed as soon as possible of the test results.
- C. The Engineer shall prepare field reports that indicate compaction test location, elevation data, testing results and acceptability. The Owner and Contractor shall be provided with written copies of the results within 24 hours of time test was performed.
- D. All costs related to reinspection, due to failures, shall be paid for by the Contractor at no additional expense to the Owner. The Owner reserves the right to direct any inspection that is deemed necessary. Contractor shall provide free access to site for inspection activities.
- E. Where soil material is required to be compacted to a percentage of maximum density, the maximum density at optimum moisture content will be determined in accordance with ASTM D 1557. Where cohesionless, free draining soil material is required to be compacted to a percentage of relative density, the calculation of relative density will be determined in accordance with ASTM D 4253 and D 4254. Field density in-place tests will be performed in accordance with ASTM D 1556, ASTM D 2922, or by such other means acceptable to the Engineer.
- F. In case the tests of the fill or backfill show non-compliance with the required density, the Contractor shall accomplish such remedy as may be required to insure compliance. Subsequent testing to show compliance shall be by a testing laboratory selected by the Owner and shall be at the Contractor's expense.
- G. Particle size analysis of soils and aggregates will be performed using ASTM D 422.
- H. Determination of sand equivalent value will be performed using ASTM D 2419.
- I. Unified Soil Classification System: References in these specifications are to soil classification types and standards set forth in ASTM D 2487. The Contractor shall be bound by all applicable provisions of said ASTM D 2487 in the interpretation of soil classifications.
- J. Comply with requirements of all applicable building codes and other public agencies having jurisdiction upon the Work.

### 1.13 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.
  - 1. Do not close or obstruct terminal lanes, streets, walks, or other adjacent occupied or used facilities without permission from the Owner and authorities having jurisdiction.
  - 2. Provide alternate routes around closed or obstructed traffic ways if required by the Owner or authorities having jurisdiction.
- B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining the Owner's property will be obtained by the Owner before award of Contract.
  - 1. Do not proceed with work on adjoining property until directed by Engineer.
- C. Utility Locator Service: Notify "One Call" for area where Project is located before beginning earth moving operations.
- D. Do not commence earth moving operations until temporary erosion and sedimentation control measures, specified in Section 015000 "Temporary Facilities and Controls," are in place.

### PART 2 - PRODUCTS

#### 2.1 SUITABLE FILL AND BACKFILL MATERIAL REQUIREMENTS

- A. General: Fill, backfill, and embankment materials shall be suitable selected or processed clean, fine earth, rock, or sand, free from grass, roots, brush, or other vegetation.
- B. Fill and backfill materials to be placed within 6 inches of any structure or pipe shall be free of rocks or unbroken masses of earth materials having a maximum dimension larger than 3 inches.
- C. Suitable Materials: Soils not classified as unsuitable as defined in Paragraph entitled, "Unsuitable Material" herein, are defined as suitable materials and may be used in fills, backfilling, and embankment construction subject to the specified limitations. In addition, when acceptable to the Engineer, some of the material listed as unsuitable may be used when thoroughly mixed with suitable material to form a stable composite.
- D. Suitable materials may be obtained from on-site excavations, may be processed on-site materials, or may be imported. If imported materials are required to meet the requirements of this Section or to meet the quantity requirements of the project the Contractor shall provide the imported materials at no additional expense to the Owner, unless a unit price item is included for imported materials in the bidding schedule.
- E. On-site fill
  - 1. On-site materials for use as fill shall consist of excavated soil from other portions of the site.

2. The Contractor shall use the on-site soil judiciously to facilitate the construction schedule including the use of the most readily compactable soil for fill in building areas and as fill within 2 feet of pavement subgrade.
3. Topsoil shall not be utilized as engineered fill.
4. Excavated material containing rock, stone or masonry debris smaller than 2 feet in its largest dimension, may be mixed with suitable material and utilized up to 3 feet below proposed subgrade.
5. Excavated material containing rock, stone or masonry debris smaller than 6 inches in its largest dimension may be mixed with suitable material and utilized up to 18 inches below proposed subgrade.
6. No material greater than 2 inches in its largest dimension may be utilized within 18 inches of proposed subgrade.
7. No material greater than 2 inches in its largest dimension may be utilized as backfill for storm drainage or utility trenches.
8. Prior to placement, on-site material to be used as fill shall not contain:
  - a. Debris other than crushed concrete and brick meeting the above requirements.
  - b. Timber or railroad ties.
  - c. Other deleterious materials such as steel rails, rebar, trash, etc.
  - d. Hazardous material - Unsuitable and deleterious materials and debris shall be disposed of off-site in accordance with all applicable regulations.

F. Off-site imported fill

1. If necessary, off-site fill shall be obtained and provided by the Contractor
2. Fill shall be clean, well graded granular soil which is non-expansive and non-collapsible and shall have less than 20% by weight passing the #200 sieve. The portion passing the #200 shall be non-plastic. Fill with less fines (less than #200) may be required on project specific basis and as required by Engineer. Likewise, fill with more than 20% fines may be acceptable on a project specific basis or as identified in a geotechnical engineering study.
3. Imported fill shall be free of all hazardous substances. Certification of compliance and, if requested, test results substantiating compliance shall be furnished to the Owner and Engineer by the Contractor not less than one week prior to its intended use.
4. The Owner reserves the right to test off-site fill material for conformance with these specifications.

5. The Contractor shall be responsible for all permits and regulatory requirements associated with offsite borrow sources.

G. The following types of suitable materials are designated and defined as follows:

1. Type 1 (one inch minus granular backfill): Crushed rock, gravel, or sand with 100 percent passing a 1-inch sieve and a sand equivalent value not less than 50.
2. Type 2 (one half inch minus granular backfill): Crushed rock, gravel, or sand with 100 percent passing a 1/2-inch sieve and a sand equivalent value not less than 50.
3. Type 3 (sand backfill): Sand with 100 percent passing a 3/8-inch sieve, at least 90 percent passing a number 4 sieve, and a sand equivalent value not less than 30.
4. Type 4 (coarse rock backfill): Crushed rock or gravel with 100 percent passing a 1-inch sieve and not more than 10 percent passing a Number 4 sieve.
5. Type 5 (pea gravel backfill - ASTM #89): Crushed rock or gravel with 100 percent passing a 1/2-inch sieve, 90 percent passing a Number 8 sieve and not more than 10 percent passing a Number 4 sieve.
6. Type 6 (coarse drainrock - ASTM #4): Crushed rock or gravel meeting the following gradation requirements:

Sieve Size	Percentage Passing
2-inch	100
1-1/2-inch	90-100
1-inch	20-55
3/4-inch	0-15
No. 200	0-3

7. Type 7 (graded drainrock): Crushed rock or gravel, durable and free from slaking or decomposition under the action of alternate wetting or drying. The material shall be uniformly graded and shall meet the following gradation requirements.

Sieve Size	Percentage Passing
1-inch	100
3/4-inch	90-100
3/8-inch	40-100
No. 4	25-40
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

The drainrock shall have a sand equivalent value not less than 75. The finish graded surface of the drainrock immediately beneath hydraulic structures shall be stabilized to provide a firm, smooth surface upon which to construct reinforced concrete floor slabs.

8. Type 8 (Ballast Rock / ¾" Rock): Crushed rock or gravel, durable and free from slaking or decomposition under the action of alternate wetting or drying. The material shall be uniformly graded and shall meet the following gradation requirements.

Sieve Size	Percentage Passing
1-inch	100
¾-inch	40-60
No. 4	0-3
No. 8	0-3

9. Type 9: (Bedding rock - ASTM #67): Well graded crushed rock or gravel meeting the following gradation:

Sieve Size	Percentage Passing
1-inch	100
¾-inch	98-100
½-inch	55-70
⅜-inch	30-40
No. 4	0-6

10. Type 10 (Class I crushed stone - ASTM #57): Manufactured angular, granular crushed stone, rock, or slag, with 100 percent passing a 1-inch sieve and less than 5 percent passing a Number 4 sieve.

11. Type 11 (aggregate base): Crushed rock aggregate base material of such nature that it can be compacted readily by watering and rolling to form a firm, stable base for pavements. At the option of the Contractor, the grading for either the 1-½-inch maximum size or ¾-inch maximum size shall be used. The sand equivalent value shall be not less than 22, and the material shall meet the following gradation requirements.

Sieve Size	Percentage Passing	
	1-½ inch Max.	¾-inch Max.
2-inch	100	-
1-½ inch	90-100	-
1-inch	-	100
¾-inch	50-85	90-100
No. 4	25-45	35-55
No. 30	10-25	10-30
No. 200	2-9	2-9

12. Type 12 (aggregate subbase): Crushed rock aggregate subbase material that can be compacted readily by watering and rolling to form a firm stable base. The sand equivalent value shall be not less than 18 and shall meet the following gradation requirements.

Sieve Size	Percentage Passing
3-inch	100
2-1/2 inch	87-100
No. 4	35-95
No. 200	0-29

13. Type 13 (cement-treated backfill): Material which consists of Type 7 material, or any mixture of Types B, C, G and H materials which has been cement-treated so that the cement content of the material is not less than 5 percent by weight when tested in accordance with ASTM D 2901. The ultimate compressive strength at 28 days shall be not less than 400 psi when tested in accordance with ASTM D 1633.
14. Type 14 (topsoil): Stockpiled topsoil material which has been obtained at the site by removing soil to a depth not exceeding 2 feet. Removal of the topsoil shall be done after the area has been stripped of vegetation and debris as specified.
15. Type 15 (trench plug): Low permeable fill material, a nondispersible clay material having a minimum plasticity index of 10.

- H. If approved by the Engineer, any bituminous concrete on the site shall be milled/removed prior to placing any fill and shall be reused only onsite immediately below the pavement stone base course.

## 2.2 UNSUITABLE MATERIAL

- A. Unsuitable soils for fill material shall include soils which, when classified under ASTM D 2487, fall in the classifications of Pt, OH, CH, MH or OL.
- B. In addition, any soil which cannot be compacted sufficiently to achieve the percentage of maximum density specified for the intended use shall be classed as unsuitable material.

## 2.3 USE OF FILL, BACKFILL, AND EMBANKMENT MATERIAL TYPES

- A. The Contractor shall use the types of materials as designated herein for all required fill, backfill, and embankment construction hereunder.
- B. Where these Specifications conflict with the requirements of any local agency having jurisdiction, or with the requirements of a material manufacturer, the Engineer shall be immediately notified. In case of conflict therewith, the Contractor shall use the most stringent requirement, as determined by the Engineer.
- C. Fill and backfill types shall be used in accordance with the following provisions:
1. Embankment fills shall be constructed of any mixture of Type 1 through Type 11 materials.



2. Pipe zone backfill, as defined under Paragraph 3.15 "Pipe and Utility Trench Backfill" herein, shall consist of the following materials for each pipe material listed below. Where pipelines are installed on grades exceeding 4 percent, and where backfill materials are graded such that there is less than 10 percent passing a Number 4 sieve, trench plugs of Type 13 or 14 materials shall be provided at maximum intervals of 200 feet or as shown on the Drawings.
  - a. Mortar coated pipe, concrete pipe, and uncoated ductile iron pipe shall be provided Type 1, 2, 3, 4, 5, 9 or 10 pipe zone backfill materials.
  - b. Coal tar enamel coated pipe, polyethylene encased pipe, tape wrapped pipe, and other non-mortar coated pipe shall be backfilled with Type 3 pipe zone backfill material.
  - c. Plastic pipe and vitrified clay pipe shall be backfilled with Type 9 or 10 pipe zone backfill material.
3. Trench zone backfill for pipelines as defined under Paragraph 3.15 "Pipe and Utility Trench Backfill" shall be or any of Types 1 through 11 backfill materials or any mixture thereof, except that Type K material may be used for trench zone backfill in agricultural areas unless otherwise shown or specified.
4. Final backfill material for pipelines under paved area, as defined under Paragraph 3.15 "Pipe and Utility Trench Backfill" shall be Type 11 backfill material. Final backfill under areas not paved shall be the same material as that used for trench backfill, except that Type K material shall be used for final backfill in agricultural areas unless otherwise shown or specified.
5. Trench backfill and final backfill for pipelines under structures shall be the same material as used in the pipe zone, except where concrete encasement is required by the Contract Documents.
6. Aggregate base materials under pavements shall be Type 11 material constructed to the thicknesses shown or specified. Where specified or shown, aggregate subbase shall be Type 12 Material.
7. Backfill around structures shall be or Types 1 through Type 11 materials, or any mixture thereof.
8. Backfill materials beneath structures shall be as follows:
  - a. Drainrock materials under hydraulic structures or other water retaining structure with underdrain systems shall be Type 7 or Type 8 material.
  - b. Under concrete hydraulic structures or other water retaining structures without underdrain systems, Types 7, 8 or 11 materials shall be used.
  - c. Under structures where groundwater must be removed to allow placement of concrete, Type 6 material shall be used.

- d. Under all other structures, Type 4, 5, 6, 7, 8, 9 or 11 material shall be used.
- 9. Backfill used to replace pipeline trench over-excavation shall be a layer of Type 6, 7, 8, 9 or 10 materials. This backfill material shall be wrapped with filter fabric to prevent migration of fines for wet trench conditions. The same material as used for the pipe zone backfill may be used if the trench conditions are not wet. Filter fabric shall be Mirafi 140 N, Mirafi 700 X, or equal.
- 10. The top 6 inches of fill on reservoir roofs, embankment fills around hydraulic structures, and all other embankment fills shall consist of Type 14 material, topsoil.

2.4 EMBANKMENT

- A. The maximum sizes of rock which will be permitted in the completed fill areas are as follows:

Depth Below Finish Grade	Maximum Allowable Diameter
Top 4 inches	1 inch
4 inches to 12 inches	3-1/2 inches
12 inches to 2 feet	6 inches
2 feet to 4 feet	12 inches
4 feet to 8 feet	24 inches
Below 8 feet	36 inches

- B. Embankments shall be constructed of material containing no muck, stumps, roots, brush, vegetable matter, rubbish or other material that will not compact into a suitable and enduring roadbed, and material designated as undesirable shall be removed from the site. Where embankments are constructed adjacent to bridge end bents or abutments, rock larger than 3-1/2 inches in diameter shall not be placed within three feet of the location of any abutment.
- C. Fill material containing debris, sod, biodegradable materials shall not be used as fill in construction areas.
- D. Fill material required for the building pads and for pavement subgrade shall be granular fill, free of organic material.
- E. Fill material required for pervious and sodded areas shall have a maximum organic component of 10%. Contractor shall provide, at his cost, organic content test results for approval by the Engineer.

2.5 GEOTEXTILES

- A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
  - 1. Survivability: Class 2; AASHTO M 288.

2. Grab Tensile Strength: 157 lbf); ASTM D 4632.
  3. Sewn Seam Strength: 142 lbf; ASTM D 4632.
  4. Tear Strength: 56 lbf; ASTM D 4533.
  5. Puncture Strength: 56 lbf; ASTM D 4833.
  6. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.
- B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
1. Survivability: Class 2; AASHTO M 288.
  2. Grab Tensile Strength: 247 lbf; ASTM D 4632.
  3. Sewn Seam Strength: 222 lbf; ASTM D 4632.
  4. Tear Strength: 90 lbf; ASTM D 4533.
  5. Puncture Strength: 90 lbf; ASTM D 4833.
  6. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
  7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
  8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

## 2.6 EQUIPMENT

- A. Compactor for mass earthwork shall be minimum 3 ton static drum weight vibratory roller or 5 ton static drum weight sheeps footed compactor as appropriate for the type of soil material at the site or other compactor approved by the Engineer.
- B. Compactor for trenches and where access or maneuverability is limited use, a double drum walk behind roller or vibratory plate compactor or "jumping jack" tampers.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Prior to bidding of all work within this section, the Contractor shall become thoroughly familiar with the geotechnical engineering study, as well as the site, site conditions, and all portions of the Work falling within this section.

- B. The Contractor shall refer to the erosion control drawings, if provided, for staging of earthwork operations and for erosion control measures to be implemented prior to commencement of earthwork.
- C. Locate and identify existing utilities that are to remain and protect them from damage.
- D. Notify utility companies to allow removal and/or relocation of any utilities that are in conflict with the proposed improvements.
- E. Protect fences, structures, sidewalks, paving, curbs, etc. to remain from equipment and vehicular traffic.
- F. Protect benchmarks, property corners and all other survey monuments from damage or displacement. If a marker needs to be removed/relocated it shall be referenced by a licensed land surveyor and replaced, as necessary, by the same at no additional cost to the Owner.
- G. Remove from the site, material encountered in grading operations that, in opinion of the Owner or Engineer, is unsuitable or undesirable for backfilling in pavement or building areas as per Paragraph 2.01.
- H. Identify required lines, levels, contours and datum to bring site grades to the proposed subgrade conditions inferred from the drawings.
- I. Do not perform any work associated with this section prior to completion of all required inspections, tests and approvals.
- J. When performing grading operations during periods of prolonged wet or dry weather, provide adequate measures for surface drainage and ground water control, and moisture control of soils (i.e., wetting or drying, scarify and discing) so as to place and compact the soil within the moisture content range a few percentage points of its optimum water content. Any disturbed areas should be proofrolled at the end of each day.
- K. Sloping, shoring, bracing, and fencing shall be installed in accordance with Federal OSHA requirements as well as the requirements of all regulatory authorities having jurisdiction.
- L. Allow no debris to accumulate on-site. Haul debris away from the site and dispose of at no cost to the Owner.
- M. The Contractor shall remove and dispose of all excess excavated material at a site selected by the Contractor and reviewed by the Engineer.

### 3.2 JOB CONDITIONS

- A. Protection: Use all means necessary to protect existing objects and vegetation. In the event of damage, immediately make all repairs, and replacements necessary to the acceptance of the Engineer at no cost to the Owner.

### 3.3 BACKFILL, FILLING & GRADING

A. Grades:

1. Cut, backfill, fill and grade to proper grade levels indicated. The proposed grades shown on the drawings are for establishing a finished grade over the site.

B. Filling:

1. Fill material shall be placed in horizontal layers and spread to obtain a uniform thickness.
2. After compaction, layers of fill are not to exceed twelve (12) inches for cohesive soils or eight (8) inches for noncohesive soils.

### 3.4 STRUCTURE, ROADWAY, AND EMBANKMENT EXCAVATION

- A. General: Except when specifically provided to the contrary, excavation shall include the removal of all materials of whatever nature encountered, including all obstructions of any nature that would interfere with the proper execution and completion of the Work. The removal of said materials shall conform to the lines and grades shown or ordered. Unless otherwise provided, the entire construction site shall be stripped of all vegetation and debris, and such material shall be removed from the site prior to performing any excavation or placing any fill. The Contractor shall furnish, place, and maintain all supports and shoring that may be required for the sides of the excavations, and all pumping, ditching, or other measure for the removal or exclusion of water, including taking care of storm water, groundwater, and wastewater reaching the site of the work from any source so as to prevent damage to the work or adjoining property. Excavations shall be sloped or otherwise supported in a safe manner in accordance with applicable State safety requirements and the requirements of OSHA Safety and Health Standards for Construction (29CFR1926).
- B. Excavation Beneath Structures and Embankments: Except where otherwise specified for a particular structure or ordered by the Engineer, excavation shall be carried to the grade of the bottom of the footing or slab. Where shown or ordered, areas beneath structures or fills shall be over-excavated. The subgrade areas beneath embankments shall be excavated to remove not less than the top 6 inches of native material and where such subgrade is sloped, the native material shall be benched. When such over excavation is shown, both over excavation and subsequent backfill to the required grade shall be performed by the Contractor. When such over-excavation is not shown but is ordered by the Engineer, such over-excavation and any resulting backfill will be paid for under a separate unit price bid item if such bid item has been established; otherwise payment will be made in accordance with a negotiated price. After the required excavation or over-excavation has been completed, the exposed surface shall be scarified to a depth of 6 inches, brought to optimum moisture content, and rolled with heavy compaction equipment to obtain 98 percent of maximum density.
- C. Excavation Beneath Paved Areas: Excavation under areas to be paved shall extend to the bottom of the aggregate base or subbase, if such base is called for; otherwise it shall extend to the paving thickness. After the required excavation has been completed, the top 12 inches of exposed surface shall be scarified, brought to optimum moisture content, and rolled with heavy compaction equipment to obtain 98 percent of maximum density. The finished subgrade shall be even, self-draining, and in conformance with the slope of the finished pavement. Areas that could accumulate standing water shall be regraded to provide a self-draining subgrade.

- D. Notification of Engineer: The Contractor shall notify the Engineer at least 3 days in advance of completion of any structure excavation and shall allow the Engineer a review period of at least one day before the exposed foundation is scarified and compacted or is covered with backfill or with any construction materials.

### 3.5 PIPELINE AND UTILITY TRENCH EXCAVATION

- A. General: Unless otherwise shown or ordered, excavation for pipelines and utilities shall be open-cut trenches. Trench widths shall be kept as narrow as is practical for the method of pipe zone densification selected by the Contractor, but shall have a minimum width at the bottom of the trench equal to the outside diameter of the pipe plus 24 inches for mechanical compaction methods and 18 inches for water consolidation methods. The maximum width at the top of the trench shall be equal to the outside diameter of the pipe plus 36 inches for pipe diameters 18 inches and larger and to the outside diameter of the pipe plus 24 inches for pipe diameters less than 18 inches, or as shown on the Drawings.
- B. Trench Bottom: Except when pipe bedding is required, the bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe. The trench bottom shall be given a final trim, using a string line for establishing grade, such that each pipe section when first laid will be continually in contact with the ground along the extreme bottom of the pipe. Rounding out the trench to form a cradle for the pipe will not be required. Excavations for pipe bells and welding shall be made as required.
- C. Open Trench: The maximum amount of open trench permitted in any one location shall be 300 feet, or the length necessary to accommodate the amount of pipe installed in a single day, whichever is greater. All trenches shall be fully backfilled at the end of each day or, in lieu thereof, shall be covered by heavy steel plates adequately braced and capable of supporting vehicular traffic in those locations where it is impractical to backfill at the end of each day. The above requirements for backfilling or use of steel plate will be waived in cases where the trench is located further than 100 feet from any traveled roadway or occupied structure. In such cases, however, barricades and warning lights meeting OSHA requirements shall be provided and maintained. Requirements of Section 01550, Section 1.02B shall also apply.
- D. Trench Over-Excavation: Where the Drawings indicate that trenches shall be over-excavated, they shall be excavated to the depth shown, and then backfilled to the grade of the bottom of the pipe.
- E. Over-Excavation: When ordered by the Engineer, whether indicated on the Drawings or not, trenches shall be over-excavated beyond the depth shown. Such over-excavation shall be to the depth ordered. The trench shall then be backfilled to the grade of the bottom of the pipe. All work specified in this Section shall be performed by the Contractor when the over-excavation ordered by the Engineer is less than 6 inches below the limits shown. When the over-excavation ordered by the Engineer is 6 inches or greater below the limits shown, additional payment will be made to the Contractor for that portion of the work which is located below said 6-inch distance. Said additional payment will be made under separate unit price bid items for over-excavation and bedding if such bid items have been established; otherwise payment will be made in accordance with a negotiated price.

- F. Where pipelines are to be installed in embankment or structure fills, the fill shall be constructed to a level at least one foot above the top of the pipe before the trench is excavated.

### 3.6 OVER-EXCAVATION NOT ORDERED, SPECIFIED, OR SHOWN

- A. Any over-excavation carried below the grade ordered, specified, or shown, shall be backfilled to the required grade with the specified material and compaction. Such work shall be performed by the Contractor at its own expense.

### 3.9 ROCK EXCAVATION

- A. Rock excavation shall include removal and disposal of the following: (1) all boulders measuring 1/3 of a cubic yard or more in volume; (2) all rock material in ledges, bedding deposits, and unstratified masses which cannot be removed without systematic drilling and blasting; (3) concrete or masonry structures which have been abandoned; and (4) conglomerate deposits which are so firmly cemented that they possess the characteristics of rock as described in Paragraph 1.3 (H).
- B. Said rock excavation shall be performed by the Contractor; provided, that should the quantity of rock excavation be affected by any change in the scope of the Work, an appropriate adjustment of the contract price will be made under a separate bid item if such bid item has been established; otherwise payment will be made in accordance with a negotiated price.
- C. Explosives and Blasting: Blasting will not be permitted, except by express permission of the Engineer on a case-by-case basis. The use of explosives will be subject to the approval and regulations of all agencies having jurisdiction. If blasting is utilized at the site of the Work, the Contractor shall take all precautions and provide all protective measures necessary to prevent damage to property and structures or injury to person. Prior to blasting, the Contractor shall secure all permits required by law for blasting operations and shall provide any additional hazard insurance required by the Owner. The Contractor shall have a fully qualified and experienced blasting foreman in charge of all blasting operations.
- D. The Contractor will be held responsible for all and shall make good any damage caused by blasting or resulting from its possession or use of explosives on the Work.
- E. All operations involving the handling, storage, and use of explosives shall be conducted in accordance with the requirements of the OSHA Standards for Construction, and in accordance with all local laws and regulations.

### 3.10 DISPOSAL OF UNSUITABLE EXCAVATED MATERIAL

- A. The Contractor shall remove and dispose of all unsuitable excavated material. This shall include muck, tree roots, rocks, garbage, debris, or any other material designated as unsuitable by Paragraph 2 of this Section. Disposal shall be at a site selected by the Contractor that is designated as an approved disposal site for the unsuitable material.

### 3.11 BACKFILL - GENERAL

- A. Backfill shall not be dropped directly upon any structure or pipe. Backfill shall not be placed around or upon any structure until the concrete has attained sufficient strength to withstand the loads imposed. Backfill around water retaining structures shall not be placed until the structures have been tested, and the structures shall be full of water while backfill is being placed.
- B. Except for drainrock materials being placed in over-excavated areas or trenches, backfill shall be placed after all water is removed from the excavation.

### 3.12 PLACING AND SPREADING OF BACKFILL MATERIALS

- A. Backfill materials shall be placed and spread evenly in layers. When compaction is achieved using mechanical equipment the layers shall be evenly spread so that when compacted each layer shall not exceed 6 inches in thickness.
- B. During spreading each layer shall be thoroughly mixed as necessary to promote uniformity of material in each layer. Pipe zone backfill materials shall be manually spread, tamped, and haunched around the pipe so that when compacted the pipe zone backfill will provide uniform bearing and side support.
- C. Where the backfill material moisture content is below the optimum moisture content water shall be added before or during spreading until the proper moisture content is achieved.
- D. Where the backfill material moisture content is too high to permit the specified degree of compaction the material shall be dried until the moisture content is satisfactory.

### 3.13 COMPACTION - GENERAL

- A. Compact each layer of fill in designated areas with approved equipment to achieve a maximum density at optimum moisture, AASHTO T 180 - latest edition.
  - 1. Building Pads: compaction shall be to 98% of maximum density, unless otherwise shown on the drawings or specifications. Building pads shall be within plus or minus one-tenth (0.1) of a foot of the elevations shown on the plans.
  - 2. Refer to Sections 02741 Asphaltic Concrete Paving and 02751 Portland Cement Concrete Paving for compaction requirements in the affected areas.
  - 3. Under landscaped area, compaction shall be to 85% of maximum density, unless otherwise shown on the drawings.
- B. No backfill shall be placed against any masonry or other exposed building surface until permission has been given by the Engineer and in no case until the masonry has been in place seven days.
- C. Heavy construction equipment will not be permitted within ten (10) feet of any masonry or other exposed building surface.



- D. Compaction in limited areas shall be obtained by the use of mechanical tampers or approved hand tampers. When hand tampers are used, the materials shall be deposited in layers not more than four inches thick. The hand tampers used shall be suitable for this purpose and shall have a face area of not more than 100 square inches. Special precautions shall be taken to prevent any wedging action against masonry, or other exposed building surfaces.

### 3.14 COMPACTION OF FILL, BACKFILL, AND EMBANKMENT MATERIALS

- A. Each layer of Types 1, 2, 3, 7, 8, and 14 backfill materials as defined herein, where the material is graded such that at least 10% passes a No. 4 sieve, shall be mechanically compacted to the specified percentage of maximum density. Equipment that is consistently capable of achieving the required degree of compaction shall be used and each layer shall be compacted over its entire area while the material is at the required moisture content.
- B. Each layer of Type 4, 5, 6, and 13 backfill materials shall be compacted by means of at least 2 passes from a flat plate vibratory compactor. When such materials are used for pipe zone backfill, vibratory compaction shall be used at the top of the pipe zone or at vertical intervals of 24 inches, whichever is the least distance from the subgrade.
- C. Type 9 and 10 material requires mechanical spreading and placement to fill voids but does not require mechanical compaction or vibration. Tamping shall be used in pipe zone areas.
- D. Fill on structure roof slabs shall be deposited at least 30 days after the concrete roof slab has been placed. Equipment weighing more than 10,000 pounds when loaded shall not be used on a roof. A roller weighing not more than 8,000 pounds shall be used to compact fill on a roof.
- E. Flooding, ponding, or jetting shall not be used for fill on roofs, backfill around structures, backfill around reservoir walls, for final backfill materials, or aggregate base materials.
- F. Pipe zone backfill materials that are granular may be compacted by a combination of flooding and vibration using concrete vibrators or by jetting, when acceptable to the Engineer. Tamping shall be used to ensure adequate bedding in the pipe zone.
- G. Pipeline trench zone backfill materials, containing 5% or less of material passing a No. 200 sieve, may be compacted using flooding and jetting or vibration if the Contractor uses effective procedures that yield the specified compaction test results. Flooding and jetting shall not be done in such a manner that the pipe or nearby utilities are damaged, in areas of poorly draining or expansive soils, or where the use of the procedure is prohibited by any agency having jurisdiction over the street or right-of-way. Approved jet pipes or immersible vibrators shall be used so that each backfill layer is saturated and consolidated to its full depth before the next layer is placed. Jet pipes shall be kept at least 6 inches away from the pipe where the backfills being consolidated and 2 feet away from other pipes or utilities.
- H. Equipment weighing more than 10,000 pounds shall not be used closer to walls than a horizontal distance equal to the fill at that time. Hand operated power compaction equipment shall be used where use of heavier equipment is impractical or restricted due to weight limitations.

- I. **Compaction Requirements:** The following compaction test requirements shall be in accordance with AASHTO T-180, T-99-C or ASTM D 2487 as applicable. Where agency or utility company requirements govern, the highest compaction standards shall apply.

Location or Use of Fill	Percentage of Maximum Density AASHTO T-180	Testing Frequency 1 per lift per
Pipe zone backfill portion above bedding for flexible pipe.	100	150 lf
Pipe zone backfill bedding and over-excavated zones under bedding/pipe for flexible pipe, including trench plugs.	100	150 lf
Pipe zone backfill portion above bedding for rigid pipe.	100	150 lf
Pipe zone backfill bedding and over-excavated zones under bedding/pipe for rigid pipe.	100	150 lf
Final backfill, beneath paved areas or structures.	100	10,000 sf
Final backfill, not beneath paved areas or structures.	95	20,000 sf
Trench zone backfill, not beneath paved areas or structures, including trench plugs.	95	150 lf
Embankments.	98	20,000 sf
Embankments, beneath paved areas or structures.	100	10,000 sf
Backfill beneath structures, hydraulic structures.	100	100 sf
Backfill around structures.	98	100 sf
Topsoil (type 14 material)	85	20,000 sf
Aggregate base or subbase (type 11 or 12 material)	100	10,000 sf

- J. Trench Backfill Requirements: the pipe has been structurally designed based upon the trench configuration specified herein.
- K. The Contractor shall maintain the indicated trench cross section up to a horizontal plane lying 6 inches above the top of the pipe.
- L. If, at any location under said horizontal plane, the Contractor slopes the trench walls or exceeds the maximum trench widths indicated in the Contract Documents, the pipe zone backfill shall be "improved" or the pipe class increased as specified herein, at no additional cost to the Owner. "Improved" backfill shall mean sand-cement backfill or other equivalent materials acceptable to the Engineer.
- M. If the allowable deflection specified for the pipe is exceeded, the Contractor shall expose and reround or replace the pipe, repair all damaged lining and coating, and reinstall the pipe zone material and trench backfill as specified at no additional expense to the Owner.

### 3.15 PIPE AND UTILITY TRENCH BACKFILL

- A. Pipe zone Backfill: The pipe zone is defined as that portion of the vertical trench cross-section lying between a plane 6 inches below the bottom surface of the pipe, i.e., the trench subgrade, and a plane at a point 6 inches above the top surface of the pipe. The bedding for flexible pipe is defined as that portion of pipe zone backfill material between the trench subgrade and the bottom of the pipe. The bedding for rigid pipe is defined as that portion of the pipe zone backfill material between the trench subgrade and a level line which varies from the bottom of the pipe to the springline as shown.
- B. Bedding shall be provided for all sewers, drainage pipelines, and other gravity flow pipelines. Unless otherwise specified or shown, for other pipelines the bedding may be omitted if all the following conditions exist.
  - 1. The pipe bears on firm, undisturbed native soil which contains only particles that will pass a one-inch sieve.
  - 2. The excavation is not through rock or stones.
  - 3. The trench subgrade soils are classified as suitable fill and backfill materials per Paragraph 2.01.
  - 4. The trench subgrade soils have, as a maximum, a moisture content that allows compaction.
- C. Where bedding is required, after compacting the bedding the Contractor shall perform a final trim using a stringline for establishing grade, such that each pipe section when first laid will be continually in contact with the bedding along the extreme bottom of the pipe. Excavation for pipe bells and welding shall be made as required.

- D. The pipe zone shall be backfilled with the specified backfill material. The pipe zone shall be well tamped per manufacturer's recommendation to prevent sags or settlement of the pipe. The Contractor shall exercise care to prevent damage to the pipeline coating, cathodic bonds, or the pipe itself during the installation and backfill operations.
- E. Trench Zone Backfill: After the pipe zone backfill has been placed as specified above, and after all excess water has completely drained from the trench, backfilling of the trench zone may proceed. The trench zone is defined as that portion of the vertical trench cross-section lying between a plane 6 inches above the top surface of the pipe and a plane at a point 18 inches below the finished surface grade, or if the trench is under pavement, 18 inches below the roadway subgrade. If flooding, ponding, or jetting is used the pipe shall be filled with water to prevent flotation.
- F. Final Backfill: Final backfill is all backfill in the trench cross-sectional area within 18 inches of finished grade, or if the trench is under pavement, all backfill within 18 inches of the roadway subgrade.

### 3.16 COMPACTION OF SUBGRADE SURFACES

- A. Any soft areas exhibiting excessive weaving or unsatisfactory material identified during excavation, fill placement, compaction and proof testing shall be removed, replaced with suitable fill, and compacted as specified.
- B. Prior to preparing the subgrade in low lying areas, perform the following procedures:
  - 1. Drain standing water by gravity or with a pump. Water should not be discharged directly to a storm drain system.
  - 2. After drainage of low area is complete, remove mulch, mud, debris, and other unsuitable material using equipment and methods that will minimize disturbance to the underlying soils.
  - 3. Thoroughly compact subgrade as specified.
  - 4. If proposed for fill, all muck, mud and other materials removed from above low areas shall be dried on-site by spreading in thin layers for observation by the Owner or Owner's representative. If, after observation by the Owner material is found to be unsuitable, it shall be removed from the site.

### 3.17 UNDERCUT EXCAVATION

- A. When approved by the Owner and recommended by the Engineer, the Contractor may be required to remove natural soil materials in areas where fills are to be placed when determined to be undesirable in their location or condition. The Contractor shall be required to remove the undesirable material and backfill with approved material properly compacted.
- B. At locations where unstable soil is shown on the drawings or identified within the geotechnical engineering study, the removal and replacement of such soil shall be as directed on the drawings or as directed by the Engineer and the Owner.

- C. At locations where soil is wet of optimum moisture, the Contractor shall provide a “good faith” effort in drying and discing these areas prior to completing undercut excavation as approved by the Engineer and the Owner.
- D. Where undercutting is required adjacent or beneath the location of the proposed drainage structure, undercut and backfill shall be done over a sufficient distance adjacent to the installation to prevent future operations from disturbing the completed drainage structure.
- E. All material removed in the work of undercut excavation will be classified by the geotechnical engineer and the Owner as either suitable for other use without excessive manipulation and utilized by the Contractor elsewhere in the work, or unsuitable for future use and disposed of by the Contractor as directed by the Engineer.
- F. The Contractor shall conduct undercut operations in such a way that the necessary measurements can be taken before any backfill is placed.
- G. Backfill in undercut areas shall be placed as a continuous operation along with the undercutting operation. No backfill material shall be placed in water unless otherwise permitted by the Engineer.

### 3.18 EXCAVATION, FILL, AND SUBGRADE PREPARATION

#### A. General

- 1. The building limits shall be as identified on the construction drawings. The building subgrade shall be constructed to include a minimum of 10 feet beyond the building limits, or as directed by the Owner;
- 2. Structures include buildings, crane girders, footings, foundations, retaining walls, embankment berms for storm water detention basins, slabs, tanks, curbs, mechanical and electrical appurtenances or other man-made stationary features constructed above or below the ground surface;
- 3. The building pad subgrade shall be prepared in strict accordance with the geotechnical engineering study and these specifications, whichever is more stringent; and,
- 4. The Contractor shall cut or fill to the proposed subgrade elevations based on finished grades and the pavement thicknesses as shown on the drawings. Subgrade elevations shall be constructed to within 0 to minus ½ inch of the proposed grades specified.

#### B. Excavation

- 1. Where existing grades are above proposed subgrade elevation, excavate materials in the building areas to line and grade as shown in the drawings being careful not to over excavate beyond the elevations needed for building subgrades.
- 2. Excavate organic soils from within the building area. Excavated on-site organic soils, which are unsuitable for building fill, may be used in landscaped areas. Otherwise this material shall be disposed of off-site.

3. Unsuitable material, such as wood and any other deleterious materials determined to be unsuitable by the geotechnical engineer for use as on-site fill, shall be disposed of off-site.

C. Subgrade Preparation for Fill

1. Existing grades below building areas shall be leveled prior to fill placement. The Contractor shall remove existing lawn and top soil in these areas prior to placement of any fill.
2. All existing grades below building areas shall be proofrolled and compacted per this section.

D. Fill Placement

1. No fill material shall be placed in areas of standing water, in areas of frozen or thawing ground, or in areas that have not been approved by the Engineer.
2. No fill materials shall be placed during unfavorable weather conditions. When work is interrupted by heavy rains, fill operations shall not be resumed until all saturated surficial soils are returned to satisfactory moisture content as determined by the Engineer.
3. Fill lift surfaces shall be made smooth and free from ruts or indentations at the end of any workday when precipitation is forecast to prevent saturation of surficial fill material. Fill surfaces shall be graded to drain and sealed with a smooth drum roller at the completion of each work day.
4. The fill shall be placed in uniform loose lifts not exceeding 12 inches and compacted in systemic method to achieve at least 6 passes of the compactor. Larger lift thickness, but no greater than 2 feet shall be permitted if broken rock is utilized and placed at least 6 feet below of finished grade.
5. Shot rock may be utilized as engineered fill as approved by the Engineer.
6. Each lift shall be compacted to the minimum densities listed in this section as appropriate for the project and as specified in the geotechnical engineering study.
7. The Contractor shall adjust the water content by aeration or adding water to achieve the required density. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to achieve proper compaction and facilitate the construction schedule.
8. Wet, saturated material shall be air dried as necessary to achieve the field densities specified in this Section. Removal and replacement shall not occur without prior approval or the Owner. Removal and replacement shall be used if necessary to facilitate the construction schedule.
9. Remove areas of finished subgrade found to have insufficient compaction density of depth necessary and replace with suitable compacted fill as approved by the Owner or Engineer. Surface of subgrade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross-section.

10. Fill placed on slopes greater than 1 vertical to 3 horizontal shall have each lift benched onto the slope at least 3 feet.

### 3.19 PROOFROLLING

- A. The work covered by this subsection consists of furnishing and operating, proofrolling equipment at the direction of the Engineer.
- B. Proofrolling shall be under the observation of the geotechnical engineer as described herein and under the following schedule:
  1. Immediately following the completion of excavation to proposed subgrades in cut areas, proofrolling shall be performed as specified.
  2. Immediately prior to and following stone base course placement, in pavement and building pad areas for final floor slab preparation, all subgrade and stone base areas shall be proofrolled. Any areas which deflect, rut or pump under the loaded dump truck shall be undercut and replaced with compacted fill material or stone base course as directed by the Engineer and approved by the Owner, at no additional cost to the Owner.
- C. Proofrolling shall be done with 1 pass of a fully loaded tandem dump truck equal to or exceeding 50,000 lbs or other construction equipment if approved by the Engineer.
- D. Construction methods shall be as follows:
  1. After the subgrade or stone base course has been completed the subgrade or stone base course shall then be proofrolled. The coverage areas and methods will be identified by the Engineer.
  2. The equipment shall be operated at a speed that the Engineer can comfortably and slowly walk alongside the equipment.
  3. If it becomes necessary to take corrective action, such as but not limited to underdrain installation, undercut and backfill of an unsuitable material, and aeration of excessively wet material in areas that have been proofrolled, see Paragraph 3.18. These areas shall be proofrolled again following the completion of the necessary corrections. If the corrections are necessary due to the negligence of the Contractor, the corrective work and additional proofrolling shall be performed by the Contractor at no cost to the Owner.
  4. The Contractor shall protect all structural facilities on the project, such as but not limited to box culverts, pipe culverts, and utilities, from damage by the proofrolling equipment.

### 3.20 MAINTENANCE OF SUBGRADE

- A. Finished subgrades shall be verified by the Contractor to ensure proper elevation and conditions for construction above subgrade.
- B. Protect subgrade from excessive construction traffic and wheel loading including concrete and dump trucks.

- C. Remove areas of finished subgrade judged to be unsatisfactory to the depth necessary and replace in a manner that will comply with compaction requirements by use of material equal to or better than the best subgrade material on site. Surface of subgrade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross-section.

### 3.21 CORRECTION OF GRADE

- A. Bring to required grade levels areas where settlement, erosion or other grade changes occur.

### 3.22 MAINTENANCE AND PROTECTION OF WORK

- A. While construction is in progress adequate drainage for the roadbed shall be maintained at all times.
- B. The Contractor shall maintain all earthwork construction throughout the life of the contract, unless otherwise provided, and shall take all reasonable precautions to prevent loss of material from the roadway due to the action of wind or water. He shall repair at his expense, except as otherwise provided herein, any slides, washouts, settlement, subsidence, or other mishap which may occur prior to final acceptance of the work.
- C. All channels excavated as a part of the contract work shall be maintained against natural shoaling or other encroachments to the lines, grades, and cross sections shown on the plans, until final acceptance of the project.

### 3.23 AS-BUILT SURVEY

- A. At the completion of the work and prior to final inspection of the area, the Contractor shall provide the Engineer with an as-built topographic survey made by a registered Professional Surveyor & Mapper, of the State of Florida.
- B. The Professional Surveyor & Mapper is to certify on the survey whether or not the as-built conditions conform to the elevations shown on the Drawings to within plus or minus one-tenth (.1) of a foot.

END OF SECTION



## SECTION 31 22 00 - SITE GRADING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. All applicable provisions of the Bidding and Contract Requirements, and Division 1 - General Requirements shall govern the work under this section.

#### 1.2 WORK INCLUDED

- A. The work covered by this section shall include all labor, equipment, services and materials necessary for bringing the entire site to elevations shown in the plans. The work included in this section shall include all necessary excavations for streets, ditches and swales. It shall include the construction of embankments and fills by the loading, movement, deposition and compaction of suitable fill materials resulting from above listed excavations. It shall include stockpiling of any excess material to an on-site location as specified by the Owner.
- B. It shall include rough grading within the roadways, driveways, swales, and parking lots to the elevations or cross-section details shown on the drawings.
- C. It shall include the erection and maintenance of any barricades that are required for accident prevention and property protection.
- D. It shall include removal and disposal of muck, rock boulders or any foreign material interfering with construction.

#### 1.3 RELATED WORK (See Related Sections as Applicable)

### PART 2 - PRODUCTS (Not Applicable)

### PART 3 - EXECUTION

#### 3.1 GENERAL

- A. The Contractor shall acquaint himself with all work to be performed as specified and shown on the Drawings. He shall ascertain where all excavation will be required and shall be solely responsible for all excavating to complete the Contract.

#### 3.2 PAYMENT

- A. No extra payment will be allowed for type or classification of material in excavation.

#### 3.3 MATCHING EXISTING GRADES

- A. Where existing roadbed surfaces are not at the elevation required prior to subgrade compaction, the Contractor shall perform any such excavation, filling, earthmoving and grading as may be necessary to attain the proper compacted subgrade elevation before proceeding with base course construction.

### 3.4 UNSUITABLE MATERIAL

- A. All muck, large rocks and boulders encountered during the work under this Contract shall be removed and disposed of in a manner approved by the Engineer.

### 3.5 EXCAVATION

- A. All excavation shall be unclassified regardless of material encountered.
- B. The Contractor shall make probings or sounding for subsurface rock to ascertain its location and depth.
- C. It shall be the Contractor's responsibility to be familiar with soil conditions on the site. Borings, in addition to those provided by others, if any, shall be acquired by the Contractor, at the Contractor's expense.
- D. Any wet excavated materials shall be drained before hauling or moving.

### 3.6 EMBANKMENT (FILL)

- A. Embankment shall be constructed from suitable materials resulting from roadway or site excavation or approved materials furnished from off-site borrow areas.
- B. Embankments shall be placed in successive layers of not more than eight inches in thickness, measured loose, for the full width of the embankment.
- C. Each layer of the material used in the formation of roadbed embankments shall be compacted at optimum moisture content to a density of at least 98% of the Maximum Density as determined by Moisture-Density Tests AASHTO T-180 test results.
- D. The existing material on the site may vary as to stability. The Contractor shall satisfy himself by site inspection borings, probings, etc., prior to bidding, as to the subsurface character of the material.
- E. All unstable soil shall be removed and shall be replaced by material approved by the Engineer.

### 3.7 GRADING

- A. The material excavated shall be transported and spread over the entire work site and shall be graded so that the finished grade shall be within +0.04 feet of the grades indicated on the Contract Drawings. Due to the minimal slope of the roadways, swale grades shall be within +0.04 feet of the grades indicated on the Contract Drawings.
- B. Due to the minimal longitudinal slope of the roadways, the Contractor shall be required to demonstrate (through finish rock and first lift of asphalt as-builts) a positive flow from high points to low points along the edge of pavement and road crown as indicated on the Contract Drawings.
- C. Deviations from the proposed grades and drainage patterns as indicated on drawings will be reviewed at the discretion of the Engineer.

- D. The disposal of large rocks in excess of 8", within roadways and parking areas is prohibited. Where allowable, the disposal of large rocks by burial in areas designated by the Engineer shall have a minimum 30 inches of cover below finished grade elevation.

### 3.8 FINISH GRADING

- A. Following completion of the paving work, all swales, etc., adjacent to the roadway shall be shaped and graded to the elevations and cross-sections shown on the DRAWINGS. The finished surface shall be maintained until seeding and mulching work is completed.

### 3.9 CONSTRUCTION OF SWALES

- A. This work consists of regrading existing swales and construction of new swales adequate for conveying storm water along the right-of-way to catch basins. The swale shall be shaped according to the cross section shown on the plan. In areas adjacent to existing roadways all swales shall be regraded to match their existing condition prior to construction, unless otherwise noted.
- B. Requirements: All soft and yielding material and other portions of the swale which will not compact readily shall be removed and replaced with suitable material and the entire swale area brought to the proper grade. Stumps, roots, and other deleterious organic matter encountered during the shaping for the swale shall be removed.
- C. The bottom of all excavated areas and the top of all fills of swale areas shall be thoroughly compacted by rolling. Water shall be used as necessary to insure thorough compaction. The stability of the top 12" thickness of swale area shall be at least 50 PSI as determined by the Florida Bearing Value Method. Sufficient stabilizing material shall be added to swale area soil as required to provide the specified stability.
- D. The Contractor shall place sod over existing areas damaged by construction. The sod shall match the existing sod type in the affected areas.

### 3.10 SURVEYS

- A. All initial surveys, including detail construction stakes, will be furnished by the Contractor.
- B. The Contractor will carefully maintain benchmarks, monuments, stakes and other reference points, and if disturbed or destroyed, be replaced as directed at the Contractor's expense.

END OF SECTION

## SECTION 31 23 19 - DEWATERING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes construction dewatering.
- B. Related Requirements: (See Related Sections)

#### 1.3 ACTION SUBMITTALS

- A. Shop Drawings: For dewatering system, prepared by or under the supervision of a qualified professional engineer.
  - 1. Include plans, elevations, sections, and details.
  - 2. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.
  - 3. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
  - 4. Include written plan for dewatering operations including sequence of well and well-point placement coordinated with excavation shoring and bracings and control procedures to be adopted if dewatering problems arise.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer that has specialized in dewatering work.

#### 1.5 FIELD CONDITIONS

- A. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from this data.
  - 1. Make additional test borings and conduct other exploratory operations necessary for dewatering according to the performance requirements.
  - 2. The geotechnical report is referenced elsewhere in Project Manual.

- B. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT

- A. Dewatering, where required, may include the use of temporary reservoirs and diking, well points, sump pumps, temporary pipelines for water disposal; discharge testing for petroleum products, metals, pH, turbidity, etc.; rock or gravel placement; and other means. Standby pumping equipment must be maintained on the jobsite and operate within any local noise ordinance limits. All safety requirements, fencing, etc. shall be installed and maintained by the Contractor.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.
  1. Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer.
  2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, prevention of flooding in excavation, and prevention of damage to subgrades and permanent structures.
  3. Prevent surface water from entering excavations by grading, dikes, or other means.
  4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
  5. Remove dewatering system when no longer required for construction.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with water- and debris-disposal regulations of authorities having jurisdiction.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
  1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site or surrounding area.
  2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

- B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from The Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Provide temporary grading to facilitate dewatering and control of surface water.

### 3.2 INSTALLATION

- A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
  - 1. Space well points or wells at intervals required to provide sufficient dewatering.
  - 2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.
- B. Place dewatering system into operation to lower water to specified levels before excavating below ground-water level.
- C. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
- D. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails.

### 3.3 OPERATION

- A. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.
- B. Operate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
  - 1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
  - 2. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
- C. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.
- D. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.

### 3.4 GENERAL REQUIREMENTS

- A. The Contractor shall provide all equipment necessary for dewatering. It shall have on hand, at all times, sufficient pumping equipment and machinery in good working condition and shall have available, at all times, competent workmen for the operation of the pumping equipment. Adequate standby equipment shall be kept available at all times to insure efficient dewatering and maintenance of dewatering operation during power failure.
- B. Dewatering for structures and pipelines shall commence when groundwater is first encountered, and shall be continuous until such times as water can be allowed to rise in accordance with the provisions of this Section or other requirements.
- C. At all times, site grading shall promote drainage. Surface runoff shall be diverted from excavations. Water entering the excavation from surface runoff shall be collected in shallow ditches around the perimeter of the excavation, drained to sumps, and be pumped or drained by gravity from the excavation to maintain a bottom free from standing water.
- D. Dewatering shall at all times be conducted in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation.
- E. If foundation soils are disturbed or loosened by the upward seepage of water or an uncontrolled flow of water, the affected areas shall be excavated and replaced with pea rock at no additional cost to the County.
- F. The Contractor shall maintain the water level below the bottom of excavation in all work areas where groundwater occurs during excavation construction, and backfilling, up to natural groundwater level.
- G. Flotation shall be prevented by the Contractor by maintaining a positive and continuous removal of water. The Contractor shall be fully responsible and liable for all damages which may result from failure to adequately keep excavations dewatered.
- H. If well points or wells are used, they shall be adequately spaced to provide the necessary dewatering and shall be sand-packed and/or other means used to prevent pumping of fine sands or silts from the subsurface. A continual check by the Contractor shall be maintained to ensure that the subsurface soil is not being removed by the dewatering operation.
- I. The Contractor shall dispose of water from the Work in a suitable manner without damage to adjacent property. Contractor shall be responsible for obtaining any permits that may be necessary to dispose of water including water sampling and testing per all regulatory requirements. No water shall be drained into work built or under construction without prior consent of the Engineer. Water shall be filtered using a silt box or another approved method to remove sand and fine-sized soil particles before disposal into any drainage system. Dewatering disposal points shall be approved by the Engineer prior to being used. Storm drains used by the Contractor for dewatering shall be cleaned by a jet vac or other method approved by the Engineer after dewatering is complete.
- J. The release of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils, prevent disturbance of compacted backfill and prevent flotation or movement of structures, pipelines, and sewers.

- K. Dewatering of trenches, testing, and other excavations shall be considered as incidental to the construction of the Work and all costs thereof shall be included in the various contract prices in the Bid Forms, unless a separate bid item has been established for dewatering. If the Contractor chooses to construct a dewatering pit a copy of the land lease shall be submitted to the County. Perimeter berms and chain link fence shall be constructed as necessary for safety.
- L. The Contractor shall submit a dewatering plan to the Consultant for review. The Contractor is advised that the SFWMD, FDOT, Broward County Environmental Protection Department. (BCEPD), etc. may require that a dewatering plan, prepared by a State of Florida licensed Professional Engineer or Registered Professional Geologist, be submitted and approved prior to issuance of a dewatering permit. The Consultant will retain a State of Florida Licensed Professional Engineer or Registered Professional Geologist to prepare and submit dewatering report application to the regulatory agencies for permitting.
- M. The Contractor is advised that the Broward County Environmental Protection Department may have identified contaminated sites within ¼ mile radius of the project site. The Contractor may be required to provide testing and monitoring of the dewatering operations, and to institute dewatering methods and controls, as required by BCEPD, SFWMD, FDOT, etc. The Contractor will be responsible for all costs associated with means and methods of dewatering which will be set forth by dewatering permits.

### 3.5 QUALITY CONTROL

- A. It shall be the sole responsibility of the Contractor to control the rate and effect of the dewatering in such a manner as to avoid all objectionable settlement and subsidence.
- B. All dewatering operations shall be adequate to assure the integrity of the finished project and shall be the responsibility of the Contractor.
- C. Where critical structures or facilities exist immediately adjacent to areas of proposed dewatering, reference points shall be established and observed at frequent intervals to detect any settlement which may develop. The responsibility for conducting the dewatering operation in a manner which will protect adjacent structures and facilities rests solely with the Contractor. The cost of repairing any damage to adjacent structures and restoration of facilities shall be the responsibility of the Contractor.

### 3.6 PROTECTION

- A. Protect and maintain dewatering system during dewatering operations.
- B. Promptly repair damages to adjacent facilities caused by dewatering.

### 3.7 MEASUREMENT AND PAYMENT

- A. There shall be no special measurement or payment for the work under this section, it shall be included in the appropriate unit price bid.

END OF SECTION



## SECTION 31 23 34 - EXCAVATION AND BACKFILLING FOR UTILITIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Work under this section shall include, but not be limited to excavating trenches for the installation of storm drains and utilities, backfilling trench with bedding material as specified and finish filling trenches with suitable material to proposed subgrade, compacting subgrade, bedding, and backfill materials, and compliance with all environmental and health and safety regulations.
- B. This work shall include all labor and materials and equipment necessary to meet all applicable requirements as specified in the contract documents.

#### 1.3 REFERENCED SECTIONS

- A. Related Sections (See related sections)

#### 1.4 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM) Latest Edition
  - 1. D 422 Method for Particle Size Analysis.
  - 2. D 698 Test of Moisture Density Relations of Soils - Standard Proctor Method.
  - 3. D 1557 Test for Moisture-Density Relations of Soils Using 10-lb. (4.5 Kg)  
Hammer and 18-inch (457 mm) Drop (Modified Proctor)
  - 4. D 2216 Laboratory Determination of Moisture Content of Soil.
  - 5. D 2487 Classification of Soils for Engineering Purposes.
  - 6. D 2922 Tests for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
  - 7. D 3017 Test for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
  - 8. D 4318 Test for Plastic Limit, Liquid Limit, & Plasticity Index of Soils.
- B. American Association of State Highway and Transportation Officials (AASHTO) Latest Edition.

1. T 88 Mechanical Analysis of Soils.
2. M 43 Standard Sizes of Coarse Aggregate for Highway.

C. National Electric Code

1. NEC 300-5.
2. NEC 710-36.

1.5 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of all subsurface utilities, structures and obstructions encountered.
- B. Accurately record any as-built variation from the construction drawings and specifications. The Contractor shall provide final as-built drawings at time of substantial completion.
- C. If portions of the work are to be certified for use prior to the completion of the project, the Contractor shall provide final as-built drawings 30 days prior to the anticipated date of use of that portion of the utility.

1.6 QUALITY ASSURANCE

- A. An Engineer shall perform construction inspection and testing on backfilling operations as stated herein. This inspection will not relieve the Contractor from his responsibility to complete the work in accordance with the drawings and specifications.

1.7 SUBMITTALS

- A. The Contractor shall contact all utility companies and identify any requirements. Contractor shall provide written confirmation of the status of all utility construction to the Owner at the time of the preconstruction conference or no later than 30 days following the project NTP.
- B. Submit a sample of each type of offsite fill and/or bedding material that is to be used in backfilling in accordance with Section 312000 - Earth Moving.

1.8 FIELD CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by the Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
  1. Notify Engineer no fewer than three days in advance of proposed interruption of utility.
  2. Do not proceed with interruption of utility without Engineer's written permission.

- B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. The Owner is not responsible for interpretations or conclusions drawn from the data.
  - 1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection according to the performance requirements.
  - 2. The geotechnical report is referenced elsewhere in Project Manual.
- C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Backfill material shall be as specified and approved by the Owner and/or the Engineer.
- B. Bedding Material: Bedding material shall only be utilized when specified on the Drawings. Bedding material shall conform to ASTM #67 aggregate free from debris, clay lumps, organic, or other deleterious material.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.
  - 1. Shore, support, and protect utilities encountered.
- B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from the Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Locate excavation support and protection systems clear of permanent construction so that construction and finishing of other work is not impeded.

### 3.2 PREPARATION

- A. Set all lines, elevations, and grades for utility and drainage system work and maintain for the duration of work. Provide careful maintenance of benchmarks, property corners, monuments, or other reference points.
- B. Protect and maintain in operating condition, existing utilities encountered during utility installation. Repair any damage to surface or subsurface improvements shown on Drawings.
- C. Verify location, size, elevation, and other pertinent data required to make connections between existing utilities, drainage systems, and proposed construction indicated on Drawings. Coordinate all building utility connection locations and elevations with existing conditions. Contractor shall comply with all local codes and regulations.

### 3.3 EXCAVATION

- A. General: This work shall consist of the excavation of whatever substances shall be encountered to the depths as shown on the plans. Excavated materials not required for fill or backfill shall be removed from the work site as directed by the Engineer and shall be considered to be a part of the bid price of the utility pipe for which excavation and backfill is required.
- B. Contact regulatory authorities having jurisdiction and utility companies before excavation begins. Dig trenches at proper width and depth for laying pipe, conduit, or cable and in accordance with utility company requirements. Cut trench banks for safety and remove stones as necessary to avoid point-bearing.
- C. All excavation side walls shall be sloped, shored, sheeted, braced or otherwise supported by means of sufficient strength to protect the workmen within them in accordance with the applicable rules and regulations established for construction by the Department of Labor, Occupational Safety and Health Administration (OSHA), and by regulatory authorities having jurisdiction, codes and ordinances. Such bracing or shoring shall be considered to be part of the bid price of the pipe for which excavation and backfill is required.

The Contractor shall furnish, put in place and maintain such sheeting, bracing, as may be required to support the side of the excavation, and to prevent any movement which can in any way damage the work or endanger adjacent structures. If the Engineer is of the opinion that supports are insufficient, he may order additional supports. The compliance with such order shall not release the Contractor from his responsibility for the sufficiency of the sheeting.

The Contractor shall leave all sheeting in place. The Engineer may require sheeting to be cut off at any specified elevation, but in no case will any sheeting be left closer than three (3) feet below the natural surface, nor cut off below the elevation of the top of the pipe.

- D. Provide uniform bearing and support for each section of pipe at every point along the entire length, except where necessary to excavate for bell holes, pipe joints, or other required connections. Dig bell holes and depressions for joints after trench bottom has been graded. Dig no deeper, longer, or wider than needed to make the joint connection properly.
- E. During excavation, stockpile excavated material suitable for backfilling in an orderly manner far enough from the trench to avoid overloading and slides.

- F. Any abandoned structures utilities or debris discovered during excavation shall be removed and disposed of, or capped.
- G. Utility alignments have been designed to avoid expected obstructions wherever possible. If unanticipated significant obstructions are encountered during utility installation work immediately notify the Owner.
- H. Prevent surface water from flowing into trenches or other excavations by temporary grading or other methods, as necessary. Remove accumulated water in trenches or other excavations by pumping or other acceptable methods. Water shall not be directly pumped to the sewer system.
- I. Utility installation shall meet the following minimum pipe installation depths, or applicable codes and ordinances, measured from finished grade.
  - 1. Water Mains: 36 inches to top of pipe barrel for PVC or 30 inches to top of pipe barrel for DIP or as specified on the plans.
  - 2. Sanitary Sewer: Elevations, and grades as indicated on Drawings.
  - 3. Storm Sewer: Elevations, and grades as shown on Drawings.
  - 4. Electrical Conduits: 24 inches to top of secondary service conduits, 36 inches minimum to the top of primary service conduits, or as required by NEC 300-5, NEC 710-36 codes, or the regulatory authorities having jurisdiction, and utility company requirements, whichever is deeper.
  - 5. Telephone Conduits: 24 inches to top of conduit, or as required by the regulatory authorities having jurisdiction and utility company, whichever is deeper.
  - 6. Underground Irrigation: See Section 32 80 00.
- J. Excavation for structures and other accessories shall have a minimum clearance of twelve inches and a maximum clearance of twenty-four inches on all sides.
- K. Excavation shall not be carried below the required depths as indicated by the plans. Excess excavation below the required level shall be backfilled at the Contractor's expense with sharp sand, gravel or other suitable material thoroughly compacted and approved by the Engineer.
- L. Any unstable soil shall be removed and shall be replaced by material acceptable to the Engineer. The removal and replacement of such unstable soil shall be considered to be part of the bid price of the pipe for which excavation and backfill is required.
- M. Water shall not be permitted to accumulate in the excavated area. It shall be removed by pumping or other means as approved by the Engineer. The removal of water shall be considered to be a part of the bid price of the pipe for which excavation and backfill is required.

Well points, pumps or other approved means shall be used to keep the ground water sufficiently low in the opinion of the Engineer to permit the placing of concrete, masonry or pipe in first class condition, and sufficiently long thereafter to protect the concrete, masonry or joints against washing or damage.

The Contractor shall also use such other means as may be necessary to keep the excavation in satisfactory condition for the construction of the Work, and the use of well points, or other approved method, will not relieve the Contractor of his responsibility to make structures water tight.

Predigging of trenches in order to install well point systems shall be included in the bid price of the pipe.

- N. Banks and trenches shall be vertical unless shown otherwise on plans. The width of the trench shall be no less than eight inches (8") and no more than twelve inches (12"), or as approved by the Engineer, on each side of the pipe bell for pipe up to 16" diameter. Bell holes shall be accurately excavated by hand.
- O. If the bottom of the trench is rock, the excavation shall be carried eight inches below the invert of the pipe and backfilled with thoroughly compacted sharp sand, gravel or other suitable material approved by the Engineer.
- P. Rock excavation shall include any material as described in Section 31 20 00 "Earth Moving" Paragraph 3.09 (A).
- Q. Haunching, including tamping, material, and compaction, shall be in conformance with the pipe manufacturer's recommendation.

### 3.4 LATERALS

- A. All utilities intended to connect to services within any building will be extended to within 5 feet of the building limits in the direction and at elevations to connect at those geometrical locations indicated or inferred on the drawings. All utility ends will be plugged and marked by a 2 inch x 4 inch piece of wood extending from the utility invert to 4 feet above final grade.

### 3.5 PIPE BEDDING (When Specified)

- A. Accurately cut trenches for pipe or conduit to designated line and grade 6 inches below the bottom of the pipe, to width as specified previously. Compact trench bottoms a minimum of 92% of the maximum dry density as determined by ASTM D1557, Modified Proctor Test.
- B. Over excavate wet or unstable soil, if encountered, from trench bottom as necessary to provide a suitable base for continuous and uniform bedding.
- C. Place bedding material and compact in 6 inch loose lifts to obtain at least 95% of the maximum dry density per ASTM D1557. Accurately shape bedding material to conform to lower portion of pipe barrel. After pipe installation, place and compact bedding material as specified above in maximum 6-inch loose layers to the springline of the pipe.

### 3.6 BACKFILLING

- A. After pipes, structures and other appurtenances have been installed, the trench or opening shall be backfilled with material free from large stones or clods of a quality acceptable to the Engineer.
- B. Backfill around the pipe and to a point twelve inches above the top of the pipe shall be placed in six inch layers compacted with 20-pound hand tampers or mechanical tampers suitable for this purpose. Backfilling shall follow pipe laying closely, and shall not be more than one hundred (100) feet behind completed pipe laying. Backfill over pipe shall be carefully placed by experienced labor and thoroughly consolidated without shock to the pipe, and carried up uniformly on both sides of the pipe. No backfilling with bulldozers will be permitted adjacent to pipeline.
- C. Within roadway right-of-ways, or within areas where pavements are to be constructed over the pipe, the remainder of the trench shall be placed in six-inch layers (compacted thickness) and shall be compacted to 100% of maximum density as determined by AASHTO T-99. Contractor will be responsible for correcting settlement in all backfilled areas whether under the pavement or otherwise.
- D. In areas where no pavement is to be constructed, the backfill above the twelve-inch line above the pipe shall be compacted to a firmness approximately equal to that of the soil adjacent to the pipe trench or 95% of maximum density as determined by AASHTO T-180 in public rights of way. Backfill below the 12-inch line shall be compacted in 6-inch layers (compacted thickness) and shall be compacted to 100% of maximum density as determined by AASHTO T-180.

### 3.7 EXPLOSIVES

- A. The use of explosives will not be permitted.

### 3.8 PAYMENT

- A. No separate payment is provided for work covered by this Section. All costs in connection with Excavation and Backfilling, including testing, shall be included in the bid price of any item for which excavation and backfilling is required.

END OF SECTION

## SECTION 31 31 16 - TERMITE CONTROL

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Soil treatment with termiticide.
2. Polymer sheet barrier system with termiticide.
3. Polymer barrier fittings with termiticide for installation around utility penetrations.

#### 1.3 DEFINITIONS

- A. EPA: Environmental Protection Agency.
- B. PCO: Pest control operator.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of termite control product.
  1. Include the EPA-Registered Label for termiticide products.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Certificates: For termite control products, from manufacturer.
- C. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:
  1. Date and time of application.
  2. Moisture content of soil before application.
  3. Termiticide brand name and manufacturer.
  4. Quantity of undiluted termiticide used.
  5. Dilutions, methods, volumes used, and rates of application.



6. Areas of application.
  7. Water source for application.
- D. Polymer Sheet Barrier System with Termiticide Application Report: After installation of polymer sheet barrier system with termiticide is completed, submit report for Owner's records and include the following:
1. Plan drawing showing extent of sheet barrier and number and locations of each type of polymer barrier fitting.
  2. Termiticide brand name and manufacturer.
  3. Schedule of inspections for one year from date of Substantial Completion.
- E. Polymer Barrier Fittings with Termiticide Application Report: After installation of polymer barrier fittings with termiticide is completed, submit report for Owner's records and include the following:
1. Plan drawing showing number and locations of each type of polymer barrier fitting with termiticide.
  2. Termiticide brand name and manufacturer.
  3. Schedule of inspections for one year from date of Substantial Completion.
- F. Warranties: Sample of special warranties.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located and who is experienced and has completed termite control treatment similar to that indicated for this Project and whose work has a record of successful in-service performance.
- B. Regulatory Requirements: Formulate and apply termiticides and termiticide devices according to the EPA-Registered Label.

## 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.
- B. Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

- C. Install polymer sheet barrier system with termiticide prior to placing concrete slab reinforcement and pouring concrete and after installation and inspection of footings, foundations, and plumbing and electrical pipes and conduits.
- D. Install polymer barrier fittings with termiticide around utility penetrations prior to pouring concrete and after installation and inspection of plumbing and electrical pipes and conduits, slab vapor barrier, and concrete slab reinforcement.

## 1.8 WARRANTY

- A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.
  - 1. Warranty Period: Five years from date of Substantial Completion.
- B. Polymer Sheet Barrier System with Termiticide Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work, consisting of installation of polymer sheet barrier system with termiticide, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat and repair or replace damage caused by termite infestation.
  - 1. Warranty Period: 10 years from date of Substantial Completion.
- C. Polymer Barrier Fittings with Termiticide Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work, consisting of installation of polymer barrier fittings with termiticide, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat and repair or replace damage caused by termite infestation.
  - 1. Warranty Period: Five years from date of Substantial Completion.

## 1.9 MAINTENANCE SERVICE

- A. Continuing Service: Beginning at Substantial Completion, provide 12 months continuing service including monitoring, inspection, and re-treatment for occurrences of termite activity. Provide a standard continuing service agreement. State services, obligations, conditions, terms for agreement period, and terms for future renewal options.

## PART 2 - PRODUCTS

### 2.1 SOIL TREATMENT

- A. Termiticide: Provide an EPA-Registered termiticide, complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.

1. Products: Available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. AgrEvo Environmental Health, Inc.; a Company of Hoechst and Schering, Berlin.
  - b. American Cyanamid Co.; Agricultural Products Group; Specialty Products Department.
  - c. Bayer Corp.; Garden & Professional Care.
  - d. DowElanco.
  - e. FMC Corp.; Pest Control Specialties.
  - f. Zeneca Professional Products.
  - g. BASF Corporation, Agricultural Products; Termidor.
2. Service Life of Treatment: Soil treatment termiticide that is effective for not less than five years against infestation of subterranean termites.

## 2.2 POLYMER SHEET BARRIER SYSTEM

- A. Polymer Sheet: 16-mil- (0.40-mm-) thick, multilayered, laminated, polymer sheet with lambda-cyhalothrin termiticide sealed between two outer polymer layers.
  1. Products: Subject to compliance with requirements[available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Syngenta; IMPASSE Termite System.

## 2.3 POLYMER BARRIER FITTINGS

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  1. Syngenta; IMPASSE Termite Blockers.
- B. Pipe/Conduit Fitting: Integral 2-1/2-inch- long polymer sleeve and 1-inch- wide circular flange with lambda-cyhalothrin termiticide sealed between two outer polymer layers; with fasteners.
- C. Tub Trap Fitting: Integral polymer boot and 23-by-23-inch flange with lambda-cyhalothrin termiticide sealed between two outer polymer layers; with fasteners.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label requirements, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.
- B. Proceed with application only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparation before beginning application of termite control treatment. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.
- B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.
  - 1. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

### 3.3 APPLICATION, GENERAL

- A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

### 3.4 APPLYING SOIL TREATMENT

- A. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute treatment evenly.
  - 1. Slabs-on-Grade and Basement Slabs: Underground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
  - 2. Foundations: Adjacent soil, including soil along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
  - 3. Crawlspace: Soil under and adjacent to foundations as previously indicated. Treat adjacent areas including around entrance platform, porches, and equipment bases. Apply overall treatment only where attached concrete platform and porches are on fill or ground.

4. Masonry: Treat voids.
  5. Penetrations: At expansion joints, control joints, and areas where slabs will be penetrated.
- B. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.
  - C. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.
  - D. Post warning signs in areas of application.
  - E. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.
- 3.5 INSTALLING POLYMER SHEET BARRIER SYSTEM
- A. Install polymer sheet barrier system according to manufacturer's EPA-Registered Label to provide a complete and continuous barrier to entry of subterranean termites.
  - B. Remove any pipe wrap material so that the polymer sheet barrier system and fittings can be applied directly to the pipe or conduit. After installing the barrier, reapply pipe wrap material both below and above the blocker to protect the pipe from contact with concrete.
  - C. Install polymer barrier fittings around each utility pipe and conduit penetrating concrete slab according to the EPA-Registered Label for the product and manufacturer's written instructions.
- 3.6 INSTALLING POLYMER BARRIER FITTINGS
- A. Remove any pipe wrap material so that the polymer barrier fittings can be applied directly to the pipe or conduit. After installing the barrier, reapply pipe wrap material both below and above the blocker to protect the pipe from contact with concrete.
  - B. Install polymer barrier fittings around each utility pipe and conduit penetrating concrete slab according to the EPA-Registered Label for the product and manufacturer's written instructions.

END OF SECTION

## SECTION 31 63 16 - AUGER CAST GROUT PILES

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section includes machine augered shaft, placement of pressure injected concrete and internal reinforcement, and pile load test.
- B. Auger cast grout piles – 16” diameter for Switchgear building foundation, 18” and 24” diameters for crane rail girder
- C. Related Sections:
  - 1. Section 03 20 00 - Concrete Reinforcing.
  - 2. Section 03 30 00 - Cast-In-Place Concrete.
  - 3. Section 31 09 19 - Pile Load Tests.
  - 4. Section 31 23 16 - Excavation.

#### 1.2 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures.
- B. Proof of experience and qualifications, and certificate of insurance.
- C. Means and methods for installing the piles so as to meet the requirements of these specifications. Include:
  - 1. A complete description of the pile installation equipment.
  - 2. Identification of pile grout and reinforcement.
- D. Schedule for performing the work in accordance with the construction phasing plan
- E. The pile load test set-up for each type of test. Include details of load test reaction frame; reaction piles; dial gauges accurate to .001 inch; certificate of strain gauge and readout box calibration; and type, specification, and recent (not more than one month old) calibration curves for jacks, load cells, and gauges certified by a recognized testing laboratory and Florida licensed Professional Engineer.
- F. Grout mix design with supporting mix proportioning data prepared by an approved supplier. Include supplier's maximum recommended time to place grout after batching. Submit written reports to Engineer of the proposed mix at least 15 days prior to start of work. The Contractor shall not begin operation until the Engineer has reviewed the mix design. The proposed mix design Pile reinforcing steel manufacturer's and/or suppliers certificate certifying pile materials conform to the requirements specified herein, including but not limited to certified mill test reports covering physical and chemical tests

#### 1.3 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements.

- B. Project Record Document: Record actual locations of piles, pile diameter, and pile length.
- C. Accurately record the following on Project record documents:
  - 1. Sizes, lengths, and locations of piles.
  - 2. Sequence of placement.
  - 3. Final base and top elevations.
  - 4. Deviation from indicated locations.

#### 1.4 QUALITY ASSURANCE

#### 1.5 QUALIFICATIONS

- A. Installer: Company specializing in performing the Work of this section with minimum five years documented experience.
- B. Tierra South Inc. is the Geotechnical Engineer for the project and will inspect pile installation.

#### 1.6 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements.
- B. Convene minimum three days prior to commencing Work of this section.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

- A. Reinforcement: Specified in Section 03 20 00; spiral wound.
- B. Portland cement, aggregates, admixtures: Specified in Section 03 00 00.
- C. Auger cast grout mix: See Section 31 09 19.
- D. Auger pile equipment: See Section 31 09 19.

### PART 3 EXECUTION

#### 3.1 PILE DESIGN INFORMATION

- A. A pre-construction meeting will need be held with the Contractor prior to mobilizing his equipment to the site. The Contractor shall perform the test pile installation and pile load tests work in accordance with these specifications and any modifications agreed to at the pre-construction meeting and from discussions with the Geotechnical and Structural Engineers.

- B. The test pile program consists of one (1) 16-inch-diameter test pile, one (1) 18-inch-diameter test pile, and two (2) 24-inch-diameter test piles and their associated reaction piles.
- C. The piles shall be installed at locations approved by the Owner and the Geotechnical Engineer. All pile installation work shall be performed under the full-time inspection of the Geotechnical Engineer in accordance with the approved Contractor's procedures and equipment.
- D. The Contractor may perform test installation(s) to identify any site specific requirements for subsurface satisfactory installation of the load tested piles. If the Contractor selects to do so, all the test installations shall be fully grouted.
- E. Capacity/Size of Pile: The 16-inch-diameter piles shall have a safe compression load capacity of 75 tons per pile. The 18-inch-diameter piles shall have a safe compression load capacity of 240 tons per pile. The 24-inch-diameter piles shall have a safe compression load capacity of 330 tons per pile. The pile shall have a safe tension capacity of 200 tons. For load testing purposes only, the 24-inch-diameter pile is assumed to have a safe lateral load capacity of 20 tons.
- F. The 16-inch-diameter piles shall be installed at least 13 ft into the upper limestone which is expected to be encountered at about 20 feet from existing grade, as determined by the Geotechnical Engineer. The 16-inch-diameter pile is expected to be between 32 and 34 feet long from existing grade. The 18-inch-diameter and 24-inch-diameter piles shall be installed at least 15 ft into the lower limestone which is expected to be encountered between about 65 and 70 feet from existing grade, as determined by the Geotechnical Engineer. The 18-inch-diameter and 24-inch-diameter pile is expected to be between 80 and 85 feet long from existing grade. Localized variations in the top of the bearing limestone stratum of several feet may be possible.
- G. If localized soft rock is encountered during pile installation, as determined by the Geotechnical Engineer, the piles shall be installed deeper into the bearing stratum or downgraded and additional piles shall be installed as required.
- H. The final pile tip elevation shall be determined by the Geotechnical Engineer and no grout shall be pumped until then.

### 3.2 PILE INSTALLATION

- A. The pile Contractor shall provide at least 3 day-notice to the General Contractor and Geotechnical Engineer.
- B. The piles shall be installed by the rotation of the continuous flight auger into the ground to the tip elevation as determined by the Geotechnical Engineer. Once the final depth has been attained, a slow positive rotation shall be maintained and the auger initially withdrawn 0.5 ft to 1 ft. Grout shall then be pumped through the auger tip until a minimum grout head of 8 ft is achieved for the 16-inch-diameter piles, and 12 ft is achieved for the 18-inch-diameter and 24-inch-diameter piles. This will be estimated by the Geotechnical Engineer by counting the number of strokes pumped.



- C. The auger shall then be lowered to the bottom of the augered shaft, and then slowly and steadily withdrawn in a continuous operation while grout is being injected without interruption. The rate of auger withdrawal and that of grout injection shall be coordinated such that the amount of grout pumped per foot of pile during auger retrieval is equal to or greater than the volume per foot of pile. A positive grout pressure head above the tip of the auger shall be maintained at all times as verified by the return of slurry/grout from around the auger flights. A minimum grout head (return) as specified above shall be observed during auger retrieval.
- D. If the auger jumps during withdrawal, if the pump skips a stroke, or if there is a break in the slurry/grout return as observed from the top of the augered shaft, the auger shall be lowered a minimum of 5 feet below the depth of questionable area and regouted.
- E. The augered shaft shall be completely filled to the ground surface with grout. The test piles shall be sleeved as necessary to provide necessary extension for performing the load test. Grout shall not be removed from the augered shafts by dipping or other means prior to setting of the grout. Installed piles shall be periodically checked by the Contractor to determine if the grout in the piles has settled. If the grout level drops more than about 1 ft, the top of the pile shall be purged and fresh grout shall be added to the top of the pile prior to the grout reaching its initial set. If the grout level drops to an elevation where the grout cannot be seen, the pile shall be re-augered and re-grouted. The tops of piles that subside more than 8 inches overnight shall be evaluated on an individual basis.
- F. Immediately upon completion of the grouting operation of each pile, the specified reinforcement shall be installed. Care shall be taken not to contaminate the pile grout with soil or other foreign material during reinforcing steel cage installation. The steel cages shall be maintained at the center of the grout-filled augered pile shaft at all times. If difficulty is encountered during installation of the reinforcement, the pile shall be redrilled and regouted. If problems are still encountered, then the shaft shall be filled with grout and abandoned.
- G. In case there is a loss of grout upon pile grouting or if there is no return of grout from the shaft during pumping, the shaft shall be temporarily abandoned and shall be redrilled and regouted after approximately 1 hour, if problems are still encountered, then the shaft shall be redrilled and regouted the following day, If problems are still encountered, then a replacement pile shall be installed at a location determined by the Geotechnical Engineer.
- H. Where the pile cutoff is near the surface or above the bottom of the pile cap excavation, metal sleeves or casing of the proper diameter and at least 12 inches in length shall be placed around the pile tops.
- I. Pile cut-off elevations shall be shown on the drawings and be to an accuracy of plus or minus 1 inch.

- J. Maximum permissible variation of location of the centerline of piles shall not be more than 3-inches of the position shown on the Foundation Plans at the cut-off elevation. If this tolerance is exceeded, the Contractor shall provide corrective construction to compensate for excessive eccentricity. The Contractor shall submit corrective construction methods to the Structural Engineer for review before proceeding. The Contractor shall be responsible for all costs associated with corrective and/or remedial work.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Perform load tests to requirements of Section 31 09 19.
- C. Unacceptable Piles: Piles that fail, are placed out of position, are below elevations, or are damaged.
- D. Provide additional piles failing to conform to specified requirements.

END OF SECTION

## SECTION 32 12 16 - ASPHALT PAVING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Cold milling of existing asphalt pavement.
2. Hot-mix asphalt patching.
3. Hot-mix asphalt paving.
4. Hot-mix asphalt overlay.
5. Asphalt curbs.
6. Asphalt traffic-calming devices.
7. Asphalt surface treatments.

- B. This section of the specifications covers the control and general conduct of asphalt paving construction for roads, parking, walks and court areas.

- C. All work within the right-of-way shall be constructed using materials and methods in accordance with the drawings, Broward County and Florida Department of Transportation Standard Specifications for Road and Bridge Construction.

1. Grade deviations from Contract and Drawings shall conform to Section 312200, Site Grading.

- D. Provide all labor, materials, necessary equipment and services to complete the Asphaltic Concrete Paving work, as indicated on the drawings, as specified herein or both, except as for items specifically indicated as "By other contractor" at Berth 30 Extension.

- E. Including, but not necessarily limited to the following:

1. Preparation of subgrade.
2. Installation and compaction of base course.
3. Spreading of asphalt surface course.

F. Related Requirements: (See related sections as applicable)

### 1.3 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO)

1. M140 - Standard Specification for Emulsified Asphalt Nineteenth Edition; Revised Per Interim Specifications - Specifications - 1999 R(1998).
2. M226 - Standard Specification for Viscosity Graded Asphalt Cement Nineteenth Edition R(1996).
3. T245 - Standard Method of Test for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus Nineteenth Edition; ASTM D1559-76

B. American Society for Testing and Materials (ASTM).

1. D1559 - Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus.
2. D2041 - Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures.
3. D2171 - Standard Test Method for Viscosity of Asphalts by Vacuum Capillary Viscometer (RAP Asphalt Mixes).

C. Asphalt Institute (AI)

1. MS-2 - Mix Design Method for Asphalt Concrete and Other Hot Mix Types.
2. MS-22 - Principles of Construction of Hot-Mix Asphalt Pavement, Addendum.

### 1.4 TRAFFIC CONTROL

A. The Contractor shall provide and maintain access to and from all properties along the line of his work. The Contractor shall also provide temporary by-passes and maintain them in a safe and usable condition whenever detouring of traffic to parallel routes cannot be done without hardship or excessive increases in travel by the public.

### 1.5 SPECIAL SUBGRADE CONDITIONS

A. When special subgrade conditions are encountered for which these "Asphaltic Concrete Paving Specifications" are not applicable, portions of these specifications shall be deleted or revised to provide a properly finished paved surface. A requested revision or deletion of the specifications shall be accompanied with reports and laboratory tests on existing field conditions. Any change from these "Asphaltic Concrete Paving Specifications" shall be approved by the Engineer and shall be in effect only for a specified area or paving project.

## 1.6 SUBMITTALS

- A. Job Mix Designs: Contractor shall submit a mix design for each pavement course proposed for construction for the Owner's review and approval 45 days prior to schedule production and lay down of the mix. The design mix submittal shall be formatted as indicated in Asphalt Institute Manual MS-2, the "Marshall Stability Method"; and shall include type/name of mix, gradation analysis, grade of asphalt cement, Marshall Stability in pounds flow, effective asphalt content in percent (%), and corresponding copies of governing State Department of Transportation (DOT) material specifications or regulatory authorities having jurisdiction for each proposed material.
- B. The Contractor may submit to the Owner a superpave asphalt mix design for review and approval, in lieu of a Marshall Mix Design asphalt, meeting the specifications of the governing State Department of Transportation or regulatory authorities having jurisdiction.
- C. Material Certificates: Contractor shall submit certificates stating that asphalt mix to be supplied complies with the specifications of the governing State Department of Transportation (DOT) or regulatory authority having jurisdiction, as well as copies the regulatory specifications corresponding to the asphalt mix formula and material. The certificates shall be signed by the asphalt mix producer and the Contractor.
- D. Product Data: For each type of product.
  - 1. Include technical data and tested physical and performance properties.
  - 2. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
  - 3. Job-Mix Designs: For each job mix proposed for the Work.
- E. Samples for Verification: For the following product, in manufacturer's standard sizes unless otherwise indicated:
  - 1. Paving Fabric: 12 by 12 inches minimum.

## 1.7 QUALITY ASSURANCE

- A. D.O.T. Standard Specifications.
  - 1. Work and materials shall conform to all applicable requirements of Florida Department of Transportation "Standard Specifications for Road and Bridge Construction - 2000" (referred to herein as D.O.T.).
- B. American Society for Testing and Materials.
  - 1. ASTM 3515-80 "Standard Specification for Hot-Mixed, Job Laid, Bituminous Paving Mixtures."
- C. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

## 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
1. Prime Coat: Minimum ambient air temperature of 50 deg F, and when temperature has not been below 35 degrees for 12 hours immediately prior to application.
  2. Tack Coat: Minimum ambient air temperature of 60 deg F.
  3. Slurry Coat: Comply with weather limitations in ASTM D 3910.
  4. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
  5. Asphalt Surface Course: Minimum surface temperature of 40 deg F at time of placement and base is dry.

## 1.9 LOCATIONS, LAYOUT AND GRADES

- A. Locate and layout paved areas and right-of-ways with reference to benchmarks, property lines or buildings according to the drawings and as accepted by the Engineer. Contractor shall not utilize electronic files from the Engineer for layout.
- B. Determine locations of paved edges and right-of-way line from surveyor's permanent reference monuments and information on the Horizontal Control drawings.
- C. Where permanent reference monuments are not available, obtain proper line locations from authorities having jurisdiction.
- D. Establish and maintain required lines and elevations.
- E. Furnished rock as-builts shall demonstrate a positive flow along the edge of pavement and road crown from the high point to the low point (catch basin /inlet) as indicated on the contract drawings.

## PART 2 - PRODUCTS

### 2.1 FILL

- A. All fill shall be clean rock and sand (maximum rock size = 1 inch).
- B. Fill shall be compacted thoroughly as per Section 312000 - Earth Moving.

### 2.2 LIMEROCK

- A. Limerock shall be obtained from pits for which all overburden has been removed previous to blasting and shall show no tendency to air slake and must undergo the following chemical requirements.

- |                                | Percent                                                                                                                                                                                                  |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Carbonates of Calcium       | Min.70.0 (Miami Limerock) and Magnesium.<br>(24' roadway)<br>Min 60.0 (Miami Limerock) and Magnesium.<br>(22' roadway)<br>95.0 (Ocala Limerock)                                                          |
| 2. Oxides of Iron and Aluminum | Max. 2.0                                                                                                                                                                                                 |
| 3. Organic Matter              | Max. 0.5                                                                                                                                                                                                 |
| 4.                             | Any constituents of other than the above shall be silica or inert material.                                                                                                                              |
| 5.                             | The material shall be crushed to such size that not less than 97% shall pass a 3-1/2" sieve and it shall be graded uniformly down to dust. All fine material shall consist entirely of dust of fracture. |
| 6.                             | Limerock from on-site may be used if the material meets the requirements of this section of the specifications.                                                                                          |
- B. All limerock shall comply with requirements set forth under D.O.T. Section 911.
- C. Equipment: The equipment for constructing the rock base shall be in first class working condition and shall include:
1. Vibratory compactor weighing not more than three tons. If approved in writing by the Engineer, larger vibratory compaction equipment may be allowed if operated in static mode only.
  2. Self-propelled blade grader weighing not less than three tons. The wheel base shall be not less than fifteen feet and blade length not less than ten feet.
  3. Scarifiers shall have teeth space not to exceed 4-1/2 inches.
  4. Provision for furnishing water at the construction site by tank or hose at a rate not less than 50 gallons per minute.
- 2.3 PRIME COAT
- A. Prime coat shall be Grade RC-70, cut-back asphalt, D.O.T. Section 916-2.
  - B. Prime coat shall have full compatibility with surface treatment asphalt.
  - C. The bituminous material shall conform to the requirements of the Florida Department of Transportation Standard Specifications for Road and Bridge Construction, Section 300-2.
  - D. The sand for cover shall be clean dry sand.

2.4 TACK COAT

- A. The bituminous material to be used for the tack coat shall conform to the requirements of the Florida Department of Transportation Standard Specifications for Road and Bridge Construction, Section 300-2.

2.5 ASPHALT

A. Asphalt Concrete

- 1. The asphaltic concrete surface course shall be in accordance with Broward County, Florida Department of Transportation Standard Specifications for Type S-1 and Type S-III Asphaltic Concrete Surface Course, and SP 9.5.
- 2. Pavement within public road right-of-way which has been disturbed by this construction shall be replaced with the same type to match the existing pavement section.
- 3. Final lift of asphaltic concretes shall be virgin material only and shall be placed at the end of the project. (First lift may be R.A.P. [reclaimed asphaltic paving] in accordance with DOT standards).

B. General composition of mixtures:

- 1. The aggregate in the asphaltic concrete shall be crushed stone and manufactured sand screening of natural sand or combination of both when necessary to meet requirements of composition of mix. All aggregate shall have a Los Angeles abrasion loss of less than 40%.



2. The mineral aggregate shall be so graded, and the prescribed constituents, prepared as hereinafter set out, shall be combined in such proportions as to produce a mixture conforming to the following general composition limits by weight:

Constituent	Passing Sieve	S-1 Percent by Weight	S-III Percent by Weight
Course Aggregate	3/4"	100	100
	1/2"	88-98	100
	3/8"	75-93	88-98
	No. 4	47-75	60-90
Total Course Aggregate	No. 10	31-53	40-70
Fine Aggregate	No. 40	19-35	20-45
	No. 80	7-21	10-30
Filler	No. 200	2-6	2-6
Total Fine Aggregate and Filler	No. 10	100	100
Total Mineral Aggregate		100	100
Total Mix		100	100
Constituent		Percent by Weight	
Total Mineral Aggregate		91-95	
Asphalt Cement		5-9*	
(Bitumen) Total Mix		100	

\*For highly absorptive aggregates the upper limit may be raised.

## 2.6 SEAL COATING

- A. Homogeneous mixture of emulsified coal tar pitch, asbestos, sand and other inert fillers. It shall be easily remixed if settlement occurs in storage (except in the case of freezing). It shall be capable of application and complete coverage by rubber squeegee, brush, or approved mechanical method, to the surface of bituminous pavements at the spreading rate of 0.2 to 0.3 gallons per square yard in two coats.
- B. Approved product: "TARFEX" manufactured by Bitucote Products Co. or approved equal.

## 2.7 AUXILIARY MATERIALS

- A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled tires, asphalt shingles or glass from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.
- B. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.
- C. Sand: ASTM D 1073 Grade No. 2 or No. 3.
- D. Paving Geotextile: AASHTO M 288 paving fabric; nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.
- E. Joint Sealant: ASTM D 6690 hot-applied, single-component, polymer-modified bituminous sealant.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to begin paving.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
  - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
  - 2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
  - 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- C. Proceed with paving only after unsatisfactory conditions have been corrected.

### 3.2 COLD MILLING

- A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.
  - 1. Mill existing asphalt pavement at the depth and location as indicated on the Construction Drawings or as directed by the Owner.
  - 2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
  - 3. Control rate of milling to prevent tearing of existing asphalt course.

4. Repair or replace curbs, manholes, and other construction damaged during cold milling.
  5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
  6. Patch surface depressions deeper than 1 inch (25 mm) after milling, before wearing course is laid.
  7. Handle milled asphalt material according to approved waste management plan required in Section 017419 "Construction Waste Management and Disposal."
  8. Keep milled pavement surface free of loose material and dust.
  9. Do not allow milled materials to accumulate on-site.
- B. The milled surface shall be reasonably smooth and free of excessive scarification marks, gouges, ridges, continuous grooves, or other damage. The milled pavement surface shall be thoroughly cleaned of all loose aggregate particles, dust, and other objectionable material by the use of power brooms, power blowers, power vacuums or other means.
- C. The Contractor shall coordinate the adjustment of manhole, meter boxes, drainage inlets, and valve boxes with the milling operation.
- D. All milled material shall become the property of the Contractor and shall be disposed of off-site or used in conformance with Section 31 20 00 - Earth Moving, or for utilization as Reclaimed Asphalt Pavement, in conformance with the specification provided above, as approved by the Owner.

### 3.3 PATCHING

- A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into perimeter of adjacent sound pavement, unless otherwise indicated or directed by Owner. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.
- B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseal concrete pieces firmly.
1. Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseal pieces firmly.
  2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.
- C. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

D. Placing Patch Material: Fill excavated pavement areas with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

E. Placing Patch Material: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

### 3.4 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.

1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch.

1. Clean cracks and joints in existing hot-mix asphalt pavement.
2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

### 3.5 BARRICADES

A. Provide substantial temporary barricades around all areas of operation and maintain until work under this section is completed and approved.

B. Install temporary traffic markers, signals, and signs as per Broward County Highway Construction & Engineering Services Division Standard Specification to:

1. Eliminate potentially hazardous conditions.
2. Maintain adequate traffic patterns free of conflict with work under this Contract.

### 3.6 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

- B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

- 1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.

### 3.7 PREPARATION OF SUBGRADE

- A. This work consists of bringing the bottom of excavations and top of embankments of the roadway between the outer limits of the shoulders or base course to a surface conforming to the grades, lines, and cross sections shown on the plans. The subgrade shall be of uniform density ready to receive the rock base of the paving course.
- B. All soft and yielding material and other portions of the subgrade which will not compact readily shall be removed and replaced with suitable material and the entire subgrade brought to line and grade to provide a foundation of uniform compaction and supporting power.
- C. Stumps, roots, and other deleterious organic matter encountered in the preparation of the subgrade shall be removed.
- D. Where fills are required on areas covered or partly covered by existing paving, the entire area of such existing paving shall be scarified to a depth of at least six inches, and the scarified material spread evenly over the area to be filled to a width not less than that of the proposed paving.
- E. Material for fills shall consist of sand or other suitable material approved by the Engineer free from stumps, roots, brushes, and other deleterious organic matter.
- F. Where fill is more than 1 foot in depth, the backfill material above the ground water table shall be compacted in 8 inch depth lifts. Each individual layer of fill under the rock base shall have a density of 98% of the maximum density as determined by the AASHTO T-180 unless shown otherwise on the plans. Each individual layer of fill under the shoulder area shall have a density of 98% of the maximum density as determined by AASHTO T-180, unless shown otherwise on the plans.
- G. The bottom of all excavated areas and the top of all fills where rock base is to be constructed shall be thoroughly compacted by rolling. Water shall be used to insure thorough compaction. The stability of the top 12 inch thickness of the subgrade immediately under the base, for the full base width plus 1 foot on each side, shall be minimum LBR 40.
- H. Bring subgrade which has been properly filled and shaped to a firm unyielding surface, by rolling an entire area with an approved power roller:
  - 1. Thoroughly compact area inaccessible to the roller with approved hand tamper.
  - 2. Apply water sufficiently to compact the subgrade where the subgrade is of a dry, sandy nature and cannot be rolled.
- I. The subgrade shall be maintained free from ruts, depressions or other irregularities until rock base material is spread.

- J. For all roads, streets and paved areas other than State Highway, the stabilized subgrade shall have a minimum Limerock Bearing Ratio (LBR) of 40, unless otherwise noted on the plans.
- K. Where the bearing value of the existing subgrade is adequate without addition of stabilizing material, the subgrade shall be scarified and disked, harrowed, bladed or tilled for removal of boulders, roots, etc. to assure uniformity and thorough mixing of material to the full width and depth of required stabilization. The compacted subgrade shall conform to the lines, grades and cross-section shown on the plans.
- L. Test subgrade for crown and elevation after preparation and immediately before base of paving course is laid:
  - 1. Remove or add material and compact to bring to a correct elevation and uniform bearing if the subgrade is found not to be at the specified elevation at all points.
  - 2. Adjust the manhole rims, catch basin frames and valve boxes where necessary to match proposed finish grade.

### 3.8 CONSTRUCTION OF BASE COURSE

- A. This work consists of construction of lime rock base course for the asphaltic concrete wearing surface. The base course shall be constructed on the prepared subgrade in a 8 inches thick limerock bases constructed in two four inch lifts as shown on the drawings. Twelve (12) inch thick limerock bases shall be constructed in two six-inch lifts. The limerock base shall be a minimum LBR of 100.
- B. Spreading Rock: The rock shall be transported to the points where it is to be used over rock previously placed, and dumped on the end of the preceding spread. It shall then be spread uniformly with hand tools, or mechanical equipment. In no case shall rock be dumped directly on the subgrade. No hauling shall be done over the subgrade.
- C. Compacting Rock:
  - 1. Following spreading, the rock shall be rolled with a three wheel roller weighing not less than ten tons, water being added as required, until the entire depth of base is compacted into a dense unyielding mass.
  - 2. No greater area of rock base shall be placed during any one day than that which can be rolled and compacted on the same day.
- D. Finishing Base:
  - 1. After watering and rolling, the entire surface shall be thoroughly scarified to a depth not less than 4 inches and shaped to exact crown and cross section, re-watered and again thoroughly rolled. Rolling shall continue until the entire depth of base is bonded and compacted into a dense, unyielding mass, true to grade and cross section.
    - a. Any irregularities which may develop in the surface during such finishing shall be corrected by the removal or addition of rock as the case may be.

- b. If at any time the subgrade material becomes churned up and mixed with the base rock, the Contractor shall dig out and remove the mixture, reshape and compact the subgrade and replace the materials removed with clean rock which shall be watered and rolled until satisfactorily compacted.
  - c. Where cracks or checks appear in the base either before or after priming, which in the opinion of the Engineer would impair the structural efficiency of the base course, the Contractor shall remove such cracks or checks by re-scarifying, reshaping, watering, rolling and adding rock where necessary.
  - d. During final compacting operations, if grading of any areas is necessary to obtain the true grade and cross section, the compacting operations for such areas shall be completed prior to making the density tests on the finished base.
- E. **Inferior Rock:** If in the opinion of the Engineer at any time during the progress of the work, rock of inferior quality is being delivered to the construction site, a laboratory analysis of the rock shall be made. Should the results of such tests indicate that the rock does not conform to specifications, the Contractor shall, at his own expense, remove such inferior material from the area indicated and deliver and spread satisfactory rock on said area.
- F. **Testing Surface:** The finished surface of the rock base shall be true to the required cross section. Any irregularities in the grade greater than 1/4", as determined by placing a ten foot straight edge parallel with the centerline and use of full width crown board, shall be corrected by scarifying to a depth of 3 inches, removing or adding rock as may be required and again watering, rolling, and compacting the scarified area. In testing the surface for irregularities, the measurements under the straight edge shall not be taken in small holes caused by individual pieces of rock having been pulled out by the road grader. The finished rock base shall provide positive flow from the high point to the low point (catch basin/inlet) as indicated on the Contract Drawings.
- G. **Thickness Determination:** Thickness of the base shall be measured by intervals as required by the Engineer. Measurements shall be taken at various points on the cross section. The measurements shall be taken in holes through the base of not less than 3 inches in diameter. Where the base is more than 1/2" less than the required compacted thickness, the Contractor shall correct such areas by scarifying and adding rock. The affected areas shall then be watered, rolled and brought to a satisfactory state of completion, and of required thickness and cross section.
- H. **Density:** Density determinations shall be made by the Contractor or at intervals required by the Engineer. An average required density shall be 98% of maximum density obtainable under AASHTO Method T-180. No section of base shall be accepted when more than 10% of tests fall below 98% of maximum density and in no case shall a density of less than 96% of maximum be accepted.
- I. **Testing:** The Contractor shall coordinate with Engineer for all testing. One test shall be made in accordance with AASHTO, T-180 for each class of material in the subgrade and base:
- 1. In place density tests in accordance with AASHTO T-147 shall be made in the locations shown on the plans. Two copies of the test reports will be sent directly to the Engineer for evaluation.

2. Any material which fails to meet these specifications shall be removed, replaced, and retested, all at the Contractor's expense.
3. Tests shall be taken at least every 1,000 square yards and taken at locations and lifts as directed by the Engineer.

### 3.9 PRIME COAT FOR BASE COURSE

#### A. Cleaning the prepared base:

1. Before any bituminous material is applied, all loose material (dust, dirt, caked clay and foreign matter) which might prevent proper bond with the existing surface shall be moved to the shoulders, to the full width of the treatment, by means of revolving brooms or approved mechanical sweepers and by mechanical blowers, of approved types, supplemented by hand sweeping. Dust and other loose materials not removed by mechanical means shall be removed with hand brooms. Particular care shall be taken to clean the outer edges of the strip to be treated in order to insure that the prime coat will adhere. Sweeping and blowing shall be continued until all the loose dust and dirt is removed from the surfaces.
2. Application of bituminous material shall be made during the same day surface has been swept and as soon as practical thereafter.

#### B. Application for prime coat:

1. The bituminous material shall be applied to the clean dry surface of the rock base at such temperature as will insure uniform distribution. The amount applied will be at the rate of approximately 0.10 to 0.20 gallons per square yard of base area. The application shall be made by means of self-propelled pressure distributor operating under a pressure not less than 20 pounds per square inch. Application of bituminous material shall be made on only one-half of the width of base at one time.
2. The primed base shall then be covered with a uniform layer of clean sand, and kept thoroughly and uniformly covered by additional sand or sweeping until it shows no signs of picking up under traffic. For a period of one week after priming, the Contractor shall again broom any area where insufficient cover sand or excess of bituminous material causes "bleeding" and, if necessary, spread additional sand on such area.

#### C. Prime coat finish: After prime has cured or sat and been sanded, the shoulder shall be shaped to conform to all grade lines and cross sections and the entire area shall be rolled and compacted with a rubber tired roller or a power roller before asphalt surface is laid on the finished base.

### 3.10 BITUMINOUS TACK COAT

- A. Before applying any bituminous material, all loose material: dust, dirt and foreign material, which might prevent proper bond with the existing surface, shall be removed for the full width of the application.



B. Application for tack coat:

1. The surface to receive the tack coat shall be clean and dry. The tack coat shall be clean and dry. The tack coat shall be applied with a pressure distributor except that on small jobs, if approved by the Engineer, the application may be made by other approved mechanical methods or by hand methods. The pressure distributor shall operate at a pressure not less than 20 pounds per square inch and at a consistency such that it can be properly pumped and sprayed uniformly over the surface.
2. The bituminous material shall be applied in a thin uniform layer. The rate of application shall be between 0.02 and 0.10 gallon per square yard. The tack coat shall be applied sufficiently in advance of the laying of the wearing surface to permit drying, but shall not be applied so far in advance that it might lose adhesiveness as a result of being covered with dust or other foreign material. The tack coat surface shall be kept free from traffic until the wearing surface is laid.

3.11 ASPHALTIC CONCRETE WEARING SURFACE COURSE

A. Cleaning and preparing base:

1. Prior to the laying of the asphaltic concrete, the base of pavement to be covered shall be cleaned of all loose deleterious material by the use of power brooms or blowers. A tack coat shall be applied on all pavement. The tack coat shall not be applied so far in advance of laying operations as to allow shifting and sand or weather conditions to nullify its effectiveness.
2. After the surface has been thoroughly cleaned, all holes shall be filled with asphaltic concrete, if necessary, and thoroughly compacted to conform to the existing surface and to form a smooth surface.

B. Placing asphaltic concrete: The asphaltic concrete surface course applied after the tack coat and be permitted a reasonable time for drying, but not to an extent that the tack coat is allowed to lose its adhesiveness:

1. Machine spreading: Upon arrival the mixture shall be dumped into the approved mechanical spreader and immediately spread and struck off to the full width required and to such appropriate loose depth for each successive course that when the work is completed the required weight of the mixture per square yard or the specified thickness will be secured. An excessive amount of mixture shall be carried ahead of the screen at all times. Hand raking shall be done behind the machine as required.
  - a. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
  - b. Place hot-mix asphalt surface course in single lift.
  - c. Spread mix at a minimum temperature of 250 deg F.
  - d. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.

- e. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
2. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
  - a. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches from strip to strip to ensure proper compaction of mix along longitudinal joints.
  - b. Complete a section of asphalt base course before placing asphalt surface course.
3. Hand spreading: In limited areas, where, on account of irregularities or unavoidable obstacles, the use of mechanical spreading and finishing equipment is impractical, the mixture may be spread by hand, when so authorized by the Engineer.
4. The mixture shall be laid only when the surface to be covered is dry and only when weather conditions are suitable.
5. All structures which will be in actual contact with asphaltic mixture, including the face or surface of curbs or gutters and their vertical faces of existing pavements, shall be painted with a uniform coating of asphalt material to provide a closely bonded, watertight joint.
6. Where necessary, due to the traffic requirements, the mixture shall be laid in strips in such manner as to provide for the passage of traffic.
7. Any mixtures caught in transit by a sudden rain may be laid at the Contractor's risk. In no case shall the mixture be laid while rain is falling or when there is water on the surface to be covered.
8. The depth of the layer being spread shall be gauged as directed, and where the thickness fails to average the specified thickness, immediate steps shall be taken to correct the depth.
9. Before any rolling is started, the course surface shall be checked, any inequalities adjusted, and all drippings, fat sand accumulations from the screed and fat spots from any source shall be removed and replaced with satisfactory material.
10. Straight-edging and back-patching shall be done after initial completion has been obtained and while the material is still hot. Any irregularity greater than 1/4" either longitudinally or transversely shall be corrected at this time.
11. 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. If irregularities occur and are not corrected while the mixture is still hot, the irregularities shall be cut out the full depth of the layer and replaced with fresh mixture.
12. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

- C. Compacting mixture: After the spreading, the mixture shall be rolled when it has set sufficiently or come to the proper condition to be rolled, and when the rolling does not cause undue displacement or shoving:
1. The motion of the roller shall at all times be slow enough to avoid displacement and shall at once be corrected by the use of rakes and fresh mixture where required. The rolling shall include all transverse, longitudinal, and diagonal rolling, as may be necessary to obtain the maximum density.
  2. The seal rolling with tandem steel rollers weighing from five to eight tons shall follow as close behind the spreader as is possible without picking up, or displacing or blistering the material.
  3. Rolling with the self-propelled pneumatic-tired rollers shall follow as soon as possible and as close behind the seal rolling as the heat of the mixture will permit. The rolling shall be done while pavement temperature is between 175° and 240° F, and to such an extent that the self-propelled traffic roller shall cover every area of the surface with at least ten passes. Final rolling with tandem steel rollers shall be done after the rolling with self-propelled pneumatic tired rollers is completed. This final rolling shall be done before the pavement temperature is lower than 175° F, and shall be continued until all roller marks or tire marks are eliminated.
  4. Self-propelled pneumatic rollers shall be used for the rolling of patching and leveling courses. At the option of the Contractor, a steel-wheeled roller may be used to supplement the self-propelled pneumatic-tired rollers but not more than one steel-wheeled roller may be used in conjunction with the necessary number of self-propelled pneumatic-tired rollers. After final completion, the finished pavement shall at no point have a density less than 95% of the laboratory compacted density.
  5. Rolling with the self-propelled pneumatic-tired roller shall proceed at a speed from six to twelve miles per hour and the rate of rolling shall not exceed 3,000 square yards per hour per roller. A sufficient number of self-propelled pneumatic-tired rollers shall be used so that the rolling of the surface for the required number of 10 passes within this maximum rolling rate shall not delay any other phase of the placing operation and not result in excessive cooling of the mixture before the rolling is complete. In the event that the rolling is not properly maintained to schedule as outlined above, the laying operation shall be discontinued until the rolling operations are sufficiently caught up.
  6. In all places inaccessible to a roller, such as adjacent to curbs, headers, gutters, bridges, manhole, etc., the required compaction shall be secured with tamps. Depressions which may develop before the completion of the rolling shall be remedied by loosening the mixture laid and adding new material to bring such depressions to a true surface.
  7. Should any depressions remain after final compaction has been obtained, the mixture shall be removed sufficiently and new material added to form a true and even surface. All high spots, high joints and honeycombs shall be adjusted as directed by the Engineer.

8. The mixture, after compaction, shall be of the thickness shown on the plans. After compaction, the surface shall not show an excess of asphalt. Any area showing such excess or other defect shall be cut out and replaced with fresh mixture and immediately compacted to conform with the surrounding area. Any mixture which becomes loose or broken, mixed with dirt in the wearing course shall be removed and replaced with fresh mixture which shall be immediately compacted to conform with surrounding areas.
  9. Gasoline or oil from rollers shall not be allowed to deposit on the pavement and any pavement damaged by such deposits shall be removed and replaced as directed by the Engineer.
  10. Any mixture remaining unbonded after rolling shall be removed and replaced.
- D. Protection of pavement: After the completion of the pavement, no vehicular traffic of any kind shall be permitted on the pavement until it has set sufficiently as approved by the Engineer.

### 3.12 ASPHALT OVERLAY

- A. Clean existing asphalt and clear of loose aggregate. Road edges shall be milled to a minimum depth of 1".
- B. Risers shall be installed to bring existing manhole rims, valves, basins, etc to grade.
- C. Structural patching necessary to seal existing cracks or pot holes shall be done prior to tack coat. Tack coat shall be applied to ensure proper adhesion between the old surface and new asphalt.
- D. Hot mix asphalt shall be applied at the depth specified on the plans. All edges and ends shall be sloped to create a smooth seam between old and new pavement surfaces.

### 3.13 ABUTTING EXISTING PAVING

- A. Meet elevation of existing paving and structures, facilities and utilities where applicable by feathering the thickness of the new surface course for not more than 1 foot in the periphery of the structure, facility or utility. Do not cover access covers, manhole tops, water meters or other similar devices.

### 3.14 PAVEMENT EDGES

- A. Make edges of paved area conform to details and sections as shown on drawings.

### 3.15 SEAL COATING

- A. Preparation of surface: Pavement to be sealed must be sound and free of loose dust, dirt, stones, or other foreign matter:
  1. Repair any breaks or holes.
  2. Scrape off accumulations of oil or fuel drippings and scrub with detergent and water. Remove all traces of detergent.

3. Soft or damaged spots must be repaired.
  4. Flush entire area with clean water.
  5. Pavement should be damp (no puddles or excess water) when seal coating is applied.
- B. MIXING: Stir seal coating to a uniform consistency, use no solvents for thinning. Dilute seal coating with 10% to 20% clean water, stirring to uniform consistency.
- C. Application:
1. Seal coat may be applied to dampened surface with a rubber squeegee, soft bristled push broom, or approved mechanized equipment.
  2. Seal coating may be poured directly onto pavement in a ribbon or windrow. Squeegee is placed on pavement at a slight angle to edge line of pavement and pulled in a window along pavement in parallel lines, always working excess material toward bottom edge of squeegee.
  3. Seal coating should be applied in two (2) thin coats. After first coat is completely dry to touch, a second coat may be applied at right angles to the first. Rate of application will depend on porosity of surface.
  4. Allow to cure for 24 hours before opening to traffic.
  5. Do not apply seal coating when temperature is below 50°F, or falling, before sealer is dry, or rain appears imminent or forecast.
  6. Apply in strict accord with manufacturers published instructions.

### 3.16 PAVING GEOTEXTILE INSTALLATION

- A. Apply **tack coat** uniformly to existing pavement surfaces at a rate of 0.20 to 0.30 gal./sq. yd.
- B. Place paving geotextile promptly according to manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints 4 inches and transverse joints 6 inches.
- C. Protect paving geotextile from traffic and other damage, and place hot-mix asphalt overlay the same day.

### 3.17 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
  1. Clean contact surfaces and apply tack coat to joints.
  2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.

3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

### 3.18 ASPHALT CURBS

- A. Construct hot-mix asphalt curbs over compacted pavement surfaces. Apply a light tack coat unless pavement surface is still tacky and free from dust. Spread mix at a minimum temperature of 250 deg F.
  1. Asphalt Mix: Same as pavement surface-course mix.
- B. Place hot-mix asphalt to curb cross section indicated or, if not indicated, to local standard shapes, by machine or by hand in wood or metal forms. Tamp hand-placed materials and screed to smooth finish. Remove forms after hot-mix asphalt has cooled.

### 3.19 ASPHALT TRAFFIC-CALMING DEVICES

- A. Construct hot-mix asphalt speed humps over compacted pavement surfaces. Apply a tack coat unless pavement surface is still tacky and free from dust. Spread mix at a minimum temperature of 250 deg F.
  1. Tack Coat Application: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.
  2. Asphalt Mix: Same as pavement surface-course mix.
  3. Before installation, mill pavement that will be in contact with bottom of traffic-calming device. Mill to a depth of 1 inch from top of pavement to a clean, rough profile.
- B. Place and compact hot-mix asphalt to cross section indicated, by machine or by hand in wood or metal forms. Tamp hand-placed materials and screed to smooth finish. Remove forms after hot-mix asphalt has cooled.

### 3.20 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
  1. Base Course: Plus or minus 1/2 inch.
  2. Surface Course: Plus 1/4 inch, no minus.

- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
  - 1. Base Course: 1/4 inch.
  - 2. Surface Course: 1/8 inch.
  - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.
- C. Asphalt Traffic-Calming Devices: Compact and form asphalt to produce the contour indicated and within a tolerance of plus or minus 1/8 inch of height indicated above pavement surface.
- D. Finish grade of asphaltic concrete wearing course shall be within +0.04 feet of the grades indicated on the plans.

### 3.21 SURFACE TREATMENTS

- A. Fog Seals: Apply fog seal at a rate of 0.10 to 0.15 gal./sq. yd. to existing asphalt pavement and allow to cure. With fine sand, lightly dust areas receiving excess fog seal.
- B. Slurry Seals: Apply slurry coat in a uniform thickness according to ASTM D 3910 and allow to cure.
  - 1. Roll slurry seal to remove ridges and provide a uniform, smooth surface.

### 3.22 FIELD QUALITY CONTROL

- A. Testing Agency: the Owner will engage a qualified testing agency to perform tests and inspections.
- B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- D. Asphalt Traffic-Calming Devices: Finished height of traffic-calming devices above pavement will be measured for compliance with tolerances.
- E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979 or AASHTO T 168.
  - 1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
  - 2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.

- a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than three cores taken.
  - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
- F. Replace and compact hot-mix asphalt where core tests were taken.
- G. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.
- 3.23 CLEAN UP
- A. Remove all debris and excess material immediately from project site.
  - B. Take down all barricades and temporary traffic markers, signals and signs only after all work included in this section is finished and inspected, and only after so directed by the Engineer.
  - C. Leave project area clean, orderly and free of any hazardous conditions.

END OF SECTION



## SECTION 32 13 13 - CONCRETE PAVING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

##### A. Section Includes:

1. Curbs and gutters.
2. Walks.
3. Drainage Aprons.

- B. Provide all labor, materials, necessary equipment and services to complete the Portland Cement Concrete Paving work, as indicated on the drawings, as specified herein or both, except as for items specifically indicated as "NIC ITEMS".

##### C. Including, but not necessarily limited to the following:

1. Fill, subgrade, and limerock base.
2. Concrete formwork.
3. Concrete reinforcement.
4. Isolation and contraction joints.
5. Concrete paving.

##### D. Related Sections: (See related sections as applicable)

#### 1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

#### 1.4 REFERENCE STANDARDS

##### A. American Society of Testing Materials (ASTM)

1. A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

2. A185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
  3. A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
  4. C33 - Standard Specification for Concrete Aggregates.
  5. C94 - Standard Specification for Ready-Mixed Concrete.
  6. C150 - Standard Specification for Portland Cement.
  7. C171 - Standard Specification for Sheet Materials for Curing Concrete.
  8. C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
  9. C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
  10. C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
  11. C979 - Standard Specification for Pigments for Integrally Colored Concrete.
  12. C1116 - Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
  13. D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
  14. D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
  15. D3405 - Standard Specification for Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements.
  16. D5249 - Standard Specification for Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints.
  17. D5893 - Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.
- B. American Concrete Institute (ACI)
1. 301R-99 - Specifications for Structural Concrete.
  2. 304R - Placing and Handling Concrete, etc.
  3. 309R-96 - Guide for Consolidating of Concrete.
  4. 330.1 - Standard Specifications for Plain Concrete Parking Lots.

5. 330R-92 - Guide for Design & Construction of Concrete Parking Lots.
6. 211.1R-91 - Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.

C. American Association of State Highway and Transportation Officials (AASHTO)

1. M182 - Standard Specifications for Burlap Cloth made from Jute for Kenaf.
2. M153 - Standard Specifications for Preformed Sponge Rubber and Cork Expansion Joint Filler.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.
- C. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color selection.
- D. Samples for Verification: For each type of product or exposed finish, prepared as Samples of size indicated below:
  1. Exposed Aggregate: 10-lb Sample of each mix.
  2. Wheel Stops: 6 inches showing cross section; with fasteners.
  3. Preformed Traffic-Calming Devices: 6 inches showing cross section; with fasteners.
- E. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- F. Test Reports: Reports of concrete compression, yield, air content, and slump tests.
- G. Certificates:
  1. Manufacturer's certification that materials meet specification requirements.
  2. Material content on a cubic yard basis of each class of concrete furnished.
    - a. Dry weights of cement.
    - b. Saturated surface-dried weights of fine and coarse aggregate.
    - c. Quantities, type and name of admixtures.
    - d. Weight of water.

3. Ready-mix delivery tickets, ASTM C-94.
- H. Shop Drawings:
1. Show sizes and dimensions for fabrication and placing of reinforcing steel and bar supports.
  2. Indicate bar schedules, stirrup spacing, and diagrams of bend bars.
- I. Qualification Data: For qualified Installer of detectable warnings, ready-mix concrete manufacturer and testing agency.
- J. Material Certificates: For the following, from manufacturer:
1. Cementitious materials.
  2. Steel reinforcement and reinforcement accessories.
  3. Fiber reinforcement.
  4. Admixtures.
  5. Curing compounds.
  6. Applied finish materials.
  7. Bonding agent or epoxy adhesive.
  8. Joint fillers.
- K. Material Test Reports: For each of the following:
1. Aggregates.
- L. Field quality-control reports.
- 1.6 QUALITY ASSURANCE
- A. Requirements of Regulatory Agencies: Perform work in accordance with local building and other applicable codes.
  - B. Installation: Performed only by skilled workmen with satisfactory record of performance on completed projects of comparable size and quality.
  - C. Detectable Warning Installer Qualifications: An employer of workers trained and approved by manufacturer of stamped concrete paving systems.
  - D. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").
  - E. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
    1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
  - F. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.
  - G. ACI Publications: Comply with ACI 301 unless otherwise indicated.
  - H. Inspection and Testing: Performed in accordance with appropriate related sections
    1. Test cylinders - as per ASTM C-39.
      - a. Minimum of three (3) concrete test cylinders shall be taken for every 75 or less cubic yards of concrete placed.
      - b. Minimum of one (1) additional test cylinder shall be taken during any cold weather concreting, and be cured on job site under same conditions as the concrete it represents.
    2. Slump test - as per ASTM C-143:
      - a. Minimum of one (1) slump test shall be taken for each set of test cylinders taken.
- 1.7 DELIVERY, STORAGE AND HANDLING
- A. Deliver reinforcement to project site in bundles marked with metal tags indicating bar size and length.
  - B. Handle and store materials to prevent contamination.
- 1.8 JOB CONDITIONS
- A. Allowable concrete temperatures:
    1. Hot weather: Maximum 90°F as per ASTM C-94.
  - B. Do not place concrete during rain, unless protection is provided.
- 1.9 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials 55 deg F for water-based materials, and not exceeding 95 deg F.

## PART 2 - PRODUCTS

### 2.1 FORMS

- A. Formwork: Matched, tight fitting and adequately stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of concrete, conform with ACU 347, Chapter 3, Material and Form Work.
- B. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
  - 1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less.
- C. Lumber:
  - 1. Softwood framing lumber: Kiln dried, PS-20.
  - 2. Boards less than 1-1/2 inch thick and 2 inches wide, used for basic forms and form liners: Kiln dried.
  - 3. Grade marked by grading rules agency approved by American Lumber Standards Committee.
  - 4. Light framing or studs for board or plywood forms, 2 inches to 4 inches width and thickness, construction standard grade.
  - 5. Boards for basic forms, construction standard grade.
  - 6. Board surface: Smooth.
- D. Plywood:
  - 1. Exterior type softwood plywood, PS 1-66.
  - 2. Each panel stamped or branded indicating veneer grades, species, type and identification.
  - 3. Wood faced plywood for Architectural concrete surfaces.
    - a. Panel veneer grades: B-C.
    - b. Mill-oiled sides and mill-sealed edges of panels.

E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

1. Pine oil derivative.

F. Ties:

1. Material: Steel.

2. Type: Snap ties.

3. Depth of breakback: 1 in.

4. Maximum diameter, 1/4 in.

## 2.2 STEEL REINFORCEMENT

A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from galvanized steel wire into flat sheets.

C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

D. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A, plain steel.

E. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

F. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 deformed bars.

G. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 deformed bars.

H. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.

I. Plain-Steel Wire: ASTM A 82/A 82M, galvanized.

J. Deformed-Steel Wire: ASTM A 496/A 496M.

K. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated.

L. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars; zinc coated (galvanized) after fabrication according to ASTM A 767/A 767M, Class I coating. Cut bars true to length with ends square and free of burrs.

- M. Epoxy-Coated, Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, plain-steel bars.
- N. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.
- O. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- P. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
  - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
  - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
- Q. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.
- R. Zinc Repair Material: ASTM A 780.
- S. Tie Wire: FS QQ-W-461-G, annealed steel, black, 16 ga. minimum.

## 2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:
  - 1. Portland Cement: ASTM C 150, portland cement Type I.
    - a. Fly Ash: ASTM C 618.
    - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
  - 2. Blended Hydraulic Cement: ASTM C 595, Type IP, portland-pozzolan cement.
- B. Normal-Weight Aggregates: ASTM C 33, uniformly graded. Provide aggregates from a single source with documented service-record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.
  - 1. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal.
  - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.



- C. Exposed Aggregate: Selected, hard, and durable; washed; free of materials with deleterious reactivity to cement or that cause staining; from a single source, with gap-graded coarse aggregate as follows:
1. Aggregate Sizes 1/2 to 3/4 inch nominal.
  2. Aggregate Source, Shape, and Color: As directed by the Engineer.
- D. Water: Potable and complying with ASTM C 94/C 94M.
- E. Air-Entraining Admixture: ASTM C 260.
- F. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- G. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ChemMasters.
    - b. Davis Colors.
    - c. Dayton Superior Corporation.
    - d. Elementis Pigments.
    - e. Hoover Color Corporation.
    - f. Lambert Corporation.
    - g. LANXESS Corporation.
    - h. QC Construction Products.

- i. Scofield, L. M. Company.
  - j. Solomon Colors, Inc.
  - k. Stampcrete International, Ltd.
  - l. SureCrete Design Products.
2. Color: As selected by Engineer from manufacturer's full range.

#### 2.4 FIBER REINFORCEMENT

A. Synthetic Fiber: Monofilament or fibrillated polypropylene fibers engineered and designed for use in concrete paving, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 inches long.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Monofilament Fibers:

- 1) Axim Italcementi Group, Inc.; FIBRASOL II P.
- 2) Euclid Chemical Company (The), an RPM company; Fiberstrand 100, Fiberstrand 150.
- 3) FORTA Corporation.
- 4) Grace, W. R. & Co. - Conn.; Grace MicroFiber.
- 5) Metalcrete Industries; Polystrand 1000.
- 6) QC Construction Products; QC FIBERS.

b. Fibrillated Fibers:

- 1) Axim Italcementi Group, Inc.; FIBRASOL F.
- 2) Euclid Chemical Company (The), an RPM company; Fiberstrand F.
- 3) FORTA Corporation.
- 4) Grace, W. R. & Co. - Conn.; Grace Fibers.
- 5) Propex Concrete Systems Corp.; Fibermesh 300.

#### 2.5 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Axim Italcementi Group, Inc.; Caltexol CIMFILM.
    - b. BASF Construction Chemicals, LLC; Confilm.
    - c. ChemMasters; Spray-Film.
    - d. Conspec by Dayton Superior; Aquafilm.
    - e. Dayton Superior Corporation; Sure Film (J-74).
    - f. Edoco by Dayton Superior; BurkeFilm.
    - g. Euclid Chemical Company (The), an RPM company; Eucobar.
    - h. Kaufman Products, Inc.; VaporAid.
    - i. Lambert Corporation; LAMBCO Skin.
    - j. L&M Construction Chemicals, Inc.; E-CON.
    - k. Meadows, W. R., Inc.; EVAPRE.
    - l. Metalcrete Industries; Waterhold.
    - m. Nox-Crete Products Group; MONOFILM.
    - n. Sika Corporation, Inc.; SikaFilm.
    - o. SpecChem, LLC; Spec Film.
    - p. Symons by Dayton Superior; Finishing Aid.
    - q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
    - r. Unitex; PRO-FILM.
    - s. Vexcon Chemicals Inc.; Certi-Vex EnvioAssist.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Anti-Hydro International, Inc.; A-H Curing Compound #2 DR WB.
  - b. ChemMasters; Safe-Cure Clear.
  - c. Conspec by Dayton Superior.
  - d. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
  - e. Edoco by Dayton Superior.
  - f. Euclid Chemical Company (The), an RPM company; Kurez W VOX.
  - g. Kaufman Products, Inc.; Thinfilm 420.
  - h. Lambert Corporation; AQUA KURE - CLEAR.
  - i. L&M Construction Chemicals, Inc.; L&M CURE R.
  - j. Meadows, W. R., Inc.; 1100-CLEAR SERIES.
  - k. Nox-Crete Products Group; Resin Cure E.
  - l. SpecChem, LLC; PaveCure Rez.
  - m. Symons by Dayton Superior; Resi-Chem Clear.
  - n. Tamms Industries, Inc., Euclid Chemical Company (The); TAMMSCURE WB 30C.
  - o. TK Products, Division of Sierra Corporation.
  - p. Vexcon Chemicals Inc.; Certi-Vex Enviocure 100.
  
- F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.
  1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Anti-Hydro International, Inc.; A-H Curing Compound #2 WP WB.
    - b. ChemMasters; Safe-Cure 2000.
    - c. Conspec by Dayton Superior.
    - d. Dayton Superior Corporation; Day-Chem White Pigmented Cure (J-10-W).
    - e. Edoco by Dayton Superior; Resin Emulsion Cure V.O.C. (Type II).

- f. Euclid Chemical Company (The), an RPM company; Kurez VOX White Pigmented.
- g. Kaufman Products, Inc.; Thinfilm 450.
- h. Lambert Corporation; AQUA KURE - WHITE.
- i. L&M Construction Chemicals, Inc.; L&M CURE R-2.
- j. Meadows, W. R., Inc.; 1100-WHITE SERIES.
- k. SpecChem, LLC; PaveCure Rez White.
- l. Symons by Dayton Superior; Resi-Chem White.
- m. Vexcon Chemicals Inc.; Certi-Vex Enviocure White 100.

## 2.6 RELATED MATERIALS

- A. Isolation and contraction joints: Minimum 3/4 inch thick asphaltic impregnated fiberboard as per ASTM D-1751.
- B. Joint-Sealant Backer Materials: ASTM D5249, Non-Staining, compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint sealant manufacturer based on field experience and laboratory testing.
- C. Joint Sealant: Non-priming, pourable self-leveling silicone sealant for concrete and asphalt.
  - 1. Cold-Applied Joint Sealant ASTM D5893, self leveling silicone sealant. Crafcoc Inc. "Roadwaver Silicone-SL"; Dow Corning "888, or 890-SL"; Sonneborn "Sonomeric 1 Sealant"; Tremco "Vulkem 45"; or approved equal and,
  - 2. Hot-Applied Joint Sealant: ASTM D3405, Polymeric sealant. Crafcoc Inc. "ROADSAVER 22"; W.R. Meadows, Inc. "SEALTIGHT HI-SPEC", or approved equal.
- D. Joint Fillers: Resilient pre-molded bituminous impregnated fiberboard units complying with ASTM D 1751, asphalt-saturated cellulosic fiber, ASSHTO M 153, Type I: or ASTM D 1752, cork or self-expanding cork.
- E. Exterior Concrete Sealant: Sonneborn "Kure-N-Seal 30" exterior acrylic sealer, or Euclid "Super Rez-Seal", or approved equal.
- F. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.
- G. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

- H. Epoxy Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:
1. Types I and II, non-load bearing and Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- I. Chemical Surface Retarder: Water-soluble, liquid, set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ChemMasters; Exposee.
    - b. Conspec by Dayton Superior; Delay S.
    - c. Dayton Superior Corporation; Sure Etch (J-73).
    - d. Edoco by Dayton Superior; True Etch Surface Retarder.
    - e. Euclid Chemical Company (The), an RPM company; Surface Retarder Formula S.
    - f. Kaufman Products, Inc.; Expose.
    - g. Meadows, W. R., Inc.; TOP-STOP.
    - h. Metalcrete Industries; Surfard.
    - i. Nox-Crete Products Group; CRETE-NOX TA.
    - j. Scofield, L. M. Company; LITHOTEX Top Surface Retarder.
    - k. Sika Corporation, Inc.; Rugasol-S.
    - l. SpecChem, LLC; Spec Etch.
    - m. TK Products, Division of Sierra Corporation; TK-6000 Concrete Surface Retarder.
    - n. Unitex; TOP-ETCH Surface Retarder.
    - o. Vexcon Chemicals Inc.; Certi-Vex Envioset.
- J. Coloring Agent: When required, add coloring agent to mix according to manufacturer's written instructions.
1. Expansion and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork; and,

2. Coloring Agent: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.
- K. Pigmented Mineral Dry-Shake Hardener: Factory-packaged, dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Anti-Hydro International, Inc.; A-H S-Q Hardener.
    - b. BASF Construction Chemicals, LLC; Mastercron.
    - c. ChemMasters; ConColor.
    - d. Conspec by Dayton Superior; Conshake 600 Colortone.
    - e. Dayton Superior Corporation; Quartz Tuff.
    - f. Euclid Chemical Company (The), an RPM company; Surfex.
    - g. Lambert Corporation; COLORHARD.
    - h. L&M Construction Chemicals, Inc.; QUARTZPLATE FF.
    - i. Metalcrete Industries; Floor Quartz.
    - j. Scofield, L. M. Company; LITHOCHROME Color Hardener.
    - k. Southern Color N.A., Inc.; Mosaics Color Hardener.
    - l. Stampcrete International, Ltd.; Color Hardener.
    - m. Symons by Dayton Superior; Hard Top.
  2. Color: As selected by ENGINEER from manufacturer's full range.
- L. Rock Salt: Sodium chloride crystals, kiln dried, coarse gradation with 100 percent passing 3/8-inch sieve and 85 percent retained on a No. 8 sieve.

## 2.7 DETECTABLE WARNING MATERIALS

- A. Detectable Warning Stamp: Semirigid polyurethane mats with formed underside capable of imprinting detectable warning pattern on plastic concrete; perforated with a vent hole at each dome.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Advanced Surfaces Inc.
  - b. Matcrete Precision Stamped Concrete Tools.
  - c. Southern Color N.A., Inc.
  - d. Stampcrete International Ltd.
  - e. Superior Decorative by Dayton Superior.
2. Size of Stamp: One piece matching detectable warning area shown on Drawings.
- B. Liquid Release Agent: Manufacturer's standard, clear, evaporating formulation designed to facilitate release of stamp mats.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Advanced Surfaces Inc.; Liquid Release.
    - b. Matcrete Precision Stamped Concrete Tools; Liquid Release Agent.
    - c. Southern Color N.A., Inc.; SCC Clear Liquid Release.
    - d. Stampcrete International Ltd.; Stampcrete Liquid Release.
    - e. Superior Decorative by Dayton Superior; Pro Liquid Release.

## 2.8 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M), for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
  2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.
- B. Proportion mixtures to provide normal-weight concrete with the following properties:
1. Compressive Strength (28 Days): 3000 psi.
  2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.
  3. Minimum cement content 5 sacks/cubic yard.
  4. Slump Limit: 3 inches, plus or minus 1 inch.
- C. Add air-entraining admixture per the requirements of AASHTO M-154.



1. Air content:  $5\% \pm 1\%$ .

D. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd.

E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

## 2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

2. Mix concrete only in quantities for immediate use.

3. Do not retemper or use set concrete.

B. Project-Site Mixing: On-site mixing must be approved by the Owner. Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For concrete batches of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.

2. For concrete batches larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.

3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

## PART 3 - EXECUTION

### 3.1 BARRICADES

A. Provide substantial temporary barricades around all areas of operation and maintain until work under this section is completed and approved.

B. Install temporary traffic markers, signals, and signs as per D.O.T. Standard Specifications to:

1. Eliminate potentially hazardous conditions.

2. Maintain adequate traffic patterns free of conflict with work under this Contract.

### 3.2 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.
  - 1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
  - 2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
  - 3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 31 20 00 - Earth Moving.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.
- B. Ensure rough grading has brought subgrade to required elevations.
- C. Fill soft spots and hollows with additional fill.
- D. Level and compact subgrade, to receive limerock base for concrete walks, curbs and gutters, to 98% compaction as per AASHTO T-180.

### 3.4 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.
- C. Contractor is responsible for the design, construction, removal and complete safety of formwork and shoring.
- D. Form construction shall be provided to shape, lines dimensions of members shown: substantial, tight enough to prevent leakage, and properly braced or tied to maintain position and size, form sides and bottoms of members unless specifically excepted.
- E. Fill voids of plywood joints with sealant and tool smooth.

- F. Form vertical surfaces to full depth and securely position to required lines and levels. Ensure form ties are not placed so as to pass through concrete.
- G. Arrange and assemble formwork to permit easy dismantling and stripping, and to prevent damage to concrete during formwork removal.
- H. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations.
  - 1. Maintain sufficient quantity of forms to allow continuance of work so that forms remain in place a minimum of 24 hours after concrete placement;
  - 2. Forms shall be cleaned and casted with form release agent thoroughly after each use and before concrete is placed; and,
  - 3. Flexible or curved forms shall be used on curves. Forms shall be of full depth of the concrete and of a strength when staked, sufficient to resist the presence of the concrete and the loads resulting from the finish operations without springing, setting or losing their shape.

### 3.5 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Reinforce concrete curbs and gutters.
- D. Do not extend reinforcing through expansion and contraction of joints. Provide dowelled joints through expansion and contraction joints, with one end of dowels fitted with capping sleeve to allow free movement.
- E. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum 1-1/2 inch cover to reinforcement.
- F. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- G. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.
- H. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.
- I. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

### 3.6 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
  2. Expansion joints and contraction joints, pre-molded as indicated on the drawings:
    - a. Provide joint filler for the entire depth of the slab section and not less than 1 inch below finished surface so as to allow for joint sealer.
    - b. Provide thickened edge expansion joint as indicated on the drawings.
    - c. Provide 1/2 inch contraction joints for curb and gutter at 10 feet on center.
    - d. Provide 1/2 inch expansion joints for curb and gutter and sidewalk at 100 feet on center.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
  2. Provide tie bars at sides of paving strips where indicated.
  3. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
  4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
  5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
1. Locate expansion joints at intervals of 100 feet unless otherwise indicated.
  2. Extend joint fillers full width and depth of joint.
  3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.

4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
  5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
  6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes.
    - a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.
  2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
    - a. Cut joints into hardened concrete within 24 hours of the concrete placement and as soon as surface will not be torn, abraded, or otherwise damaged by cutting action.
    - b. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.
  3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes.
- 3.7 INSPECTION
- A. Assure that excavation and formwork are completed, and excess water is removed.
  - B. Check that reinforcement is secured in place.
  - C. Verify that expansion joint material, anchors, and other embedded items are secured in position.
- 3.8 PREPARATION FOR PLACEMENT
- A. Notify the Engineer and other inspectors at least 36 hours prior to inspection.

- B. Equipment forms and reinforcing shall be clean and wet down, reinforcing firmly secured in place, runways set up and not resting on or displacing reinforcing.

### 3.9 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement and items to be embedded or cast-in.
- B. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- C. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- D. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- E. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- F. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
  - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels and joint devices.
- G. Screed paving surface with a straightedge and strike off.
- H. Place concrete, screed and wood float surfaces to a smooth and uniform finish, free of open texturing and exposed aggregate.
- I. Avoid working mortar to surface.
- J. Round all edges, including edges of expansion and contraction joints, with 1/2 inch of radius edging tool.
- K. Where concrete curbs are adjacent to pavement slabs, make concrete curbs and gutters integral with slabs. Make expansion and contraction joints of curbs coincide with slab joints.
- L. All concrete walks and aprons shall be a minimum of 4 inches thick as shown on the drawings, with a turned down edge as detailed.
- M. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

- N. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.
- O. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
  - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.
- P. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
  - 1. When air temperature has fallen to or is expected to fall below 40 deg F , uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
  - 2. Do not use frozen materials or materials containing ice or snow.
  - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
- Q. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
  - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  - 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
  - 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

### 3.10 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
  - 1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
  - 2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

### 3.11 SPECIAL FINISHES

#### A. Monolithic Exposed-Aggregate Finish: Expose coarse aggregate in paving surface as follows:

1. Immediately after float finishing, spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
2. Cover paving surface with plastic sheeting, sealing laps with tape, and remove when ready to continue finishing operations.
3. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.
4. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.

#### B. Seeded Exposed-Aggregate Finish: Immediately after initial floating, spread a single layer of aggregate uniformly on paving surface. Tamp aggregate into plastic concrete and float finish to entirely embed aggregate with mortar cover of 1/16 inch.

1. Spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
2. Cover paving surface with plastic sheeting, sealing laps with tape, and remove sheeting when ready to continue finishing operations.
3. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.
4. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.

#### C. Slip-Resistive Aggregate Finish: Before final floating, spread slip-resistive aggregate finish on paving surface according to manufacturer's written instructions and as follows:

1. Uniformly spread 40 lb/100 sq. ft. of dampened, slip-resistive aggregate over paving surface in two applications. Tamp aggregate flush with surface using a steel trowel, but do not force below surface.



2. Uniformly distribute approximately two-thirds of slip-resistive aggregate over paving surface with mechanical spreader, allow to absorb moisture, and embed by power floating. Follow power floating with a second slip-resistive aggregate application, uniformly distributing remainder of material at right angles to first application to ensure uniform coverage, and embed by power floating.
  3. Cure concrete with curing compound recommended by slip-resistive aggregate manufacturer. Apply curing compound immediately after final finishing.
  4. After curing, lightly work surface with a steel wire brush or abrasive stone and water to expose nonslip aggregate.
- D. Rock-Salt Finish: After initial floating, uniformly spread rock salt over paving surface at the rate of 5 lb/100 sq. ft.
1. Embed rock salt into plastic concrete with magnesium float.
  2. Cover paving surface with 1-mil-thick polyethylene sheet and remove sheet when concrete has hardened and seven-day curing period has elapsed.
  3. After seven-day curing period, saturate concrete with water and broom-sweep surface to dissolve remaining rock salt, thereby leaving pits and holes.
- E. Pigmented Mineral Dry-Shake Hardener Finish: After initial floating, apply dry-shake materials to paving surface according to manufacturer's written instructions and as follows:
1. Uniformly spread dry-shake hardener at a rate of 100 lb/100 sq. ft., unless greater amount is recommended by manufacturer to match paving color required.
  2. Uniformly distribute approximately two-thirds of dry-shake hardener over the concrete surface with mechanical spreader; allow hardener to absorb moisture and embed it by power floating. Follow power floating with a second application of pigmented mineral dry-shake hardener, uniformly distributing remainder of material at right angles to first application to ensure uniform color, and embed hardener by final power floating.
  3. After final power floating, apply a hand-trowel finish followed by a broom finish.
  4. Cure concrete with curing compound recommended by dry-shake hardener manufacturer. Apply curing compound immediately after final finishing.
- 3.12 DETECTABLE WARNINGS
- A. Blockouts: Form blockouts in concrete for installation of detectable paving units specified in Section 321413 "Precast Concrete Unit Paving".
1. Tolerance for Opening Size: Plus 1/4 inch, no minus.
- B. Stamped Detectable Warnings: Install stamped detectable warnings as part of a continuous concrete paving placement and according to stamp-mat manufacturer's written instructions.

1. Before using stamp mats, verify that the vent holes are unobstructed.
2. Apply liquid release agent to the concrete surface and the stamp mat.
3. Stamping: While initially finished concrete is plastic], accurately align and place stamp mats in sequence. Uniformly load, gently vibrate, and press mats into concrete to produce imprint pattern on concrete surface. Load and tamp mats directly perpendicular to the stamp-mat surface to prevent distortion in shape of domes. Press and tamp until mortar begins to come through all of the vent holes. Gently remove stamp mats.
4. Trimming: After 24 hours, cut off the tips of mortar formed by the vent holes.
5. Remove residual release agent according to manufacturer's written instructions, but no fewer than three days after stamping concrete. High-pressure-wash surface and joint patterns, taking care not to damage stamped concrete. Control, collect, and legally dispose of runoff.

### 3.13 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Begin curing after finishing concrete, but not before free water has disappeared from concrete surface. Cure concrete by moisture curing, moisture-retaining-cover curing or curing compound as follows:
  1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water.
    - b. Continuous water-fog spray.
    - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
  2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

### 3.14 PAVING TOLERANCES

#### A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 1/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot-long, unlevelled straightedge not to exceed 1/4 inch.
4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of tie bar.
5. Lateral Alignment and Spacing of Dowels: 1 inch.
6. Vertical Alignment of Dowels: 1/4 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

### 3.15 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Allow concrete paving to cure for a minimum of 28 days and be dry before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.
  1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to concrete surface. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.

2. Broadcast glass beads uniformly into wet markings at a rate of 6 lb/gal.

### 3.16 WHEEL STOPS

- A. Install wheel stops in bed of adhesive applied as recommended by manufacturer.
- B. Securely attach wheel stops to paving with not less than two galvanized-steel dowels located at one-quarter to one-third points. Install dowels in drilled holes in the paving and bond dowels to wheel stop. Recess head of dowel beneath top of wheel stop.

### 3.17 PREFORMED TRAFFIC-CALMING DEVICES

- A. Install preformed speed humps in bed of adhesive applied as recommended by manufacturer for heavy traffic.
- B. Securely attach preformed speed humps to paving with hardware spaced as recommended by manufacturer for heavy traffic. Recess head of hardware beneath top surface.

### 3.18 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
  1. Testing Frequency: Obtain at least one composite sample for each 55 cu. yd. or fraction thereof of each concrete mixture placed each day.
    - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
  2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
  3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
  5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of four standard cylinder specimens for each composite sample.
  6. Compressive-Strength Tests: ASTM C 39/C 39M; test two specimen at seven days and two specimens at 28 days.

- a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- G. Concrete paving will be considered defective if it does not pass tests and inspections.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- I. Prepare test and inspection reports.

### 3.19 REPAIRS AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

### 3.20 CLEAN UP

- A. Remove all debris and excess material immediately from project site.

- B. Take down all barricades and temporary traffic markers, signals and signs only after all work included in this section is finished and inspected, and only after so directed by the Owner or Engineer.
- C. Leave project area neat, orderly and free of any hazardous conditions.

END OF SECTION

## SECTION 32 13 73 - CONCRETE PAVING JOINT SEALANTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Cold-applied joint sealants.
  - 2. Cold-applied, jet-fuel-resistant joint sealants.
  - 3. Hot-applied joint sealants.
  - 4. Hot-applied, jet-fuel-resistant joint sealants.
- B. Related Sections:(See related sections as applicable)

#### 1.3 PRECONSTRUCTION TESTING

- A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, Samples of materials that will contact or affect joint sealants.
  - 1. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
  - 2. Submit no fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
  - 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
  - 4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
  - 5. Testing will not be required if joint-sealant manufacturers submit joint-preparation data that are based on previous testing, not older than 24 months, of sealant products for compatibility with and adhesion to joint substrates and other materials matching those submitted.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.

- B. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Pavement-Joint-Sealant Schedule: Include the following information:
  - 1. Joint-sealant application, joint location, and designation.
  - 2. Joint-sealant manufacturer and product name.
  - 3. Joint-sealant formulation.
  - 4. Joint-sealant color.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Certificates: For each type of joint sealant and accessory, from manufacturer.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for joint sealants.
- D. Preconstruction Compatibility and Adhesion Test Reports: From joint-sealant manufacturer, indicating the following:
  - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility with and adhesion to joint sealants.
  - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain each type of joint sealant from single source from single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
  - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
- D. Pre-installation Conference: Conduct conference at Project site.

#### 1.7 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:



1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Compatibility: Provide joint sealants, backing materials, 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.
- B. Colors of Exposed Joint Sealants: As indicated by manufacturer's designations.

### 2.2 COLD-APPLIED JOINT SEALANTS

- A. Single-Component, Nonsag, Silicone Joint Sealant for Concrete: ASTM D 5893, Type NS.
  1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Crafcoc Inc., an ERGON company; RoadSaver Silicone.
    - b. Dow Corning Corporation; 888.
    - c. Pecora Corporation; 301 NS.
- B. Single-Component, Self-Leveling, Silicone Joint Sealant for Concrete: ASTM D 5893, Type SL.
  1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Crafcoc Inc., an ERGON company; RoadSaver Silicone SL.
    - b. Dow Corning Corporation; 890-SL.
    - c. Pecora Corporation; 300 SL.
- C. Multicomponent, Pourable, Traffic-Grade, Urethane Joint Sealant for Concrete: ASTM C 920, Type M, Grade P, Class 25, for Use T.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Pecora Corporation; Urexpan NR-200.

### 2.3 COLD-APPLIED, JET-FUEL-RESISTANT JOINT SEALANTS

A. Jet-Fuel-Resistant, Single-Component, Pourable, Traffic-Grade, Modified-Urethane Joint Sealant for Concrete: ASTM C 920, Type S, Grade P, Class 25, for Use T.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Building Systems; Sonomeric 1.

B. Jet-Fuel-Resistant, Multicomponent, Pourable, Traffic-Grade, Modified-Urethane Joint Sealant for Concrete: ASTM C 920, Type M, Grade P, Class 12-1/2, for Use T.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Pecora Corporation; Urexpan NR-300.

C. Jet-Fuel-Resistant, Multicomponent, Pourable, Traffic-Grade, Modified-Urethane Joint Sealant for Concrete: ASTM C 920, Type M, Grade P, Class 25, for Use T.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Meadows, W. R., Inc.; Sealtight Gardox.

### 2.4 HOT-APPLIED JOINT SEALANTS

A. Hot-Applied, Single-Component Joint Sealant for Concrete: ASTM D 3406.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Crafcoc Inc., an ERGON company; Superseal 444/777.

B. Hot-Applied, Single-Component Joint Sealant for Concrete and Asphalt: ASTM D 6690, Types I, II, and III.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Meadows, W. R., Inc.; Sealtight Hi-Spec.

b. Right Pointe; D-3405 Hot Applied Sealant.

## 2.5 HOT-APPLIED, JET-FUEL-RESISTANT JOINT SEALANTS

- A. Hot-Applied, Jet-Fuel-Resistant, Single-Component Joint Sealant for Concrete: ASTM D 7116, Type I.
  - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - b. Crafcoc Inc., an ERGON company; Superseal 444/777.
- B. Hot-Applied, Jet-Fuel-Resistant, Single-Component Joint Sealant for Concrete and Tar Concrete: Single-component formulation complying with ASTM D 3581.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Crafcoc Inc., an ERGON company; Superseal 1614A.

## 2.6 JOINT-SEALANT BACKER MATERIALS

- A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.
- B. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.
- C. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D 5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.
- D. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D 5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

## 2.7 PRIMERS

- A. Primers: Product 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.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. 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.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. **Surface Cleaning of Joints:** Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
- B. **Joint Priming:** Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on 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.

### 3.3 INSTALLATION OF JOINT SEALANTS

- A. **General:** Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
- B. **Joint-Sealant Installation Standard:** Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. **Install joint-sealant backings of kind indicated to support joint 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.**
  - 1. Do not leave gaps between ends of joint-sealant backings.
  - 2. Do not stretch, twist, puncture, or tear joint-sealant backings.
  - 3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.
- D. **Install joint sealants using proven techniques that comply with the following and at the same time backings are installed:**
  - 1. Place joint sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. **Tooling of Nonsag Joint Sealants:** Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:
  - 1. Remove excess joint sealant from surfaces adjacent to joints.

2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

- F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

### 3.4 CLEANING

- A. Clean off excess joint 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.

### 3.5 PROTECTION

- A. 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 and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

### 3.6 PAVEMENT-JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Joints within cement concrete pavement.

1. Joint Location:

- a. Expansion and isolation joints in cast-in-place concrete pavement.
- b. Contraction joints in cast-in-place concrete slabs.
- c. Other joints as indicated.

2. Silicone Joint Sealant for Concrete: Single component, nonsag.

3. Urethane Joint Sealant for Concrete: Multicomponent, pourable, traffic-grade.

4. Hot-Applied Joint Sealant for Concrete: Single component.

5. Joint-Sealant Color: As indicated by manufacturer's designations.

- B. Joint-Sealant Application: Fuel-resistant joints within cement concrete pavement.

1. Joint Location:

- a. Expansion and isolation joints in cast-in-place concrete pavement.
- b. Contraction joints in cast-in-place concrete slabs.

- c. Other joints as indicated.
  - 2. Jet-Fuel-Resistant, Modified-Urethane Joint Sealant for Concrete: Single-component, pourable, traffic-grade.
  - 3. Hot-Applied, Jet-Fuel-Resistant, Joint Sealant for Concrete: Single component.
  - 4. Joint-Sealant Color: As indicated by manufacturer's designations.
- C. Joint-Sealant Application: Joints between cement concrete and asphalt pavement.
- 1. Joint Location:
    - a. Joints between concrete and asphalt pavement.
    - b. Joints between concrete curbs and asphalt pavement.
    - c. Other joints as indicated.
  - 2. Hot-Applied Joint Sealant for Concrete and Asphalt: Single component.
  - 3. Joint-Sealant Color: As indicated by manufacturer's designations.
- D. Joint-Sealant Application: Fuel-resistant joints between cement concrete and tar-concrete pavement.
- 1. Joint Location:
    - a. Joints between concrete and tar-concrete pavement.
    - b. Joints between concrete curbs and tar-concrete pavement.
    - c. Other joints as indicated.
  - 2. Hot-Applied, Jet-Fuel-Resistance Joint Sealant for Concrete and Tar Concrete: Single component.
  - 3. Joint-Sealant Color: As indicated by manufacturer's designations.

END OF SECTION

## SECTION 32 17 13 - PARKING BUMPERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 32 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes wheel stops.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals:
  - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
- C. Samples for Initial Selection: For each type of exposed finish requiring color selection.
- D. Samples for Verification: For wheel stops, 6 inches long, showing color and cross section; with fasteners.

### PART 2 - PRODUCTS

#### 2.1 PARKING BUMPERS

- A. Concrete Wheel Stops: Precast, steel-reinforced, air-entrained concrete, 4000-psi minimum compressive strength, 4-1/2 inches high by 9 inches wide by 72 inches long. Provide chamfered corners, transverse drainage slots on underside, and a minimum of two factory-formed or -drilled vertical holes through wheel stop for anchoring to substrate.
  - 1. Surface Appearance: Free of pockets, sand streaks, honeycombs, and other obvious defects. Corners shall be uniform, straight, and sharp.
  - 2. Mounting Hardware: Galvanized-steel spike or dowel, 1/2-inch diameter, 10-inch minimum length.
- B. Resilient Wheel Stops: Solid, integrally colored, 96 percent postconsumer or commingled postconsumer and preconsumer recycled plastic; UV stabilized; 4 inches high by 6 inches wide by 72 inches long. Provide chamfered corners and a minimum of two factory-formed or -drilled vertical holes through wheel stop for anchoring to substrate.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Checkers Industrial Safety Products, Inc.
  - b. GNR Technologies.
  - c. Plastic Safety Systems, Inc.
  - d. Scientific Developments, Inc.
  - e. Technoflex.
  - f. Traffic Logix.
3. Color: As indicated on the drawings.
4. Embedded Markings: Molded-in, reflective markings, permanently inset in exposed surface.
5. Mounting Hardware: Galvanized-steel, 1/2-inch diameter, 10-inch minimum length.
6. Adhesive: As recommended by wheel-stop manufacturer for adhesion to pavement.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. General: Install wheel stops according to manufacturer's written instructions unless otherwise indicated.
- B. Install wheel stops in bed of adhesive before anchoring.
- C. Securely anchor wheel stops to pavement with hardware in each preformed vertical hole in wheel stop as recommended in writing by manufacturer. Recess head of hardware beneath top of wheel stop.

END OF SECTION



## SECTION 32 17 23 - PAVEMENT MARKINGS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 32 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes painted markings applied to asphalt and concrete pavement.
- B. Related Requirements:
  - 1. Section 321216 - Asphalt Paving.
  - 2. Section 321313 - Concrete Paving.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include technical data and tested physical and performance properties.
- B. Shop Drawings: For pavement markings.
  - 1. Indicate pavement markings, colors, lane separations, defined parking spaces, and dimensions to adjacent work.
  - 2. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.
- C. Samples: For each exposed product and for each color and texture specified; on rigid backing, 8 inches square.

#### 1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of local agencies for pavement-marking work.

#### 1.5 FIELD CONDITIONS

- A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for alkyd materials, 55 deg F for water-based materials, and not exceeding 95 deg F.

### PART 2 - PRODUCTS

## 2.1 PAVEMENT-MARKING PAINT

- A. Chlorinated rubber-alkyd type, as per Fed Spec. No. TT-P-115, Type III, or shall be Code T-1, conforming to Section 971-12.2 of the Florida Department of Transportation Standard Specifications.
- B. Paint shall be factory mixed, quick drying and non-bleeding type.
- C. Color shall be as per D.O.T. requirements.
- D. Striping, arrows, lane markers and stop bars shall be provided with paint containing reflective additive.
- E. Thermoplastic paint shall conform to the applicable Technical Specifications (Section 711) of the Florida Department of Transportation and Broward County Standards.
- F. Traffic paint shall conform to the applicable Technical Specifications (Section 710) of the Florida Department of Transportation and Broward County Standards.
- G. Reflectors shall be in accordance with Broward County Minimum Standards.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that pavement is dry and in suitable condition to begin pavement marking according to manufacturer's written instructions.
- B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

### 3.2 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Engineer.
- B. Allow paving to age for a minimum of 30 days before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.
  - 1. Apply in not less than (2) two coats as per manufacturer's recommended rates of applications.
  - 2. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to pavement. Mask an extended area beyond edges of each stencil to prevent paint application beyond the stencil. Apply paint so that it cannot run beneath the stencil.

3. Broadcast glass beads uniformly into wet markings at a rate of 6 lb/gal.

### 3.3 PROTECTING AND CLEANING

- A. Protect pavement markings until completely dry in accordance with manufacturers recommendations.
- B. Protect pavement markings from damage and wear during remainder of construction period.
- C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

### 3.4 TEMPORARY PAVEMENT MARKINGS

- A. Temporary paint shall be applied in accordance with permanent pavement marking specifications. However, only 1 coat of paint shall be required to a clean, dry surface using template or a striping machine. The Contractor may also propose to utilize temporary/removable pavement marking tape, as approved by the Owner.
- B. Markings shall be applied using butyl adhesive pads or paint to clean dry pavement surfaces which are free of cracking, checking, spalling, or failure of underlying base material.
- C. When required, removable marking tape or pavement marking paint shall be applied on clean dry surfaces at designated locations. Tape that has become damaged and is no longer serviceable shall be replaced without additional compensation.
- D. All temporary markings and striping shall be removed when no longer required. Any pavement area that has been determined to be damaged as a result of the removal operation shall be repaired at no cost to the Owner.

### 3.5 PAVEMENT MARKING REMOVAL

- A. Existing pavement marking lines and symbols shall be removed as to not materially or structurally damage the surface or texture of the pavement. A motorized abrasive device shall be utilized to remove existing markings. The Contractor shall repair any damage to the pavement at no expense to the Owner. The pavement surface shall be left in a condition that will not mislead or misdirect customers or motorists. Pavement marking removal within public rights of way shall be completed in accordance with the regulatory authority having jurisdiction and the specifications.

END OF SECTION

SECTION 33 05 20 - PIPING, GENERAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. The Contractor shall furnish and install all piping systems shown and specified, in accordance with the requirements of the Contract Documents. Each system shall be complete with all necessary fittings, hangers, supports, anchors, expansion joints, flexible connectors, valves, accessories, heat tracing, insulation, lining and coating, testing, disinfection, excavation, backfill and encasement, to provide a functional installation.
- B. The piping shown is intended to define the general layout, configuration, routing, method of support, pipe size, and pipe type. The mechanical drawings are not pipe construction or fabrication drawings. It is the Contractor's responsibility to develop the details necessary to construct all mechanical piping systems to accommodate the specific equipment provided, and to provide and install all spools, spacers, adapters, connectors, etc., for a complete and functional system.

1.3 RELATED WORK:(See applicable related sections)

1.4 REFERENCE STANDARDS

- A. Codes: All codes, as referenced herein are specified in Section 014219, "Reference Standards".

- B. Commercial Standards:

ANSI/ASME B1.20.1	Pipe Threads, General Purpose (inch).
ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys.
ANSI/AWWA C207	Steel Pipe Flanges for Water Works Service, Sizes 4 in through 144 in.
ANSI/AWWA C606	Grooved and Shouldered Joints.
ANSI/AWS D1.1	Structural Welding Code.
ASTM A 307	Specification for Carbon Steel Bolts and Studs, 6,000 psi Tensile.
ASTM A 325	Specification for High-Strength Bolts for Structural Steel Joints.
ASTM D 792	Test Methods for Specific Gravity and Density of Plastics by Displacement.
ASTM D 2000	Classification System for Rubber Products in Automotive Applications.

## 1.5 SUBMITTALS

- A. The Contractor shall submit complete shop Drawings and certificates, test reports, affidavits of compliance, of all piping systems, in accordance with the requirements in Section 01330, "Shop Drawings, Product Data and Samples", and as specified in the individual sections. The shop Drawings shall include all necessary dimensions and details on pipe joints, fittings, fitting specials, valves, appurtenances, design calculations, and material lists. The submittals shall include detailed layout, spool, or fabrication Drawings which show all pipe spools, spacers, adapters, connectors, fittings, and pipe supports necessary to accommodate the equipment and valves provided in a complete and functional system.
- B. All expenses incurred in making samples for certification of tests shall be borne by the Contractor.
- C. The Contractor shall submit as part of the shop Drawings a certification from the pipe fabricator stating that all pipes will be fabricated subject to a recognized Quality Control Program. An outline of the program shall be submitted to the Engineer for review prior to the fabrication of any pipe

## 1.6 QUALITY ASSURANCE

- A. Inspection: All pipe shall be subject to inspection at the place of manufacture. During the manufacture of the pipe, the Engineer shall be given access to all areas where manufacturing is in progress and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.
- B. Tests: Except where otherwise specified, all materials used in the manufacture of the pipe shall be tested in accordance with the applicable Specifications and Standards. The Contractor shall perform all tests at no additional cost to the Owner.
- C. Welding Requirements: All welding procedures used to fabricate pipe shall be pre-qualified under the provisions of ANSI/AWS D1.1. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.
- D. Welder Qualifications: All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local, approved testing agency not more than 6 months prior to commencing work on the pipeline. Machines and electrodes similar to those used in the WORK shall be used in qualification tests. The Contractor shall furnish all material and bear the expense of qualifying welders.

## 1.7 MANUFACTURER'S SERVICE REPRESENTATIVE

- A. Where the assistance of a manufacturer's service representative is advisable, in order to obtain perfect pipe joints, supports, or special connections, the Contractor shall furnish such assistance at no additional cost to the Owner.

## 1.8 MATERIAL DELIVERY, STORAGE, AND HANDLING

- A. All piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition and stored off the ground, to provide protection against oxidation caused by ground contact. All defective or damaged materials shall be replaced with new materials.

## 1.9 CLEANUP

- A. After completion of the work, all remaining pipe cuttings, joining and wrapping materials, and other scattered debris, shall be removed from the site. The entire piping system shall be handed over in a clean and functional condition.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. All pipes, fittings, and appurtenances shall be furnished in accordance with the requirements of the applicable Sections of Division 2 and as specified herein.
- B. Lining: All requirements pertaining to thickness, application, and curing of pipe lining, are in accordance with the requirements of the applicable Sections of Division 2, unless otherwise specified.
- C. Coating: All requirements pertaining to thickness, application, and curing of pipe coating, are in accordance with the requirements of the applicable Sections of Division 2, unless otherwise specified. Pipes above ground or in structures shall be field-painted as directed by the Engineer.
- D. Grooved Piping Systems: Piping systems with grooved joints and fittings may be provided in lieu of screwed, flanged, welded, or mechanical joint systems for ductile iron yard piping. (All piping above and below ground within the property limits of treatment plants, pump stations, and similar installations). All grooved couplings on buried piping must be bonded. To assure uniform and compatible piping components, all grooved fittings, couplings, and valves shall be from the same manufacturer. The Contractor shall make the coupling manufacturer responsible for the selection of the correct style of coupling and gasket for each individual location.

### 2.2 PIPE FLANGES

- A. Flanges: Where the design pressure is 150 psi or less, flanges shall conform to either ANSI/AWWA C207 Class D or ANSI B16.5 150-lb class. Where the design pressure is greater than 150 psi, up to a maximum of 275 psi, flanges shall conform to either ANSI/AWWA C207 Class E, Class F, or ANSI B16.5 150-lb class. However, AWWA flanges shall not be exposed to test pressure greater than 125% of rated capacity. For higher test pressures, the next higher rated AWWA flange or an ANSI-rated flange shall be selected. Where the design pressure is greater than 275 psi up to a maximum of 700 psi, flanges shall conform to ANSI B16.5 300-lb class. Flanges shall have flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise shown. Attachment of the flanges to the pipe shall conform to the applicable requirements of ANSI/AWWA C207. Flanges for miscellaneous small pipes shall be in accordance with the standards specified for these pipes.
- B. Blind Flanges: Blind flanges shall be in accordance with ANSI/AWWA C207, or with the standards for miscellaneous small pipes. All blind flanges for pipe sizes 12 inches and over shall be provided with lifting eyes in form of welded or screwed eye bolts.
- C. Flange Coating: All machined faces of metal blind flanges and pipe flanges shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is completed.

- D. Flange Bolts: All bolts and nuts shall conform to pipe manufacturers recommendations. Studs and bolts shall extend through the nuts a minimum of 1/4-inch. All-thread studs shall be used on all valve flange connections, where space restrictions preclude the use of regular bolts.
  - E. Insulating Flanges: Insulated flanges shall have bolt holes 1/4-inch diameter greater than the bolt diameter.
  - F. Insulating Flange Sets: Insulating flange sets shall be provided where shown. Each insulating flange set shall consist of an insulating gasket, insulating sleeves and washers and a steel washer. Insulating sleeves and washers shall be one piece when flange bolt diameter is 1-1/2-inch or smaller and shall be made of acetal resin. For bolt diameters larger than 1-1/2-inch, insulating sleeves and washers shall be 2-piece and shall be made of polyethylene or phenolic. Steel washers shall be in accordance with ASTM A 325. Insulating gaskets shall be full-face.
  - G. Insulating Flange Manufacturers, or Equal:
    - 1. JM Red Devil, Type E.
    - 2. Maloney Pipeline Products Co., Houston.
    - 3. PSI Products, Inc., Burbank, California.
  - H. Flange Gaskets: Gaskets for flanged joints shall be full-faced, 1/16-inch thick compressed sheets of aramid fiber base, with nitrile binder and non-stick coating, suitable for temperatures to 700 degrees F, a pH of one to eleven, and pressures to 1000 psig. Blind flanges shall have gaskets covering the entire inside face of the blind flange and shall be cemented to the blind flange. Ring gaskets shall not be permitted.
  - I. Flange Gasket Manufacturers, or Equal:
    - 1. John Crane, style 2160.
    - 2. Garlock, style 3000.
- 2.3 THREADED INSULATING CONNECTIONS
- A. General: Threaded insulating bushings, unions, or couplings, as appropriate, shall be used for joining threaded pipes of dissimilar metals and for piping systems where corrosion control and cathodic protection are involved.
  - B. Materials: Threaded insulating connections shall be of nylon, Teflon, polycarbonate, polyethylene, or other non-conductive materials, and shall have ratings and properties to suit the service and loading conditions.
- 2.4 MECHANICAL-TYPE COUPLINGS (GROOVED OR BANDED PIPE)

- A. General: Cast mechanical-type couplings shall be provided where shown. The couplings shall conform to the requirements of ANSI/AWWA C606. All gaskets for mechanical-type couplings shall be compatible with the piping service and fluid utilized, in accordance with the coupling manufacturer's recommendations. The wall thickness of all grooved piping shall conform with the coupling manufacturer's recommendations to suit the highest expected pressure. To avoid stress on equipment, all equipment connections shall have rigid-grooved couplings, or harness sets in sizes where rigid couplings are not available, unless thrust restraint is provided by other means. The Contractor shall have the coupling Manufacturer's service representative verify the correct choice and application of all couplings and gaskets, and the workmanship, to assure a correct installation.
- B. Couplings for Steel Pipe, Manufacturers, or Equal:
  - 1. Gustin-Bacon (banded or grooved).
  - 2. Victaulic Style 41 or 44 (banded, flexible).
  - 3. Victaulic Style 77 or 07 (grooved).
- C. Ductile Iron Pipe Couplings, Manufacturers, or Equal:
  - 1. Gustin-Bacon.
  - 2. Victaulic Style 31.

Note: Ductile iron pipe couplings shall be furnished with flush seal gaskets.

## 2.5 SLEEVE-TYPE COUPLINGS

- A. Construction: Sleeve-type couplings shall be provided where shown, in accordance with ANSI/AWWA C219 unless otherwise specified, and shall be of steel with steel bolts, without pipe stop, and shall be of sizes to fit the pipe and fittings shown. The middle ring shall be not less than 1/4-inch in thickness and shall be either 5 or 7 inches long for sizes up to and including 30 inches and 10 inches long for sizes greater than 30 inches, for standard steel couplings, and 16 inches long for long-sleeve couplings. The followers shall be single-piece contoured mill section welded and cold-expanded as required for the middle rings. They shall be of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling. The shape of the follower shall be of such design as to provide positive confinement of the gasket. Buried sleeve-type couplings shall be epoxy-coated at the factory as specified.
- B. Pipe Preparation: The ends of the pipe, where specified or shown, shall be prepared for flexible steel couplings. Plain ends for use with couplings shall be smooth and round for a distance of 12 inches from the ends of the pipe, with outside diameter not more than 1/64-inch smaller than the nominal outside diameter of the pipe. The middle ring shall be tested by cold-expanding a minimum of one percent beyond the yield point, to proof-test the weld to the strength of the parent metal. The weld of the middle ring shall be subjected to air test for porosity.
- C. Gaskets: Gaskets for sleeve-type couplings shall be rubber-compound material that will not deteriorate from age or exposure to air under normal storage or use conditions. Gaskets for wastewater and sewerage applications shall be Buna "N," grade 60, or equivalent suitable elastomer. The rubber in the gasket shall meet the following specifications:



1. Color - Jet Black.
2. Surface - Non-blooming.
3. Durometer Hardness -  $74 \pm 5$ .
4. Tensile Strength - 1000 psi Minimum.
5. Elongation - 175% Minimum.

The gaskets shall be immune to attack by impurities normally found in water or wastewater. All gaskets shall meet the requirements of ASTM D 2000, AA709Z, meeting Suffix B13 Grade 3, except as noted above. All gaskets shall be compatible with the piping service and fluid utilized.

- D. Insulating Couplings: Where insulating couplings are required, both ends of the coupling shall have a wedge-shaped gasket which assembles over a rubber sleeve of an insulating compound in order to obtain insulation of all coupling metal parts from the pipe.
- E. Restrained Joints: All sleeve-type couplings on pressure lines shall be harnessed unless thrust restraint is provided by other means. Harnesses shall be in accordance with the requirements of the appropriate reference standard, or as shown.

Manufacturers or Equal:

1. Dresser, Style 38.
2. Ford Meter Box Co., Inc., Style FC1 or FC3.
3. Smith-Blair, Style 411.

## 2.6 FLEXIBLE CONNECTORS

- A. Flexible connectors shall be installed in all piping connections to engines, blowers, compressors, and other vibrating equipment, and where shown. Flexible connectors for service temperatures up to 180 degrees F shall be flanged, reinforced Neoprene or Butyl spools, rated for a working pressure of 40 to 150 psi, or reinforced, flanged duck and rubber, as best suited for the application. Flexible connectors for service temperatures above 180 degrees F shall be flanged, braided stainless steel spools with inner, annular, corrugated stainless steel hose, rated for minimum 150 psi working pressure, unless otherwise shown. The connectors shall be 9 inches long, face-to-face flanges, unless otherwise shown. The final material selection shall be approved by the manufacturer. The Contractor shall submit manufacturer's shop drawings and calculations.

## 2.7 EXPANSION JOINTS

- A. All piping subject to expansion and contraction shall be provided with sufficient means to compensate for such movement, without exertion of undue forces to equipment or structures. This may be accomplished with expansion loops, bellow-type expansion joints, or sliding-type expansion joints. Expansion joints shall be of stainless steel, monel, rubber, or other materials, best suited for each individual service. The Contractor shall submit detailed calculations and manufacturer's shop drawings, guaranteeing satisfactory performance of all proposed expansion joints, piping layouts showing all anchors and guides, and information on materials, temperature and pressure ratings.

## 2.8 PIPE THREADS

- A. All pipe threads shall be in accordance with ANSI/ASME B1.20.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. The lining manufacturer shall take full responsibility for the complete, final product and its application. All pipe ends and joints at screwed flanges shall be epoxy-coated, to assure continuous protection.
- B. Where core drilling is required for pipes passing through existing concrete, core drilling locations shall be determined by radiograph of concrete construction to avoid damage to embedded raceways and rebars.
- C. All exposed piping shall be painted. All piping to be painted shall be color coded in accordance with Owner's standard color code. Color samples shall be submitted to Engineer for final color selection.

### 3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and utilities Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. 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:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. 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.
- E. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- G. Grooved Joints: Assemble joints with grooved-end pipe coupling with coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- H. 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 (0.20 percent maximum lead content) complying with ASTM B 32.

- I. 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.
- J. Pressure-Sealed Joints: Assemble joints for plain-end copper tube and mechanical pressure seal fitting with proprietary crimping tool to according to fitting manufacturer's written instructions.
- K. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.
  - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
  - 4. 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.
  - 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
  - 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- L. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- M. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- N. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
  - 1. Plain-End PE Pipe and Fittings: Use butt fusion.
  - 2. Plain-End PE Pipe and Socket Fittings: Use socket fusion.
- O. Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

END OF SECTION

SECTION 33 05 21 - VALVES, GENERAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 33 Specification Sections, apply to this Section.
- B. Provide all labor, materials, necessary equipment and services to complete the Water Systems work, as indicated on the drawings, as specified herein or both, except as for items specifically indicated as "NIC ITEMS."

1.2 WORK INCLUDED

- A. The Contractor shall provide all tools, supplies, materials, equipment, and labor necessary for furnishing, epoxy coating, installing, adjusting, and testing of all valves and appurtenant work, complete and operable, in accordance with the requirements of the Contract Documents. Where buried valves are shown, the Contractor shall furnish and install valve boxes to grade, with covers, extensions, and position indicators.
- B. The provisions of this Section shall apply to all valves and valve operators specified in the various Sections and Division 33 of these Specifications including test valves, except where otherwise specified in the Contract Documents. Valves and operators in particular locations may require a combination of units, sensors, limit switches, and controls specified in other Sections of these Specifications.

1.3 RELATED WORK: (See applicable related sections)

1.4 REFERENCE STANDARDS

- A. **Codes:** All codes, as referenced herein, are specified in Section 014219 "Reference Standards".

- B. Commercial Standards:

ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.

ANSI B16.5 Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys.

ANSI/ASME B31.1 Power Piping.

ASTM A 36 Specification for Structural Steel.

ASTM A 48 Specification for Gray Iron Castings.

ASTM A 126 Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

ASTM A 536	Specification for Ductile Iron Castings.
ASTM B 61	Specification for Steam or Valve Bronze Castings.
ASTM B 62	Specification for Composition Bronze or Ounce Metal Castings.
ASTM B 148	Specification for Aluminum-Bronze Castings.
ASTM B 584	Specification for Copper Alloy Sand Castings for General Applications.
ANSI/AWWA C500	Gate Valves for Water and Sewerage Systems.
ANSI/AWWA C502	Dry-Barrel Fire Hydrants.
ANSI/AWWA C503	Wet-Barrel Fire Hydrants.
ANSI/AWWA C504	Rubber-Seated Butterfly Valves.
ANSI/AWWA C507	Ball Valves 6 Inches Through 48 Inches.
AWWA C508	Swing-Check Valves for Waterwork Service, 2 Inches Through 24 Inches NPS.
ANSI/AWWA C509	Resilient-Seated Gate Valves for Water and Sewage Systems.
ANSI/AWWA C511	Reduced-Pressure Principle Backflow-Prevention Assembly.
AWWA C550	Protective Interior Coatings for Valves and Hydrants.
SSPC-SP-2	Hand Tool Cleaning.
SSPC-SP-5	White Metal Blast Cleaning.

#### 1.5 SUBMITTALS

- A. **Shop Drawings:** Shop drawings of all valves and operators including associated wiring diagrams and electrical data, shall be furnished as specified in Section 013323, "Shop Drawings, Product Data and Samples".
- B. **Valve Labeling:** The Contractor shall submit a schedule of valves to be labeled indicating in each case the valve location and the proposed wording for the label.

#### 1.6 QUALITY ASSURANCE

- A. **Valve Testing:** Unless otherwise specified, each valve body shall be tested under a test pressure equal to twice its design water-working pressure.
- B. **Bronze Parts:** Unless otherwise specified, all interior bronze parts of valves shall conform to the requirements of ASTM B 62, or where not subject to dezincification, to ASTM B 584.

- C. **Certification:** Prior to shipment, the Contractor shall submit for all valves over 12 inches in size, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, ASTM, etc.

## PART 2 - PRODUCTS

### 2.1 VALVES, GENERAL

- A. **General:** The Contractor shall furnish all valves, gates, valve-operating units, stem extensions, and other accessories as shown or specified. All valves and gates shall be new and of current manufacture. All shut-off valves, 6-inch and larger, shall have operators with position indicators. Where buried, these valves shall be provided with valve boxes and covers containing position indicators, and valve extensions. Shut-off valves mounted higher than 5 feet-6 inches above working level shall be provided with chain operators.
- B. **Valve Flanges:** The flanges of valves shall be in accordance with Section 330520, "Piping, General".
- C. **Gate Valve Stems:** Where subject to dezincification, gate valve stems shall be of bronze conforming to ASTM B 62, containing not more than 5% of zinc nor more than 2% aluminum. Gate valve stems shall have a minimum tensile strength of 60,000 psi, a minimum yield strength of 40,000 psi, and an elongation of at least 10% in 2 inches, as determined by a test coupon poured from the same ladle from which the valve stems to be furnished are poured. Where dezincification is not a problem, bronze conforming to ASTM B 584 may be used.
- D. **Protective Coating:** Except where otherwise specified, ferrous surfaces, exclusive of stainless steel surfaces, in the water passages of all valves 4-inch and larger, as well as the exterior surfaces of all submerged valves, shall be coated with 2 part thermal setting epoxy coatings. Flange faces of valves shall not be epoxy coated. The valve manufacturer shall certify in writing that such coating has been applied and tested in the manufacturing plant prior to shipment, in accordance with these Specifications.
- E. **Valve Operators:** Where shown, certain valves and gates shall be furnished with electric operators, provided by the valve or gate manufacturer. All operators of a given type shall be furnished by the same manufacturer. Where these operators are supplied by different manufacturers, the Contractor shall coordinate their selection to provide uniformity of each type of electric operator. All valve operators, regardless of type, shall be installed, adjusted, and tested by the valve manufacturer at the manufacturing plant.
- F. **Valve Labeling:** Except when such requirement is waived by the Engineer in writing, a label shall be provided on all shut-off valves exclusive of hose bibbs and chlorine cylinder valves. The label shall be of 1/16-inch plastic or stainless steel, minimum 2 inches by 4 inches in size, and shall be permanently attached to the valve or on the wall adjacent to the valve as directed by the Engineer.
- G. **Nuts and Bolts:** All nuts and bolts on valve flanges and supports shall be in accordance with manufacturer's recommendations. Where submerged or buried, all nuts and bolts on valve flanges and valve bodies shall be stainless steel.

### 2.2 GATE VALVES

A. All buried valves shall be of the inside screw, non-rising stem type. Valves shall be capable of being repacked under line pressure. Valves 14-inch and larger installed vertical pipes with their stems horizontal shall be fitted with bronze slides, tracks, rollers, and scrapers to assist the travel of the gate assembly. Quick opening valves shall have quick opening levers and cams in lieu of handwheel operators.

**B. Knife Gate Valves:**

1. Knife gate valves shall be provided with raised face and resilient seats for positive seating. Wetted parts shall be constructed of Type 316 stainless steel. Gates shall be finish-ground on both sides to prevent packing or seat damage. Valves 2 to 4 inches in size shall be furnished with cast stainless steel bodies; valves 6 to 24 inches in size shall be furnished with cast semi-steel bodies with stainless steel linings. Valve ends shall be of the flanged or wafer design, as shown. Gate guides and jams shall be steel. Actuator shall be handwheel. Port design shall be full-round.

2. Manufacturers or Equal:

- a. Red Valve Company Inc.;
- b. DeZurik Corporation;
- c. Fabri-Valves;
- d. Rovang, Inc.

**C. Resilient-Seated Gate Valves:**

1. Resilient-seated gate valves conforming to ANSI/AWWA C509 shall be provided. Resilient-seated gate valves shall have cast iron bodies with flanged, bell, or mechanical joint ends, rubber-coated cast iron disc, flanged bonnet, bronze stem, O-ring seals, and operators with handwheel or square nut, unless otherwise shown. Rubber and rubber composition materials shall be suitable for use in water containing chlorine or chloramines and in sanitary sewage.

2. Manufacturer or Equal:

- a. Clow Valve Co.; F-6100
- b. Kennedy Valve; Ken-Seal
- c. Mueller Company; 2370
- d. American - Darling Valve Co.; 80 line

2.3 ECCENTRIC PLUG VALVES

- A. **Equipment Requirements:** Plug valves shall be on the non-lubricated, eccentric type with resilient faced plugs, port areas for valves 20 inches and smaller shall be at least 80% of full pipe area. Port area of valves 24 inches and larger shall be at least 70% of full pipe area. The body shall be of semi-steel (ASTM A-126 C1.B) and shall have bolted bonnet which gives access to the intervals of the valve. Seats shall be welded overlay of high nickel content or a stainless steel plate locked in the body cavity. If a plate is used, it shall be replaceable through the bonnet access. Bearings shall be permanently lubricated of stainless steel, bronze or Teflon lined, fiber glass backed duralon. Bearing areas shall be isolated form the flow with grit seals. Valves shall have packing bonnets where the shaft protrudes from the grit seals. Valves shall have packing bonnets where the shaft protruded from the valve and the packing shall be self-adjusting chevron type which can be replaced without removing the bonnet. All nuts, bolts, springs and washers shall be stainless steel.
- B. Valves shall be designed for a working pressure of 150 psi. The valve and actuator shall be capable of satisfactory operation in either direction of flow against pressure drops up to and including 100 PSI (for plug valves over 12 inches in diameter). Valves shall be bubble tight in both directions at 100 psi differential.

Plug valves over 12" in diameter shall have worm gear operators. The operating mechanism shall be for buried service with a 2 inch square operating nut.

- C. Plug valves are to be installed with the seat pointed towards the upstream flow, when specified.

D. **Manufacturers or Equal:**

1. Clow Valve Co.
2. DeZurik Corporation.
3. U.S. Pipe.

2.4 SWING FLEX CHECK VALVE

- A. **General Requirements:** The check valve shall be of the Swing Flex, full body flanged type, with a top access cover and only one moving part, the valve disc.
- B. **Body:** The valve body shall have 100% pipe flow area, with no restrictions at any point, through the valve. The Seating surface shall be on a 45 angle to minimize disc travel. The top access port shall be full size, allowing removal of the disc without removing the valve from the pipeline.
- C. The access cover shall be domed in shape, to allow the disc to fully open should waste solids collect behind the disc. Cover shall be secured with stainless steel bolts.
- D. The disc shall be of one piece construction, compression model with an O-ring type sealing surface and contain steel and nylon reinforcements in both the pivot and a central disc area.
- E. **Materials of Construction:**
1. Body - Cast Iron ASTM A126, Class B.



2. Disc - Buna-N (NBR) , ASTM D2000-BR.
3. Bolts - 304 Stainless Steel.

The exterior shall be coated with a red oxide primer.

**F. Manufacturers or Equal:**

1. Val-Matic Valve.
2. Manufacturing Corporation; Series 500.

**2.5 BALL VALVES (4-INCH AND SMALLER)**

- A. **General Requirements:** Unless otherwise specified or shown, general purpose ball valves in size up to 4-inch shall have manual operators with lever or handwheel. Ferrous surface of 4-inch valves, which will be in contact with water shall be epoxy-coated. All ball valves shall be of best commercial quality, heavy duty construction.
- B. **Body:** All ball valves up to 1-1/2 inch (incl.) in size shall have bronze or forged brass 2 or 3 piece bodies with screwed ends for a pressure rating of not less than 300 psi WOG. Valves 2-inch to 4-inch in size shall have bronze forged brass or steel 2 or 3 piece bodies with flanged ends for a pressure rating of 125 psi or 150 psi.
- C. **Balls:** The balls shall be solid brass or chrome plated bronze, or stainless steel, with large or full openings.
- D. **Stems:** The valves seats shall be of Teflon or Buna N or equal, for bi-directional service and easy replacement.

**E. Ball Valve Manufacturers or Equal:**

1. Jamesbury Corporation.
2. Jenkins Bros.
3. Lunkenheimer Flow Control.
4. Wm. Powell Company.
5. Worcester Controls.
6. Valve Primer Corporation.

**2.6 SWING CHECK VALVES (3-INCH AND LARGER)**

- A. **General:** Swing check valves for water, sewage, sludge, and general service shall be of the outside lever and spring or weight type, in accordance with ANSI/AWWA C 508 - Swing-Check Valves for Waterworks Service, 2 in. through 24 in. NPS (Nominal Pipe Size), unless otherwise indicated, with full-opening passages, designed for a water-working pressure of 150 psi. They shall have a flanged cover piece to provide access to the disc.
- B. **Body:** The valve body and cover shall be of cast iron conforming to ASTM A 126, with flanged ends conforming to ANSI B 16.1, or mechanical joint ends, as shown.
- C. **Disc:** The valve disc shall be of cast iron, ductile iron, or bronze conforming to ASTM B 62.
- D. **Seat and Rings:** The valve seat and rings shall be of bronze conforming to ASTM B 62 or B 148, or of Buna-N or equal.
- E. **Hinge Pin:** The hinge pin shall be of bronze or stainless steel.
- F. **Swing Check Valve Manufacturers or Equal:**
  - 1. American-Darling Valve Co.
  - 2. Kennedy Valve.
  - 3. Mueller Company.
  - 4. Stockham Valves and Fittings.

## 2.7 AIR-VACUUM AND AIR-RELEASE VALVES

- A. **Air and Vacuum Valves:** Air and vacuum valves shall be capable of venting large quantities of air while pipelines are being filled, and allowing air to re-enter while pipelines are being drained. They shall be of the size shown, with flanged or screwed ends to match piping. Bodies shall be of high-strength cast iron. The float, seat, off-set piping, and all moving parts shall be constructed of Type 316 stainless steel. Seat washers and gaskets shall be of a material insuring water tightness with a minimum of maintenance. Valves shall be designed for minimum 150 psi water-working pressure, unless otherwise shown.
- B. **Air-Release Valves:** Air-release valves shall vent accumulating air while system is in service and under pressure and be of the size shown and shall meet the same general requirements as specified for air and vacuum valves except that the vacuum feature will not be required. They shall be designed for a minimum water-working pressure of 150 psi, unless otherwise shown.
- C. **Combination Air Valves:** Combination air valves shall combine the characteristics of air and vacuum valves and air release valves by exhausting accumulated air in systems under pressure and releasing or re-admitting large quantities of air while a system is being filled or drained, respectively. They shall have the same general requirements as specified for air and vacuum valves.
- D. **Air Vacuum and Release Manufacturers or Equal:**
  - 1. APCO (Valve and Primer Corporation).

2. Golden-Anderson Valve Division (GA Industries, Inc).

3. Val-Matic (Valve and Manufacturing Corporation).

## 2.8 CORPORATION STOPS (Ball Valve Type)

A. Unless otherwise shown, corporation stops shall be made of brass alloy for key operation, with screwed ends with corporation thread or iron pipe thread, as required. AWWA taper thread for inlet thread and compression type fittings for outlet.

### B. **Corporation Stop Manufacturer or Equal:**

1. Ford Meter Box Company.

2. James Jones Company.

3. Mueller Company.

## 2.9 BUTTERFLY VALVES

A. **Equipment Requirements:** Butterfly valve disc or valve body shall be cast iron or ductile iron. The valve disc or valve body shall be fitted with a resilient seat of synthetic rubber retained with an 18 - 8 stainless steel clamp ring and stainless bolting. The resilient seat shall have a cross section providing 360-degree mechanical retention against pulling out from between the retaining ring and disc. Retaining ring cap screws shall pass through the rubber seat.

The valve disc shall be rigidly attached to the shafts with keys to eliminate relative motion between the disc and shafting. The shaft keys shall be made of heat-treated 410 or 416 stainless steel. The keys shall be held in position with 18-8 stainless nuts.

Valve shafts shall be made from 18 - 8 stainless and shall be offset from the disc and body seats so that the shafting does not intersect the disc or body seats. Valve shafts 3" and smaller shall be one piece through shafts with factory set thruster to center the disc in the seat. Valve shafts larger than 3" shall be stub shafts, each rigidly keyed to the disc and provided with an adjustable thruster to move the disc and shaft assembly positively in either direction to center the disc in the seat of the valve. Shaft seal shall be designed for the use of standard split V type packing for standard O-ring seals or for a pull down packing. Valve operators for valves 24" and smaller shall be traveling nut or worm gear type fully field adjustable stops.

B. Valves shall open left or counter clockwise. The operating mechanism shall be for buried service with a 2-inch square operating nut.

## 2.10 VALVE OPERATORS

A. Electric Motor Operators

1. All motorized valves shall be furnished by the Contractor through the valve manufacturers as a complete package. Motor driven valve operators shall be furnished and installed in accordance with the applicable requirements shown on the process and instrumentation diagrams and electrical elementary diagrams. Operators shall comply with AWWA requirements for electrical operators.
2. Electric operators including the motor, all required gearing, integral continuous duty rated reversing starter, AC line surge suppressors, controls and switches shall be as manufactured by **Rotork, Limitorque, EIM; or equal.**
3. The motorized operators for modulating service shall be furnished with an integral position indicator/transmitter/controller. The above unit shall be internally powered, factory calibrated and furnished with adjustable zero, span, gain and deadband controls.
4. The position indicator/transmitter shall provide a linear, isolated, 4-20 mA, 24 VDC output to remote instrumentation and controls proportional to 0-100 percent travel span. An external DC power source shall not be required.
5. The position controller shall accept a linear 4-20 mA, 24 VDC input signal proportional to 0-100% travel span and shall generate appropriate outputs to the reversing starter to open/close the valve until the desired portion has been reached as determined by the position feedback signal to the position controller. Input signal isolation shall be provided.
6. The controller shall be furnished with circuitry to "lock in the last position" upon loss of control signal. Contractor shall be responsible for proper transmitter/controller calibration in accordance with the manufacturer's recommendations.
7. Operator capacity shall be adequate to continuously operate the valve under all operating conditions. Unless otherwise indicated, or specified, motor operators shall be furnished complete with motors, limit switch operating mechanisms, travel limit switches, torque switches, transmitters, controllers, starters, lighting and surge suppression, terminal blocks, gear reducers, handwheel, gearing, necessary components, and incidental accessories as follows:
  - a. All phases of the power supply shall be monitored. The contractor shall open de-energizing the motor upon detection of single phasing.
  - b. Logic circuits shall be protected against spurious voltage spikes, using opto-isolators in circuits connected to any remote input or output signals.
8. **Enclosure:** The starter for 240 volt single phase motor operators and all local devices shall be mounted on a common NEMA 4 and PVC coated cast aluminum enclosure. The enclosure shall be permanently affixed to the valve operator housing.
9. **Valve Stops:** Valve stops for the operators shall be positive in action. Closing shall be complete, and opening full. Stops shall be field adjustable to the required settings. The torque switches shall prevent any excessive mechanical stress or electrical overloading any direction of travel.

10. Limit switches and gearing shall be an integral part of the motorized valve operator. The limit switch gearing shall be of the intermittent type, totally enclosed in its own gear case, grease lubricated to prevent direct and foreign matter from entering the gear train and shall be made of bronze or stainless steel. Limit switches shall be of the adjustable type capable of being adjusted to trip at any point between the normal position (full open, or full closed) and 75 percent of the travel to the opposite position.
11. **Local (Motor) Devices:** Local devices shall include, but not be limited to the following:
  - a. Torque Switches: Torque switches, responsive to high torque encountered in either direction of travel. A torque switch which has tripped due to mechanical load shall not reset when the operator motor has come to a halt.
  - b. Limit Switches: Travel limit switches, for opening and closing direction of travel. Contract operations shall be as indicated on the Drawings. If not shown on the Drawings, the operator shall be furnished with a minimum of two DPDT switches. All switches shall be furnished with 5 ampere contacts. Switches shall be connected such that when the valve is fully open, or fully closed, the "open" or "close" light shall be illuminated. All limit switch contacts shall be wired out to a terminal strip so that the electrician in the field does not have to connect to the switches.
  - c. Local/remote selector switch with phase motor relay and auxiliary to provide dry contacts for collective indication of placement in the "remote" operating mode, the unit is powered, and that all safety/overload interlocks are satisfied to provide the above signal. For further requirements refer to electrical elementary control schematic.
  - d. Open/close push-button for local manual operation (modulating service).
  - e. Position indicator calibrated to 0-100% travel span.
  - f. Terminals for remote indication of full open, full closed and overload (torque).
12. **Operating Unit Gearing:** The actuator shall be double reaction unit with the capability of quickly changing the output speed with a gear change. The power gearing shall consist of generated spur or helical gears of heat-treated steel, and worm gearing where required by the type of operator. Quarter turn or traveling unit operators do not specifically require worm gearing. The worm shall be of hardened alloy steel and the worm gear shall be of alloy bronze. All power gearing shall be grease-lubricated. Ball or roller bearings shall be used throughout for all motor operators. A mechanical dial position indicator to display valve position in percent of valve opening shall be provided. The gearing shall comply with AWWA requirements.
13. **Stem Nuts:** The actuator for other than quarter turn valves shall have a stem nut of high tensile bronze or other material compatible with the valve stem and suited to the application. The nut arrangement, where possible, shall be of the two-piece type to simplify field replacement. The stem nut for rising stem valves must be capable of being removed from the top of the actuator without removing the actuator from the valve, disconnecting the electrical wiring, or disassembling any of the gearing within the actuator.

14. **Manual Operation:** A handwheel shall be provided for manual operation. The handwheel shall not relocate during hand operation nor shall a fused motor prevent manual operation.
15. When in manual operating position, the volt motor driven unit will remain in this position until motor is energized at which time the valve operator will automatically return to electric operation and shall remain in motor position until handwheel operation is desired. This movement from motor operation to handwheel operation shall be accomplished by a positive declutching knob or lever which will disengage the motor and motor gearing mechanically not electrically. Hand operation must be reasonably fast and require no more than 100 lbs. of rim effort at the maximum required torque. It shall not be possible for the unit to be simultaneously in manual and motor operation.
16. **240 Volt Single Phase Motors:** All motors on valves shall be designed for 240 volts 1-phase 60 Hz power. The motor shall be specifically designed for valve actuator service and shall be of high torque, squirrel cage reversible, totally enclosed, non-ventilated construction, with motor leads brought into the limit switch compartment without having external piping or conduit box. Motor insulation shall be NEMA Class B with maximum continuous temperature rating of 120° C (rise + ambient). Motors shall be sized to have a rated running time at the rated running torque of 15 minutes without exceeding the temperature rating of the insulation system. Running load torque shall be not more than 20% of the rated seating/unseating torque.
17. Speed-torque curves for the motors and torque calculations for seating, unseating, and running conditions shall be submitted. The maximum valve torque (seating/unseating) shall be less than 50% of stall torque or starting torque potential of the motor whichever is greater.
18. **Operator Type:**
  1. Type A: Remote set-point using a 4-20 mable analog signal
    - (a) Local Operation
      - (1) LOCAL/REMOTE selector
      - (2) OPEN/CLOSE push-buttons
      - (3) Position set-point potentiometer/indicator
      - (4) LOCAL accepts local position set-point
      - (5) OPEN/CLOSE indication
      - (6) Fault (torque) indication
    - (b) Remote operation
      - (1) REMOTE - accept a remote 4-20 mA position set-point
      - (2) Position transmitter 4-20mA signal to RTU (Remote Transmitter Unit)

- (3) Available Ready of Auto to RTU
- (4) Fault torque status to RTU

19. **Valve Closure Time:**

Valve closure time shall be 1 minute.

20. **Spare Parts:**

- a. The Contractor shall furnish loose, one unit valve operator, complete with all the devices specified herein and with all the features and characteristics similar to the equipment supplied in this Contract. The spare operator shall be delivered to the Owner still in crates.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

- A. **General:** All valves, gates, operating units, stem extensions, valve boxes, and accessories shall be installed in accordance with the manufacturer's written instructions and as shown and specified. All gates shall be adequately braced to prevent warpage and bending under the intended use. Valves shall be firmly supported to avoid undue stresses on the pipe.
- B. **Access:** All valves shall be installed to provide easy access for operation, removal, and maintenance and to avoid conflicts between valve operators and structural members or handrails.
- C. **Valve Accessories:** Where combinations of valves, sensors, switches, and controls are specified, it shall be the responsibility of the Contractor to properly assemble and install these various items so that all systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on shop drawing submittals.
- D. **Butterfly Valves:** All exposed butterfly valves shall be installed with a means of removing the complete valve assembly without dismantling the valve or operator.

END OF SECTION

## SECTION 33 11 00 - WATER DISTRIBUTION SYSTEM

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. All applicable provisions of the Bidding and Contract Requirements, and Division 33 - General Requirements shall govern the work under this Section.

#### 1.2 SUMMARY

- A. This Section includes water-distribution piping and related appurtenances from tapping of main to:
  - 1. Within 5 feet of outside the building limits for domestic and irrigation water service; and,
  - 2. 1 foot above finished floor elevation for fire service mains.
  - 3. Supply and discharge piping, including connections, to fire protection water tank if shown on plans.
- B. All work shall conform to the requirements of the local water authority, fire marshal, any other regulatory authorities having jurisdiction, or this specification, whichever is more stringent.

#### 1.3 WORK INCLUDED

- A. Provide all labor, materials, necessary equipment and services to complete the Water Systems work, as indicated on the drawings, as specified herein or both, except as for items specifically indicated as "NIC ITEMS".

#### 1.4 RELATED WORK: (See applicable related sections)

#### 1.5 REFERENCE STANDARDS

- A. Factory Mutual (FM)
  - 1. Approval Guide
- B. Underwriters Laboratories (UL)
  - 1. Fire Protection Equipment Directory
  - 2. UL 1285 - Pipe and Couplings, Polyvinyl Chloride (PVC), for Underground Fire Service
  - 3. UL 262 - Gate Valves for Fire-Protection Service
  - 4. UL 246 - Hydrants for Fire-Protection Service
- C. National Sanitation Foundation (NSF)



1. NSF 14 - Plastics Piping System Components and Related Materials
  2. NSF 61 - Drinking Water System Components - Health Effects
- D. National Fire Protection Association (NFPA)
1. NFPA 70 - National Electrical Code
  2. NFPA 24 - Hydraulic Fluid Power Systems - Methods to Improve Sealing Reliability (new standard)
  3. NFPA 1963 - Screw Threads and Gaskets for Fire Hose Connections (revision of ANSI/NFPA 1963-1993)
  4. NFPA 13 - Installation of Sprinkler Systems (latest edition)
- E. American Water Works Association (AWWA)
1. C151 Ductile-Iron Pipe, Centrifugally Cast, for Water (revision of ANSI/AWWA C151/A21.51-91)
  2. C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
  3. C150 - Thickness Design of Ductile-Iron Pipe
  4. C110 - Ductile-Iron and Gray-Iron Fittings, 3 in through 48 in (75 mm through 1200 mm), for Water and Other Liquids
  5. C153 - Ductile-Iron Compact Fittings, 3 in. through 24 in. (76 mm Through 610 mm) and 54 in. through 64 in. (1,400 mm Through 1,600 mm), for Water Service
  6. C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inch through 12 Inch for Water Distribution
  7. C500 - Gate Valves for Water and Sewage Systems
  8. C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
  9. C550 - Protective Epoxy Interior Coatings for Valves and Hydrants
  10. C509 - Resilient-Seated Gate Valves for Water Supply Service
  11. M44 - Distribution Valves: Selection, Installation, Field Testing, and Maintenance
  12. C800 - Underground Service Line Valves and Fittings
  13. C702 - Cold Water Meters - Compound Type
  14. C502 - Hydrants, Dry Barrel Fire

15. M41 - Ductile Iron Pipe and Fittings
  16. C600 - Installation of Ductile-Iron Water Mains and Their Appurtenance
  17. C605 - Water Treatment - Underground Installation of Polyvinyl Chloride PVC Pressure Pipe and Fittings for Water
  18. M23 - PVC Pipe: Design and Installation
  19. M17 - Fire Hydrants: Installation, Field Testing, and Maintenance
  20. C651 - Disinfecting Water Mains
- F. American Society for Testing and Materials (ASTM)
1. B88 - Standard Specification for Seamless Copper Water Tube
  2. B813 - Standard Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
  3. B32 - Standard Specification for Solder Metal
  4. D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
  5. D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
  6. F645 - Standard Guide for Selection, Design, and Installation of Thermoplastic Water Pressure Piping Systems
- G. American Society of Mechanical Engineers (ASME)
1. B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings R(1994)
  2. B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
- H. Manufacturer's Standardization Society (MSS)
1. SP-60 - Connecting Flange Joint Between Tapping Sleeves and Tapping Valves
- I. Copper Development Association (CDA)
1. Copper Tube Handbook
- 1.6 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements of the regulatory authorities having jurisdiction; including tapping of water mains, backflow prevention, installation, testing, and disinfection. Comply with standards of the regulatory authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Electrical Components, Devices, and Accessories: UL listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to the regulatory authorities having jurisdiction, and marked for intended use.
- D. Comply with FM's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- E. NFPA Compliance: Comply with NFPA 13 and NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.
- F. NSF Compliance: Comply with NSF 14 for plastic potable-water-service piping. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.
- G. Comply with requirements of Trench Excavation and Backfill.

#### 1.7 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by the Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify the Owner not less than 2 days in advance of proposed utility interruptions; and,
  - 2. Do not proceed with utility interruptions without written permission from the Owner.

#### 1.8 EXISTING UTILITIES

- A. Furnish temporary support, adequate protection and maintenance of all underground and surface utility structures, drains, sewers, and other obstructions encountered in the progress of the work.
- B. Where the grade or alignment of the pipe is obstructed by existing utility structure such as conduits, ducts, pipe branch connections to main sewers, or main drains, the obstruction shall be permanently supported, relocated, removed, or reconstructed by the Contractor in cooperation with the Owner's of such utility structures. No deviation shall be made from the required line or grade except as directed by the Engineer.

## PART 2 - PRODUCTS

### 2.1 PIPE

- A. All metallic pipe shall have bituminous outside coating conforming to:

Viscosity, KU at 25°	56-60
Flashpoint °F (TCC)	40°F
Dry set to touch	6 minutes
Dry hard	22 minutes

- B. Ductile iron pipe shall conform to ANSI/AWWA C151/A21.51 with pressure class 350 for 4" to 24" pipe and pressure class 250 for 30" to 60" pipe. Pipe shall be cement-lined and seal-coated in accordance with ANSI/AWWA C104/A21.4.

1. Unless otherwise indicated, all ductile iron pipe shall be factory lined and coated.
  - a. Lining: All pipe shall be cement mortar lined in accordance with AWWA Standard C104.
  - b. Coating: Unless specified otherwise, all pipe shall be coal-tar enamel coated outside to a dry film thickness of at least 1 mil with Koppers Bitumastic Tank Solution, or equal.
  - c. Repair: Anywhere that the coating is removed purposely or accidentally, the area shall be cleaned of any rust, grease and dirt and recoated to a minimum dry film as specified for the individual piece.

- C. Soft Copper Tubing, NPS 3 inches or smaller:

1. Tubing shall be manufactured in accordance with ASTM B88, Type K, annealed temper. Fittings shall be in accordance with ASME B16.18, for cast-copper-alloy, solder joint pressure fitting, or ASME B16.22 for wrought-copper, and copper-alloy, solder joint pressure fitting type. Soldering flux shall be in accordance with ASTM B813, water-flushable type. Solder filler metal shall be in accordance with ASTM B 32, lead-free type with 0.20 percent maximum lead content.

- D. Polyvinyl Chloride (PVC) Pipe, NPS 4 inches to NPS 12 inches:

1. PVC pipe shall conform to the requirements of AWWA C900, Class 150, DR 18. Pipe joints shall be elastomeric joints only. Sleeve couplings are not permitted except as necessary for repairs during testing, or connections to existing mains. Comply with UL 1285 for fire-service mains. Fittings shall be mechanical-joint ductile-iron compact fittings in accordance with AWWA C153 or standard size in accordance with AWWA C110.

- E. Polyvinyl Chloride (PVC) Pipe NPS 2 inch to NPS 3 inch:

1. Pipe shall conform to the requirements of ASTM D2241, SDR 21, with elastomeric joints conforming to ASTM D3139. Pipe jointing shall be by elastomeric joints only. Sleeve couplings are not permitted except as necessary for repairs during testing, or connections to existing mains. Fittings shall be PVC fabricated fittings with elastomeric gaskets, or ductile iron compact fittings conforming to AWWA C153 with elastomeric gaskets.

## 2.2 FITTINGS

- A. The pressure rating shall be 350 PSI for fittings.
- B. Fittings shall be cast iron or ductile iron, meeting the ANSI/AWWA Specification C-153/A21.53.
- C. Fitting must be cement lined and seal coated per ANSI/AWWA C104/A21.4.0.
- D. Flanged fittings shall conform to ASA Specifications for Class 125.
- E. Ductile iron fittings shall conform to ANSI/AWWA standard specification C110-A21.10 latest revision.

## 2.3 JOINTS

### A. BELL AND SPIGOT CONNECTIONS:

1. Joints in bell and spigot pipe shall be push-on, mechanical, or restrained mechanical joints in accordance with ANSI/ANWA Standard C-111/21.11, latest revision.

### B. FLANGED CONNECTIONS:

1. All flanged pipe barrels shall comply with the physical and chemical requirements as set forth in the Handbook of Ductile Iron Pipe of the Ductile Iron Pipe Research Association. Flanges shall be in accordance with ANSI Specification B16.1 for Class 125 flanges. Bolts shall comply with ANSI Specification B18.2.
2. Before starting fabrication of the cast iron pipe and fittings, complete detailed working drawings shall be submitted by the Contractor for approval by the Engineer. Such drawings shall show the piping layouts and contain schedules of all pipe, fittings, valves, expansion joints, hangers and supports and other appurtenances. Where special fittings are required, they shall be shown in large detail with all necessary dimensions. The drawings submitted shall show flanged jointed sections placed so as to be removed without disturbance to the main pipe sections.
3. Flanged pipe shall be faced and drilled to the American Standard drilling, unless special drilling is called for or required. Where tap or stud bolts are required, flanges shall be tapped. Flanges shall be accurately faced and drilled smooth and true, at right angles to the pipe axis and shall be covered with zinc dust and tallow or a rust preventive compound immediately after facing and drilling.

4. Flanged pipe with screwed-on flanges shall be furnished with long hubs and the flanges shall be screwed on the threaded end of the pipe in the shop and the face of the flange and end of pipe refaced together. There shall be no leakage through the pipe threads and the flanges shall be designed to prevent corrosion of the threads from outside.
5. Flanged joints shall be made with bolts or stud bolts and nuts. Bolts, stud bolts, and nuts shall conform to American Standard heavy dimensions, semi-finished with square or hexagonal heads and cold punched hexagonal nuts, meeting the requirements of ASTM Designation A-307. Bolt sizes shall be American Standard for the flanges specified, and bolts and nuts shall have good, true threads.

#### 2.4 HYDRANTS

- A. Fire hydrants shall have a 5 1/4" main valve opening. Pumper nozzle to be 18" from finish grade. All hydrants to be installed with anchoring tee and control valve. Fire hydrant shall comply with ANSI/AWWA C502-85 (or latest revision). Hydrants shall be Mueller A-423, or Clow Medallion F-2545 or approved equal.
- B. Fire hydrants installed that have not been placed into service shall be covered with a burlap bag to indicate that they are out of service.

#### 2.5 WATER TAPS

- A. Tapping Existing Pipelines.
  1. Tapping sleeves shall be Mueller H 615 or approved equal. Tapping valves shall be Mueller H 667 or approved equal.
  2. Cast iron tapping sleeve or tapping cross shall have mechanical joint connections. The flanged end for tapping valve shall include a recess to provide positive alignment of the tapping valve.
  3. Tapping valves shall conform to AWWA C509 and C500 standards. An Affidavit of Compliance shall be furnished for the valves.
  4. Tapping valves 16" and smaller shall be designed for operation in a vertical position with a vertical operating shaft. Tapping valves over 16" shall be designed for operation in a horizontal position and shall have a vertical operating shaft.

#### 2.6 WATER SERVICES

- A. Water services in the public R.O.W. shall be polyethylene tubing with a minimum working pressure of 200 psi.
- B. All water service tubing and fittings shall be in conformance with "Broward County Office of Environmental Services - Minimum Design and Construction Standards".

### PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Unloading Material: The Contractor shall exercise care in unloading and handling pipe, valves, fittings, and all other material. Dropping pipe from trucks and allowing pipe to roll against other pipe will not be permitted.
- B. Excavation: Pipe line trenches shall be excavated to required depth as shown on the drawings or as directed by the Engineer. In general, water distribution lines shall have a minimum of 30" cover for DIP pipe. If rock is encountered, excavation shall be carried a minimum of 8" below bottom of pipe, and trench backfilled with sand or earth and thoroughly tamped. Width of trench shall be sufficient to allow workmen to perform all operations incidental to constructing the pipe line. Hand dug bell holes shall be provided to permit proper joint making. No section of pipe shall bear on rock or on placed blocking. All excavations will be dewatered to permit dry joints.
- C. Work shall be properly braced where necessary. Where wood sheeting or certain designs of steel sheeting are used, the sheeting shall be cut off at a level two feet above the top of the installed pipe and that portion below that level shall be left in place. If interlocking steel sheeting of a design approved by the Engineer is used, it may be removed providing removal can be accomplished without disturbing the bedding or alignment of the pipe. Any damage to the pipe bedding, pipe or alignment of the constructed main caused by removal of sheeting shall be cause for rejection of the affected portion of the work.

### 3.2 PIPE

- A. Installation of Pipe: All installation shall conform to AWWA C-600. Pipe shall not be rolled or pushed into the trench from the bank. Before pipe is lowered into the trench, it shall be thoroughly inspected by the Contractor, as necessary, to insure sound conditions and eliminate the possibility of leakage or bursting under test pressure.
- B. Water mains shall be laid at least 10 feet horizontally from any existing or proposed sewer mains. A vertical distance of at least 18" should be maintained when a sewer pipe crosses under a water main. If this is not possible, then the sewer pipe must be of water main quality with 20 foot lengths of pipe centering on the point of crossing. If a crossing where the sewer is laid above a water line is unavoidable, then the above mentioned precautions shall be observed regardless of the distance of vertical separation between water mains and sewer piping.
- C. Pipes and valves, fittings, and all other materials showing defects shall not be used for construction. All such defective materials shall be removed from the construction site immediately. Before pipe is lowered into the trench, it shall be swabbed or brushed to insure that no dirt or foreign matter will be in the finished line.

- D. Pipe shall be laid on a flat bottom trench and backfill tamped to 6" above the top of the pipe. Pipe installation shall conform to "Type B Method" as adopted by Committee A-21 of the American Standards Association. A firm even bearing shall be provided throughout the length of each section of pipe. Pipe shall not bear on any unyielding structures, nor shall it support any other structures. All dead ends shall be plugged or capped, anchored and held in place with restrained joints as required. Except while work is in progress, all pipe openings shall be suitably plugged to prevent entrance of water or any foreign matter. Material deemed unstable for providing adequate support for pipe shall be removed and replaced by suitable material. Adequate backfill shall be deposited on the pipe to prevent floating. Any pipe which has floated shall be removed from the trench and reinstalled as directed by the Engineer.
- E. Joints: All joints shall be suitable for the type of pipe being jointed and shall be made in accordance with manufacturer's recommendations.
1. Mechanical joints: Mechanical joints shall be of the stuffing box type. The gland, followed by the rubber gasket, shall be placed over the plain end of the pipe which is inserted into the socket. The gasket is then pushed into position so that it is evenly seated in the socket. The gland shall be moved into position against the face of the socket, bolts inserted and made finger-tight. Bolts shall be tightened by a ratchet wrench suitable for the size of pipe being connected alternately, bottom, then top, etc., until the joint is completed.
  2. Compression Pipe joints: Compression joints shall be a rubber seal joint, made pressure tight by a molded rubber gasket and lubricated to facilitate assembly. The joint shall be made tight by inserting the plain end into the bell after lubrication. Joints shall be made up as recommended by the manufacturer.
  3. Flanged joints: Flanged joints shall be made with rubber gaskets. Bolts shall have rough square heads and hexagonal nuts and made to American Standard rough dimensions and shall be recommended size trimmed. Bolts shall be recommended size for the diameter of the pipe being jointed and shall be tightened as to distribute evenly the stress in the bolts and bring the pipe into alignment.
  4. Threads shall be neatly cut with sharp tools and the jointing procedure shall conform with the best practices. Before jointing, all scale shall be reamed. All pipe shall be screwed with an application of graphite and engine oil or other approved pipe compound applied to the threads. This application shall be thoroughly wiped off the inside of every joint.

### 3.3 INSTALLATION OF FITTINGS

- A. Applicable portions of these specifications shall apply to installation of fittings. Reaction of restrained joints shall be applied at bends and tees and where changes in pipe diameter occur at reducers or in fittings.

### 3.4 INSTALLATION OF FIRE HYDRANTS

- A. All hydrants shall stand plumb and burial line shall be set at finished grade. The pumper nozzle shall be set at 18" above finished grade.

### 3.5 INSTALLATION OF VALVES



- A. All valves shall stand plumb unless otherwise shown on the plans or directed by the Owner's Representative. The operation of installing tapping sleeves and valves shall be done by an experienced organization who has been engaged in this type of work not less than one (1) year with a representative list of successful installations. All valves shall be tagged per BCOES.

### 3.6 PRESSURE TESTS

- A. After pipe has been adequately backfilled, all laid pipes shall be subjected to hydro-static pressure of 150 PSI. The duration of the pressure test shall not be less than two (2) hours. Test sections shall be limited to a maximum length of 2000 feet. Care shall be taken to insure that all air has been removed from the pipe previous to pressure tests. The Contractor shall provide such means of venting the pipe as are required. Any material or installation proving defective shall be replaced by the Contractor.

### 3.7 LEAKAGE TEST

- A. After the main has been brought up to test pressure, it shall be held at this pressure and make up water shall be carefully measured by use of displacement meter or by pumping water from a vessel of known volume. The pipe line shall be walked and all visible joints inspected for leakage and movement of pipe. All visible leaks shall be repaired. Should any section of pipe line disclose joint leakage greater than that permitted, the Contractor shall at his own expense, locate and repair the defective joints until leakage is within the permitted allowance.
- B. The leakage test shall be conducted in accordance with AWWA Specification C-600, latest revision. Leakage shall be less than the number of gallons per hour as determined by the formula:

$$\text{PVC: } L = \frac{SD P^{1/2}}{148,000}$$

$$\text{DIP: } L = \frac{SD P^{1/2}}{133,200}$$

in which L equals the allowable leakage in gallons per hour, S is the pipe length in the main tested, D is the nominal diameter of the pipe in inches, and P is the average test pressure during the leakage test, in pounds per square inch, gauge. Length of test shall not be less than two (2) hours. Average test pressure shall not be less than 150 PSI. The test shall be conducted as directed by the Engineer.

### 3.8 BACKFILL

- A. No trenches or excavations shall be backfilled until the trench and installation has been inspected and written approval given by the Engineer. All backfill shall be carefully placed to avoid movement of the pipeline. Backfill shall be free from rock, stones larger than 3" in any dimension, brush, or other unsuitable material as determined by the Engineer. It shall be placed in the trench uniformly on both sides of the pipe for full width of the trench and to the horizontal diameter of the full length of the pipe. This backfill shall be thoroughly tamped to provide support free from voids.
- B. Additional backfill shall then be placed between joints to an average depth of 12" over the top of the pipe where pipe is of 8" and smaller diameter, and 24" over larger pipe. Pipe joints shall remain exposed until completion of the pressure and leakage tests unless otherwise directed by the Engineer.

- C. On completion of pressure and leakage tests, the exposed joints shall be backfilled to a depth of 12" above the top of the pipe. Backfill shall be carefully compacted until 12" of cover exists over the pipe. The remainder of the backfill shall then be placed and compacted thoroughly by puddling and tamping as required. Where directed, puddling and tamping may be omitted, and backfill shall be neatly rounded over the trench to a sufficient height to allow for settlement to grade after consolidation.

### 3.9 STERILIZATION OF COMPLETE PIPELINE

- A. Before the final acceptance of complete pipeline, all requirements of the County and Broward County Public Health Unit (BCPHU) shall be satisfied. Satisfactory bacteriological test results from the agencies shall be forwarded to the Engineer.
- B. Prior to chlorination of mains, all dirt and foreign matter shall be removed by high velocity flushing through fire hydrants or other approved blow-offs. The main shall then be filled with a chlorine solution of at least 50 parts per million of chlorine and retained in the pipe not less than twenty-four (24) hours. Chlorine residual after retention period shall be not less than 30 parts per million. After chlorination, the mains shall be thoroughly flushed with potable water and required samples taken for bacteriological analysis. Sampling to be witnessed by the Engineer.

### 3.10 RESTORATION OF SURFACE AND/OR STRUCTURES

- A. The Contractor shall restore and/or replace paving, curbing, sidewalks, fences, sod, survey points and other disturbed surfaces to a condition equal to that before the work was begun and to satisfaction of the Engineer, and shall furnish all labor and materials incidental thereto. Relative restoration of surfaces and/or structures, the Contractor shall comply with all governing agencies requirements including city, town, county and state.

### 3.11 CONNECTION TO EXISTING SYSTEM

- A. The Contractor shall make proper arrangements for compliance with the regulations for connection to any existing distribution system with the Owner of that system. Tap-in and connection will be made in strict accordance with the Engineer.

END OF SECTION

## SECTION 33 12 13 - WATER SERVICE CONNECTIONS AND TRANSFERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. All applicable provisions of the Bidding and Contract Requirements, and Division 1 - General Requirements shall govern the work under this Section.

#### 1.2 WORK INCLUDED

- A. This section covers the work necessary for service connections, laying service pipe, casing pipe, making connections to the new water main and to the existing service pipe, testing and flushing, and all incidental work necessary to accomplish the construction.
- B. The work includes trench excavation, backfill and compaction, furnishing and installing service clamps, corporation stops or valves, meter yokes or connections, service connection piping, fittings, and appurtenances within the designated limits, testing, flushing, and other incidental work as required for a complete installation. Included are the installation and transfers of 5/8-inch, one (1) inch, 1½ inch, and two (2)-inch meter connections within the limits shown on the plans.
- C. The approximate location of service connections to be installed or transferred will be determined by the CONTRACTOR, upon review and approval by the ENGINEER and COUNTY.

#### 1.3 RELATED WORK: (See applicable related sections)

### PART 2 - PRODUCTS

#### 2.1 EXCAVATION

- A. Excavation shall conform to the requirements of Section 312334, Excavation and Backfilling for Utilities.

#### 2.2 BACKFILL

- A. Acceptable material excavated from the trench shall be used for trench backfill. Select backfill material for use in the pipe zone, when required by the ENGINEER, shall contain no material larger than one (1) inch in diameter.

#### 2.3 SERVICE CONNECTION SIZE

- A. The location and size of service connection to be transferred or installed will be as determined in the field by CONTRACTOR. The meter and meter box will be installed by CONTRACTOR if required. Minimum tap size shall be one (1) inch.

#### 2.4 SERVICE SADDLES

- A. Service saddles shall be malleable or ductile iron double-strap saddles with iron pipe tap, or equal.

Saddle shall be of the size required by the pipe and shall be provided with a neoprene O-ring seal and appropriately sized IP tap. Straps shall be corrosion resistant with Type 304 stainless steel bands and hardware.

B. Service Saddle Manufacturers or Equal:

1. JCM
2. Rockwell International
3. Mueller

2.5 TAPPING MATERIALS

- A. The CONTRACTOR shall provide the necessary tapping machines for making the connections, and shall furnish the miscellaneous materials required for making the taps, such as cutting oil and similar materials.

2.6 CORPORATION STOPS

- A. Corporation stops for one (1) inch services shall have AWWA thread inlet and a compressive connection outlet suitable for service pipe. Corporation stops for two (2) inch services shall be ball valves and have outside iron thread inlet and a compression connection outlet suitable for service pipe. Corporation stops shall meet AWWA C800, latest revision.

B. Corporation Stop Manufacturers or Equal:

1. Mueller
2. Ford
3. Hays Manufacturing Company

2.7 COUPLINGS

- A. Couplings shall be hose clamp type coupling, outside IP thread to plastic for connecting polyethylene pipe to corporation stop and meter yoke. Clamp pipe with two stainless steel clamps at each connection.

B. Coupling Manufacturers or Equal:

1. Mueller
2. Ford
3. Hays Manufacturing Company

2.8 FLEXIBLE COUPLINGS

- A. Flexible couplings shall be straight cast couplings and shall be Rockwell International No. 431, or equal.

2.9 UNION

- A. Copper-to-copper union.
- B. Union Manufacturers or equal:
  - 1. Mueller H-15400
  - 2. Hays Manufacturing Company 5615

2.10 MISCELLANEOUS FITTINGS

- A. Miscellaneous fittings, includes reducers and adapters.
- B. Miscellaneous Fittings Manufacturers or equal:
  - 1. Mueller Company
  - 2. Ford
  - 3. Hays Manufacturing Company

2.11 CURB STOPS

- A. Curb stops shall meet AWWA C800, latest revision and shall be Mueller or equal.

2.12 CURB BOXES

- A. Curb boxes shall be two (2) feet long, extension type, arch pattern base, Mueller or equal, and furnished with lids and plugs.

2.13 METER STOP

- A. Meter stops shall be Mueller, Ford, Hays Manufacturing Company, or equal.

2.14 METERS, BOXES, AND COVERS

- A. Meters are provided by the COUNTY. Boxes and Covers are to be furnished by the CONTRACTOR. CONTRACTOR will install Meters, Boxes and Covers.

2.15 METER YOKES

- A. The meter yokes shall be Ford, Hays, or equal.

2.16 ANGLE VALVES

- A. Angle valves for the one (1) inch and two (2) inch meter installations shall be Ford, Crane, or equal.

2.17 COPPER TUBING

- A. Copper tubing used for one (1) inch service connections shall be Type K, soft, seamless, conforming to ASTM B88, with commercially pure wrought copper solder joint fittings. Make joints with 95-5 coreless wire solder, ASTM B32, Grade 95 TA.

2.18 POLYETHYLENE PLASTIC TUBING

- A. Polyethylene plastic tubing shall be manufactured from ultra-high molecular weight, high-density polyethylene in accordance with AWWA C901, latest revision, ASTM D3350, PE 355434C. The tubing shall have a working pressure of 200 psi and a standard dimension ratio of nine (9).
- B. Polyethylene Plastic Tubing Manufacturers or equal: Driscopipe.

2.19 CASING PIPE

- A. Casing pipe shall be galvanized or black iron, or equal, as determined by Engineer.

PART 3 - EXECUTION

3.1 TRENCH EXCAVATION AND BACKFILL

- A. Conform to the requirements of Section 312334, Excavation and Backfilling for Utilities. Place only select backfill material in the trench within six (6) inches of the service connection pipe or line. Cover around pipe shall be 8 inches or as indicated on the plans. Backfill and compact remainder of trench with excavated material as specified in the referenced section.

3.2 CONNECTION TO MAIN

- A. Clean exterior of main of dirt or other foreign matter that may impair the quality of the completed connection. Then place service clamp at the desired location and clamp tight by tightening alternate nuts progressively. Do not place service clamp within one (1) foot of pipe joint or other clamp.
- B. Taps shall be made in the pipe by experienced workmen using tools in good repair with the proper adapters for the size main being tapped.

3.3 PREPARATION OF TRENCH

- A. Grade the bottom of the trench by hand to the line and grade to which the pipe is to be laid, with proper allowance for special bedding. All other conditions and operations as specified in Section 312334, Excavation and Backfilling for Utilities must be adhered to. The trench bottom shall form a continuous and uniform bearing support for the pipe. A six (6) inch layer of imported earth or other specified material will be required over and under pipe in areas where suitable trench side material is not available.

### 3.4 UNDERCROSSING OF ASPHALT-SURFACED ROADS

- A. Service connection piping under asphalt-surfaced roads shall be bored or jacked. Open cutting of asphalt-surfaced roads is not permitted except at the direction of the ENGINEER. The service connection pipe shall be installed so that it has a minimum cover of two (2) feet with a slight grade sloping away from the water main.

### 3.5 COPPER TUBING

- A. The copper tubing shall be cut with square ends, reamed, and flared with the proper size flaring tool, cleaned, and made up tightly. Care shall be taken to prevent the tubing from kinking or buckling on short-radius bends. Kinked or buckled sections of copper tubing shall be cut out and the tubing spliced with the proper brass fitting at the CONTRACTOR's sole expense.

### 3.6 POLYETHYLENE PLASTIC TUBING

- A. Install polyethylene plastic tubing in accordance with the manufacturer's recommendations.

### 3.7 INSTALLATION OF METER BOXES AND METERS

- A. Meters and meter boxes or vaults shall be installed by the CONTRACTOR as shown on the plans. Finish grade of completed meter enclosure shall be flush with existing ground or as shown otherwise. Meter boxes or vaults shall be set or constructed plumb with the top set to conform to the slope of the finish grade. Lightly compacted earth backfill shall be placed inside of the meter boxes to depth indicated. Grade adjustment of the meter boxes or vaults shall be by using standard extension sections for the box or vault specified. Install meter in a horizontal position with the meter dial or dials at a depth below the cover as shown on the plans. Backfill around meter vaults as specified for adjoining pipe.
- B. Water meters shall be reinstalled by the CONTRACTOR. Corporation stops shall be in the open position and angle stops shall be closed, prior to reinstallation of the meter.
- C. Withhold reinstalling meters until the new water system is ready for operation. The remainder of the service connection, excluding the meter, may be installed at any time during or after construction of the main.
- D. Where existing meters are designated for relocation, contractor shall read, record, and submit existing meter readings on the form supplied by the county prior to removal of meters, and after completion of relocation work. Contractor shall furnish ENGINEER and county with copies of all meter readings on a monthly basis or as requested by the ENGINEER.

### 3.8 HYDROSTATIC TEST AND LEAKAGE

- A. Test service connections and service connection tubing by either testing in conjunction with the main at the test pressure required for the main, or by testing at the normal hydrostatic main pressure after the main has been completely installed and tested. Inspect visually for leaks and repair any leaks before backfilling. Duration of the test shall be at least fifteen (15) minutes.

3.9 DISINFECTION

- A. Service connection transfers shall be disinfected as follows:
1. Make connection to the main pipeline which shall have been previously hydrostatically tested and disinfected.
  2. Prior to connecting new copper or plastic tubing to existing copper tubing or meter stop, flush new copper or plastic tubing by fully opening corporation stop and allowing water to run for 2 minutes.
  3. Close corporation stop and meter stop, connect new copper or plastic tubing to existing copper tubing or to meter stop, as applicable. Open corporation stop and allow to stand for a minimum of 30 minutes retention period. Open meter stop.
- B. The COUNTY may put extra chlorine in the water system during the time of service connection transfers to provide sufficient chlorine residual to adequately disinfect service connections when the above procedure is followed.

END OF SECTION



## SECTION 33 31 00 - SANITARY SEWER SYSTEM

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. All applicable provisions of the Bidding and Contract Requirements, and Division 1 - General Requirements shall govern the work under this Section.

#### 1.2 SUMMARY

- A. This section includes sanitary sewer piping and related appurtenances from connection to main to within 5 feet of outside the building limits.
- B. All work shall conform to the requirements of the local sewer authority and any other regulatory authorities having jurisdiction, or this specification, whichever is more stringent.

#### 1.3 WORK INCLUDED

- A. The work under this Section shall consist of furnishing and installing sewer pipes and service connections as indicated on the plans and in accordance with these Specifications.

#### 1.4 RELATED WORK: (See applicable related sections)

#### 1.5 DEFINITIONS

- A. Manholes shall be designated as M.A.S., maintenance access structures.

#### 1.6 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
  - 1. A746 - Standard Specification for Ductile Iron Gravity Sewer Pipe
  - 2. D3034 - Standard Specification for Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings
  - 3. F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
  - 4. F679 - Standard Specification for Poly Vinyl Chloride (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
  - 5. C476 - Standard Specification for Grout for Masonry
  - 6. C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
  - 7. C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals

8. D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
  9. C478 - Standard Specifications for Precast Reinforced Concrete Manhole Sections
  10. C969 - Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.
- B. American Society of Sanitary Engineers (ASSE)
- C. American National Standards Institute (ANSI)
- D. American Concrete Institute (ACI)
1. 318 - Building Code Requirements for Structural Plain Concrete
- E. National Sanitation Foundation (NSF)
- F. American Water Works Association (AWWA)
1. C110 - Ductile-Iron and Gray-Iron Fittings, 3 in through 48 in (75 mm through 1200 mm), for Water and Other Liquids (revision of ANSI/AWWA C110/A21.10-93)
  2. C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings C153 - Ductile-Iron Compact Fittings, 3 in. through 24 in. (76 mm Through 610 mm) and 54 in. through 64 in. (1,400 mm Through 1,600 mm), for Water Service (revision of ANSI/AWWA C153/A21.53-94)
  3. C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances revision of ANSI/AWWA C600-93)
  4. C150 - ANSI Standard for Thickness Design of Ductile Iron Pipe
  5. C151 - ANSI Standard for Ductile Iron Pipe
  6. C153 - ANSI Standard for Ductile Iron Pipe Compact Fittings
- G. Federal Specifications
1. SS-S-00210 - Sealing Compound Preformed Plastic for Pipe Joints
- H. Uni-Bell PVC Pipe Association
1. UNI-B-6 - Low-Pressure Air Testing of Installed Sewer Pipe
- 1.7 PERFORMANCE REQUIREMENTS
- A. Gravity-Flow, Nonpressure-Piping Pressure Ratings: At least equal to system test pressure.
- B. Force-Main Pressure Ratings: At least equal to system operating pressure, but not less than 150 psig.

## 1.8 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements of the regulatory authorities having jurisdiction; including tapping of sewer mains, installation, and testing.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Comply with requirements of Trench Excavation and Backfill.

## 1.9 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify the Owner not less than two days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without written permission from the Owner.

## 1.10 COORDINATION & FEES

- A. Contractor shall be responsible for obtaining and payment of all tap and construction permit fees associated with this section.
- B. Contractor shall install all sewer lines and appurtenances as shown on the drawings to within 5 feet of building limits. This shall include any taps, pumps, tanks, etc. If Contractor's work terminates at a connection point where work by others is complete, Contractor shall make the connection. If future connections will be required by others, Contractor shall install plugging and marking apparatus as necessary to protect, identify and locate his work.

## PART 2 - PRODUCTS

### 2.1 PIPE

- A. PVC plastic pipe and fittings for gravity sanitary sewers shall be unplasticized, PVC Plastic Gravity Sewer Pipe conforming to ASTM D 3034 with SDR 26 or C900 (depending on pipe depth) and integral wall bell and spigot joints for conveyance of domestic sewage. Sewer pipe, including laterals and fittings shall be of the same material composed of PVC plastic having a cell classification of 12454B or 12454C as defined in ASTM D 1784. Rubber sealing rings for pipe joints shall meet the requirements of ASTM D 1869. No solvent welded pipe will be permitted.
  - 1. In addition to the above requirements, pipe shall also conform to the following tests:
    - a. Drop Impact Test in accordance with ASTM D 2444.
    - b. Pipe Stiffness Test in accordance with ASTM D 2412.
    - c. Acetone Immersion Test in accordance with ASTM D 2152.

- B. PVC plastic gravity sewer pipe shall be as manufactured by Johns-Manville, Certain-Teed Products Corporation or approved equal. Prior to delivery of PVC plastic pipe to the jobsite, Contractor shall furnish the Engineer complete data from the manufacturer of the type of PVC pipe and fittings he proposes to install.
- C. Ductile iron pipe shall be epoxy lined and conform to ANSI/AWWA standard C151/A21.51 and C150/A21.50.
  - 1. DIP pipe shall conform with pressure class 350 for 4" through 24".

## 2.2 FORCE MAIN

- A. Pipe Material
  - 1. Force main shall be epoxy lined ductile iron pipe as specified on the plans. All pipe material shall be in accordance with material specified in Sections 330520 "Piping General" and 331100 "Water Distribution System".

## 2.3 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318, 4,000 psi.

## 2.4 CLEANOUTS

- A. Cleanouts shall be provided on sewer service laterals at no more than 75' on centers. Exterior cleanout plug shall be US Foundry cover USF 7621 or equal. Each cleanout plug shall be level with adjacent grade and provided with 24 inches by 24 inches square, 8 inch thick concrete apron.

## PART 3 - EXECUTION

### 3.1 GRAVITY SEWER INSTALLATION

- A. All sewer pipes shall be true to line and grade with bells up grade. The sections of the pipe shall be so laid and fitted together that when complete, the sewer shall have a smooth and uniform invert. The pipe shall be maintained clean. All pipe shall be free from defects. Trenches shall be kept dry while the pipe is being laid.
- B. Bedding of the pipe shall consist of ASTM C33 #67 rock requiring the bottom of the trench to be shaped to fit the bottom of the pipe for distance equal to one-half of the outside diameter of the pipe. Bell holes shall be deep enough to insure proper bearing of the pipe barrel on the bedding.
- C. All joints shall be carefully fitted so as to ensure a tight waterproof joint. Joints shall not be covered until approved by the Engineer. The exposed end of all pipe shall be protected so as to prevent dirt or other debris from entering the pipe. Pipes shall be thoroughly flushed at the completion of the work.
- D. Identification: Materials and their installation are specified in Section 312000 - Earth Moving. Arrange for installing green warning tapes directly over piping and at outside edges of underground structures.

1. Use warning tape or detectable warning tape over ferrous piping; and,
  2. Use detectable warning tape over nonferrous piping and over edges of underground structures.
- E. Piping Applications: Include watertight joints.
- F. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- G. Use maintenance access structures for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.
- H. Install gravity-flow piping to within 5 feet of the building, at the building's sanitary drains, of sizes and in locations indicated. Terminate piping as indicated.
- I. Install piping at slope shown on the drawings. If no slope is shown, minimum slope shall be 1% for 6 inch diameter pipes and 0.5% for 8 inch diameter pipes.
- J. Install piping with 36 inch minimum cover.
- K. Pipe Joint Construction and Installation: Join and install pipe and fittings according to installations indicated.
1. PVC Sewer Pipe and Fittings: Install according to ASTM D 2321.
  2. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and that fit both systems' materials and dimensions.
- L. Maintenance Access Structures Installation: Install complete with appurtenances and accessories indicated.
1. Form continuous concrete channels and benches between inlets and outlet.
  2. Set tops of frames and covers flush with finished surface of Maintenance Access Structures that occur in pavements.
- M. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- N. Clear interior of piping and structures of dirt and superfluous material as work progresses.
1. Place plug in end of incomplete piping at end of day and when work stops.
  2. Flush piping between Maintenance Access Structures and other structures to remove collected debris.

### 3.2 SERVICE LATERAL CONNECTIONS

- A. All connections which are for future use shall be properly capped. No pipe shall be cut for connections unless approved by the Engineer. Wyes for service connections shall be installed as shown on the plans or as directed by the Engineer to align with existing septic tank locations. The upper end of service connections shall be laid at a depth not less than 36 inches nor more than 48 inches below finish grade elevation.

### 3.3 FORCE MAIN INSTALLATION

- A. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the drawings. 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.
- B. Pipe handling. All loading or unloading of pipe, fittings, valves and accessories shall be done in such a manner so as to avoid damage. The pipe shall not be skidded or rolled against pipe already unloaded.
- C. Force mains shall be constructed of ductile iron pipe as specified on the Plans. Fittings 4 inches and over shall be properly anchored and braced with restrained joints conforming to the details shown in the plans.
- D. Force main piping shall be laid at continuously ascending or descending grades with restrained joint fittings, concrete encasement and appurtenances shown on the plans or required by these Specifications.
- E. Air release valves shall be installed at all summits in the pipe where air can collect, as shown on the plans or as directed by the Engineer. The Contractor shall provide a record of elevations along the entire length of force main laid in the trench.
- F. The interior of all pipe, fittings and other appurtenances shall be kept free of dirt and foreign matter at all times. Pipe shall be flushed clean before valves and other appurtenances are installed.
- G. Pipe laying. All pipe shall be laid to line and grade with valves stems plumb. All pipe shall have a minimum cover of 30 inches for DIP pipe.
- H. All fittings, encasement and appurtenances shall be incidental to the cost of furnishing and installing the force mains, unless separate payment for such items is provided in the Bid Schedule.
- I. The force main shall be flushed full bore with clean water to remove any trapped air, silt, dirt and debris before testing. No cross-connection from any potable water system will be permitted.

### 3.4 TESTS

- A. Gravity Sanitary Sewers:

1. After the joints have been inspected and approved, backfilling may be done until backfilled to one foot over the pipes. Backfilling shall be in accordance with Section 312334 of these Specifications.
2. After backfilling gravity sewers to the aforesaid level, the Engineer and a representative of the Owner will "lamp" the lines between maintenance access structures. If this alignment is true and no pipes are broken or misaligned, the backfilling shall be completed.
3. Tests for watertightness of gravity sewers shall be made by the Contractor in the presence of the Engineer. The sewer and connections shall not leak under the normal exterior ground water pressure at a rate in excess of 100 gallons per inch of diameter per mile per 24 hours for any section of line up to 15 inches in diameter. Special consideration shall be given to leakage allowance for sizes larger than 15 inches in diameter. Exfiltration from individual maintenance access structures shall not exceed 4 gallons in 24 hours. A maximum run of three maintenance access structures may be used per test.
4. Where the crown of the pipe is below the natural ground water table at the time and place of testing, the pipe shall be tested for infiltration. Suitable watertight plugs shall be installed and sections of pipe to be tested shall be pumped dry before start of the test. Where the crown of the pipe is above the natural water table, the pipe shall be tested for exfiltration by installing necessary plugs and filling pipes and maintenance access structures with water and maintaining a static head of water of two feet above the crown of the pipe during the test. Exfiltration tests shall be conducted on gravity lines, building and house lateral lines, unless waived by the Engineer. With sanitary sewers, the water level or internal pressure to be used for exfiltration tests shall be determined by the Engineer.
5. All visible leaks, regardless of results of infiltration tests, shall be repaired. All repairs shown necessary by the tests are to be made, broken or cracked pipe replaced, all deposits removed, the sewer left true to line and grade and entirely clean, free from lumps of cement, protruding gaskets, bulkheads, etc., and ready for use before final acceptance is made.
6. Repair of any defects found in the system are to be completed at the expense of the Contractor.
7. On sanitary sewers, final infiltration and exfiltration tests shall be made by the Contractor at his expense after all backfilling operations and pavement restorations are completed and the sewers are cleaned and ready for use.
8. The Engineer shall maintain a record showing date and time of inspection, calculation of allowable exfiltration or infiltration and amount of measured exfiltration or infiltration.

B. Force Mains:

1. Force mains shall be filled with clear water, flushed to evacuate trapped air, then pumped to a pressure of 150 psi and all visible leaks stopped by approved methods. A leakage test shall then be conducted at the above mentioned pressure and no installation will be acceptable until the leakage is less than the number of gallons per hour as determined by the formula:

$$L = \frac{SDP^{1/2}}{133,200}$$

In which L equals the allowable leakage in gallons per hour; S is the pipe length in the force main tested; D is the nominal diameter of the pipe in inches; and P is the average test pressure during the leakage test in pounds per square inch gauge. The test shall be maintained for two hours. Water supplied to the force main during the test to maintain the required pressure shall be measured by a 5/8-inch meter installed on the discharge side of the test pump, or by pumping from a calibrated container.

2. Pipe lines shall be tested before backfilling all joints except where otherwise required by necessity, local ordinance or public convenience. All visible leaks at exposed joints and all leaks evident at the surface where joints are covered shall be made tight, regardless of total leakage as shown by the test. Lines which fail to meet tests shall be repaired and retested as necessary until test requirements are met. Defective materials, pipes, valve, and accessories shall be removed and replaced.
3. The Engineer shall maintain a record of pipe tested indicating date, time of test, test pressure variations, calculation of allowable leakage and amount of measured leakage.

3.5 WARRANTY

- A. Any repairs or replacement necessitated by mechanical failure due to faulty materials, improper installation or poor workmanship shall be completed within five (5) days after notification by the Engineer. At the expiration of this time, the Owner shall be entitled to have work done by others at the expense of the Contractor. Such repair work done by others shall not void the warranty nor the responsibility of the Contractor as to balance of the installation by the Contractor.

END OF SECTION



SECTION 33 41 00 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Work under this section shall consist of providing all labor, plant facilities, materials, tools, equipment, shop drawings and supervision necessary and required to install all of the storm drainage facilities, including piping, fittings, structures, bedding, and backfilling, as specified in accordance with the contract documents.
- B. Section Includes:
  - 1. Pipe and fittings.
  - 2. Nonpressure transition couplings.
  - 3. Pressure pipe couplings.
  - 4. Expansion joints and deflection fittings.
  - 5. Backwater valves.
  - 6. Cleanouts.
  - 7. Drains.
  - 8. Encasement for piping.
  - 9. Manholes.
  - 10. Channel drainage systems.
  - 11. Catch basins.
  - 12. Stormwater inlets.
  - 13. Stormwater detention structures.
  - 14. Pipe outlets.
  - 15. Dry wells.

16. Stormwater disposal systems.

1.3 WORK INCLUDED

- A. Provide all labor, materials, necessary equipment and services to complete the Storm Drainage Facilities work, as indicated on the drawings, as specified herein or both, except as for items specifically indicated as "NIC ITEMS."

1.4 RELATED WORK: (See related sections as applicable)

1.5 DEFINITIONS

- A. FRP: Fiberglass-reinforced plastic.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.
- D. Handle catch basins and stormwater inlets according to manufacturer's written rigging instructions.

1.7 REFERENCE STANDARDS

- A. American Society For Testing and Materials (ASTM)
  - 1. A185 - Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
  - 2. A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
  - 3. A760 - Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
  - 4. A798 - Installation of Corrugated-Steel Pipe for Sewers and Other Applications
  - 5. A929 - Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
  - 6. C76 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
  - 7. C478 - Precast Reinforced Concrete Manhole Sections
  - 8. C1479 - Installation of Reinforced Concrete Pipe
  - 9. C990-01A - Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
  - 10. D2321 - Installation of Thermoplastic Pipe for Sewer/Gravity-Flow Applications
  - 11. D3034 - Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

12. D3212 - Joints for Drain and Sewer Plastic Pipes Using Elastomeric Seals
  13. F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe
  14. F794 - Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
  15. F949 - Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings
- B. American Association of State Highway and Transportation Officials (AASHTO)
1. M198 - Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets
  2. M252 - Corrugated Polyethylene Drainage Tubing
  3. M274 - Aluminum-Coated (Type 2), for Corrugated Steel Pipe
  4. M294 - Corrugated Polyethylene Pipe. 12 to 14 inch Diameter
  5. M36 - Metallic Coated Corrugated Steel Culverts and Underdrains
  6. M190 - Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches
  7. M199 - Standard Specification for Precast Reinforced Concrete Manhole Sections
- C. American Water Works Association (AWWA)
1. C110 - Ductile-Iron and Gray-Iron Fittings, 3 in through 48 in (75 mm through 1200 mm), for Water and Other Liquids (revision of ANSI/AWWA C110/A21.10-93)
  2. C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
  3. C151 - Ductile-Iron Pipe, Centrifugally Cast, for Water
- D. American Concrete Institute (ACI)
1. 301 - Structural Concrete for Buildings, Specifications for
  2. 318 - Building Code Requirements for Structural Plain Concrete
- 1.8 CLEARING
- A. Clearing or installation of pipe and all drainage structures shall be confined within the working limits of the trenches. Trees, utility poles, survey monuments, underground and overhead utilities shall be suitably protected and preserved.
- 1.9 EXISTING UTILITIES

- A. Furnish temporary support, adequate protection and maintenance of all underground and surface utility structures, drains, sewers, cables, etc., and other obstructions encountered in the progress of the work.
- B. When the grade of alignment of the pipe is obstructed by existing utility structures, such as conduits, ducts, pipes, branch connections to water or sewer mains, and other obstructions, the obstructions shall be permanently supported, relocated, removed or reconstructed by the Contractor in cooperation with the owners of such structures. No deviation shall be made from the required line or grade except as directed in writing by the Engineer.
- C. It shall be the responsibility of the Contractor to notify the owners of existing utilities in the area of construction a minimum of 48 hours prior to any excavation adjacent of such utilities, so that field locations of said utilities may be established.
- D. Temporary relocation of existing utilities (to be removed) to accommodate installation of storm drain pipe shall be the responsibility of the Contractor and approved by the Engineer. No additional payment shall be made for temporary relocation of existing utilities and shall be considered part of the bid item for the pipe.

#### 1.10 PROJECT RECORD DOCUMENTS

- A. Accurately record as-built locations of pipe runs, connections, catch basins, cleanouts, top elevations and invert elevations.
- B. Identify and describe unexpected variations of subsurface conditions and location of any utilities encountered.

#### 1.11 QUALITY ASSURANCE

- A. All costs related to reinspection due to failures shall be paid for by the Contractor at no additional expense to the Owner. The Owner reserves the right to direct any inspection that is deemed necessary. Contractor shall provide free access to site for inspection activities.

### PART 2 - PRODUCTS

#### 2.1 PIPE

- A. Aluminum Metal Pipe:
  - 1. Pipe material shall be full round or spiral, hy-flo aluminum culvert pipe, as specified in A.S.T.M. B209 and A.A.S.H.T.O. M-196. Aluminum pipe shall be in accordance with Florida D.O.T. Specification Section 945.
  - 2. Metal pipe shall be jointed according to the pipe manufacturer's specifications for the pipe manufacturer's water tight joint. Corrugated metal band or coupling with bolts as recommended and furnished by the pipe manufacturer shall be used for joints. No pipe or pipe fittings which have been dented, scratched or marred in any way shall be accepted. The Contractor must receive written approval to backfill before placing any backfill over the pipe. The metal pipe shall be furnished in standard laying lengths of 20' or 40'.

3. Perforated corrugated metal pipe shall be aluminum full round or spiral pipe as specified in A.S.T.M. B209 and A.A.S.H.T.O. M-196, perforated corrugated metal underdrain pipe shall be referred to as P.C.M.P.

**B. Reinforced Concrete Culvert Pipe**

1. Concrete pipe shall be produced by a reputable manufacturer engaged in the full time business of manufacturing concrete pipe. Pipe manufacturer shall produce the pipe from an approved, permanent plant acceptable to the Engineer.
2. All concrete pipe shall be reinforced and shall conform to the requirements of ASTM C-76. "Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe." All pipe shall be a minimum of Class III. Pipe shall have an interior surface which is smooth, uniform and free from rough spots, irregularities and projections. Nominal pipe lengths shall be 8' unless authorized otherwise by the Owner's Representative. Lifting holes will be permitted, one (1) hole per length.
3. Concrete pipe may be either bell and spigot, tongue and groove, or modified tongue and groove.
4. Internal rubber gasket joints shall be used. The internal rubber gasket joint shall be supplied by the pipe manufacturer and shall be completely compatible in every respect with the pipe furnished. The rubber gasket on the inside of the bell or groove shall be installed on the pipe at the plant by the pipe manufacturer. All materials and accessories for the rubber gasket joint and the methods of jointing shall be in strict conformance with the pipe manufacturer's direction and recommendation. Joint must be completely water tight.
5. Cement grout joints shall be completely water tight and acceptable to the Owner's Representative. A full bed of mortar shall be placed in the bell and/or groove and on the tongue and/or spigot. The annular space in the pipe joint shall be wiped with cement mortar to insure the joint is filled and to present a smooth surface. The complete exterior periphery of the joint shall have a standard cement grout diaper joint. Diaper shall be installed with the aid of an approved cloth ring. Cement mortar joints shall be made in the dry. Mortar and grout shall be one part Portland Cement to two parts by weight of sand. Mortar shall have enough water to make a stiff mixture that can be molded and worked. Cement mortar joints shall not be covered until inspected and approved by the Owner's Representative.

**C. High Density Polyethylene Pipe**

1. High Density Polyethylene Pipe (HDPE) sizes 12" - 36", shall be corrugated type, smooth interior, conforming to ASTM F405, ASTM F667, AASHTO M252 and AASHTO M294 as manufactured by Advanced Drainage Systems or approved equal.
2. Basic Material:
  - a. Extruded Pipe and Blow Molded Fittings: Pipe and fittings shall be made of virgin PE compounds which conform with the requirements for Type III, Category 4 or 5, Grade P33, Class C; or Grade P34, Class C, as defined and described in ASTM D 1248.



F. Polyvinyl Chloride Pipe (PVC)

1. Pipe shall meet the requirements of ASTM D3034, SDR 26.
2. Rubber gaskets shall meet the requirements of ASTM F477 with joints conforming to ASTM D3212.

G. Corrugated Polyvinyl Chloride Pipe

1. Pipe shall meet the requirements of ASTM F949 and F794.
2. Rubber gaskets shall meet the requirements of ASTM F477 with joints conforming to ASTM D3212.
3. Approved Manufacture: Contech "A2000", 1001 Grove Street, Middletown, OH 45044, (336) 854-2177 or approved equal.

H. Ductile Iron Pipe (DIP)

1. Pipe shall meet the requirements of AWWA C151.
2. Fittings shall meet the requirements of AWWA C110 with rubber gaskets conforming to AWWA C111.

I. Aluminized Steel Type 2 Corrugated Steel Slotted Drain Pipe

1. Pipe shall meet the requirements of AASHTO-M36/ASTM A760 and shall be Aluminized Steel Type 2 per AASHTO M 274; or galvanized steel per AASHTO M-218.
2. The corrugated steel shall have a minimum of two rerolled annular ends.
3. The Slotted Drain bands shall be modified Hugger Bands or approved equal to secure the pipe.
4. The grates shall be manufactured from ASTM A1011, Grade 36 steel. The spacers and bearing bars (sides) shall be 3/16" material  $\pm 0.0008$ ."
5. The spacers shall be 6" centers and welded on both sides to each bearing bar (sides) with four (4) 1-1/4" long 3/16" fillet welds on each side of the bearing bar.
6. The plate extender shall be 7 gauge steel meeting ASTM A 761 with a minimum yield / tensile strengths of 28,000 and 42,000 respectively.
7. The grates shall be vertical (straight sides) with 1-3/4" opening in the top and spacers centered 6" unless otherwise shown on the plans.
8. The grate shall be fillet welded with a minimum weld 1" long to the corrugated steel pipe on each side of the grate at every other corrugation.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Contractor shall only use the pipe material as specified on the plans. Alternate materials will not be allowed unless approved by the Engineer in writing.
- B. The Contractor shall install all drainage structures and pipe in the locations shown on the drawings and/or as approved by the Owner. Pipe shall be of the type and sizes specified on the drawings and shall be laid accurately to line and grade. Structures shall be accurately located and properly oriented.
- C. Excavation and Backfill - The provisions in Section 02305, Trench Excavation and Backfill shall govern all work under this Section.
- D. Storage and Handling of Pipe - All pipe shall be protected against impact, shock and free fall, and only equipment of sufficient capacity and proper design shall be used in the handling of the pipe. Storage of pipe on the job shall be in accordance with the pipe manufacturer's recommendations.
- E. Damage to Pipe
  - 1. Pipe which is defective from any cause, including damage caused by handling, and determined by the Owner as unrepairable, shall be unacceptable for installation and shall be replaced at no cost to the Owner and as directed by the Owner.
  - 2. Pipe that is damaged or disturbed through any cause prior to acceptance of the work, shall be repaired realigned or replaced as directed by the Owner, at the Contractor's expense.
- F. Maintenance Access Structures, catch basins and drain inlets shall be constructed as soon as the pipe laying reaches the location of the structures. Should the Contractor continue his pipe laying without making provisions for completion of the structures, the Owner shall have the authority to stop the pipe laying operations until the structure is completed.
- G. Any structure, which is mislocated or oriented improperly, shall be removed and re-built in its proper location, alignment and orientation at the Contractor's expense.

### 3.2 EXCAVATIONS

- A. Trenches shall be kept as nearly vertical as possible and, if required, shall be properly sheeted and braced. Where, in the opinion of the Engineer, damage could result from withdrawing sheeting, the sheeting shall be left in place. Not more than 100 feet of trench shall be opened at any one time or in advance of pipe laying unless permitted by the Engineer.



1. Except in rock, water-bearing earth or where a granular or concrete base is to be used, mechanical excavation of trenches shall be stopped above the final grade elevation so that the pipe may be laid on a firm, undisturbed native earth bed. If overdigging occurs, all loosened earth shall be removed and the trench bottom brought back to grade with granular material.
2. Excavations and trenches in rock shall be carried to a depth of not less than 8" below the pipe bottom. This space shall be filled with granular material or washed rock.
3. Width of trenches shall be such as to provide adequate space for placing and jointing pipe properly, but in every case the trench shall be kept to a minimum width.
4. Any unstable soil encountered shall be removed and replaced with gravel, crushed rock or rock and sand suitably compacted.

### 3.3 PREPARATION TO TRENCH BOTTOM

- A. Water shall not be allowed in the trenches while the trench bottom is being prepared or while pipe is being installed, unless directed by the Engineer.
- B. A continuous trough shall be shaped to receive the bottom quadrant of the pipe barrel. Bell holes shall be excavated so that after placement, only the barrel of the pipe receives bearing pressure from the trench bottom.
- C. Where unsuitable soil conditions are encountered, the trench bottom shall be excavated to a minimum of eight (8) inches below the proposed bottom of the pipe, and a trough as described above shall be formed with sharp sand or bedding rock to uniformly support the bottom quadrant of the pipe barrel.

### 3.4 BEDDING

- A. Bedding material, when required, shall be in accordance with Section 31 23 33 - Excavation and Backfill for Utilities for work described within this Section.

### 3.5 PIPE INSTALLATION

- A. Comply with Section 31 23 34 - Excavation and Backfill for Utilities.
- B. Laying Pipe
  1. Unloading and Handling: All pipes shall be unloaded and handled with reasonable care. Pipes shall not be rolled or dragged over gravel or rock during handling. The Contractor shall take necessary precautions to ensure the method used in lifting or placing the pipe does not induce stress fatigue in the pipe and the lifting device used uniformly distributes the weight of the pipe along its axis or circumference.

2. Each length of pipe shall be inspected for defects and cracks before carefully lowered into the trench. Any damaged or any pipe that has had its grade disturbed after laying shall be removed and replaced. Bituminous coated pipe shall be handled with special care and repair of damaged coating shall conform with AASHTO M190.
3. Lay pipe on prepared foundation starting at the downgrade end according to line and grade with the necessary drainage structures, fittings, bends and appurtenances as shown on the drawings. Rigid pipes shall be laid with the bell or groove ends upgrade with the spigot or tongue fully inserted. Flexible pipes shall be laid with the inside circumferential laps pointing downstream and with the longitudinal laps at the side or quarter points. Reinforced concrete pipe shall be installed in accordance with ASTM C1479. Bituminous coated corrugated steel pipe and arch pipe shall be installed in accordance with ASTM A798. HDPE pipes shall be installed in accordance with pipe manufacture's installation guidelines for heavy duty drainage applications and ASTM D2321.
4. Pipe sections shall be firmly joined together with appropriate gaskets or bands.
5. Pipe shall be protected during handling against impact shocks and free falls. Pipe shall be kept clean at all times and no pipe shall be used that does not conform to the Specifications.
6. The laying of the pipe shall be commenced at the lowest point with spigot ends pointing in the direction of flow. All pipe shall be laid with ends abutting and true to line and grade. They shall be laid in accordance with manufacturer's requirements as approved by the Engineer.
7. Pipe shall be laid accurately to the line and grade as designated on the plans. Preparatory to making pipe joints, all surfaces of the portions of the pipe to be jointed, or of the factory made jointing material, shall be clean and dry. Lubricant, primers, adhesive, etc., shall be used as recommended by the pipe or joint manufacturer's specifications. The jointing materials or factory fabricated joints shall then be placed, fitted, joined and adjusted in such a manner as to obtain a water tight line. As soon as possible after the joint is made, sufficient backfill material shall be placed along each side of the pipe to prevent movement of pipe off line and grade.
8. The exposed ends of all pipe shall be suitably plugged to prevent earth, water, or other substances from entering the pipe when construction is not in progress.

### 3.6 BACKFILLING TRENCHES

- A. No trenches or excavations shall be backfilled until the trench and installation has been inspected and written approval given by the Owner's Representative. Under no circumstances shall water be permitted to rise in unbackfilled trenches after pipe has been placed. Trenches shall be backfilled with approved material, free of large clods, stones or rocks and carefully deposited in layers not to exceed 6" until enough fill has been placed to provide a cover of not less than 1' above the pipe. Each layer shall be placed, then carefully and uniformly tamped, so as to eliminate the possibility of pipe displacement. The remainder of backfill materials shall then be placed, moistened and compacted in 8" layers to 98% maximum AASHTO T-180 density.

- B. Whenever the trenches have been improperly filled or if settlement occurs, they shall be refilled, compacted, smoothed off and made to conform to grade. Unless otherwise directed or shown on the plans, backfill in trenches in or through roadways shall be made as specified above, except that the entire fill above 1' over the pipe shall be deposited in layers not to exceed 8" in thickness, moistened, and compacted to density equal to or greater than that of adjacent material so that pavement can be placed immediately.

### 3.7 CONCRETE ENCASEMENT OF DRAINAGE PIPE

- A. Trenches in which encasement for pipe are to be placed, may be excavated completely with mechanical equipment. Prior to formation of the encasement, temporary supports consisting of timber wedges or masonry shall be used to support the pipe in place. Temporary supports shall have minimum dimensions and shall support the pipe at no more than two places, one at the bottom of the barrel of the pipe adjacent to the shoulder of the socket and the other near the spigot end.

### 3.8 DRAINAGE STRUCTURES

- A. All structures shall be built to the line and grade shown on drawings. All reinforced concrete work shall be in strict conformance with the concrete specifications contained herein. After erection of the forms and placing of the steel, the Contractor must have inspection and approval from the Engineer before placing any concrete. After removal of the forms, the Contractor shall backfill around each structure with approved granular fill. The fill shall be placed in layers not exceeding 8" in depth measured loose and compacted to 98% of the maximum density as determined by the modified proctor, AASHTO T-180. No defects of any kind in the pipe section will be accepted. All pipe stubs shall be made of the same type of pipe. Pipe stubs shall be sealed with a concrete plug, water tight. The ends of the pipes which enter masonry shall be neatly cut to fit the inner face of the masonry. Cutting shall be done before the pipes are built in.

### 3.9 INFILTRATION AND EXFILTRATION TESTS

- A. Tests for watertightness shall be made by the Contractor. Leakage of completed storm sewer system shall not exceed 500 U.S. gallons per day per inch diameter per mile of pipe under minimum hydrostatic pressure of 2'. Test shall be conducted in a manner satisfactory to the Engineer. Any portion of the project not conforming to the above requirements shall be corrected by the Contractor, at his own expense, prior to acceptance by the Engineer.

### 3.10 CHANNEL DRAINAGE SYSTEM INSTALLATION

- A. Install with top surfaces of components, except piping, flush with finished surface.
- B. Assemble channel sections to form slope down toward drain outlets. Use sealants, adhesives, fasteners, and other materials recommended by system manufacturer.
- C. Embed channel sections and drainage specialties in 4-inch minimum concrete around bottom and sides.
- D. Fasten grates to channel sections if indicated.
- E. Assemble channel sections with flanged or interlocking joints.

- F. Embed channel sections in 4-inch minimum concrete around bottom and sides.

### 3.11 STORMWATER DISPOSAL SYSTEM INSTALLATION

- A. Chamber Systems: Excavate trenches of width and depth, and install system and backfill according to chamber manufacturer's written instructions. Include storage and leaching chambers, filtering material, and filter mat.
- B. Piping Systems: Excavate trenches of width and depth, and install piping system, filter fabric, and backfill, according to piping manufacturer's written instructions.

### 3.12 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
  - 1. Close open ends of piping with at least 8-inch-thick, brick masonry bulkheads.
  - 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
- B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:
  - 1. Remove manhole or structure and close open ends of remaining piping.
  - 2. Remove top of manhole or structure down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.
- C. Backfill to grade according to Section 312000 "Earth Moving."

### 3.13 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
  - 1. Submit separate reports for each system inspection.
  - 2. Defects requiring correction include the following:
    - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.

- d. Infiltration: Water leakage into piping.
  - e. Exfiltration: Water leakage from or around piping.
  - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
  - 4. Reinspect and repeat procedure until results are satisfactory.
  - B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
    - 1. Do not enclose, cover, or put into service before inspection and approval.
    - 2. Test completed piping systems according to requirements of authorities having jurisdiction.
    - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
    - 4. Submit separate report for each test.
    - 5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
      - a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
      - b. Option: Test plastic piping according to ASTM F 1417.
      - c. Option: Test concrete piping according to ASTM C 924.
    - 6. Force-Main Storm Drainage Piping: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psig.
      - a. Ductile-Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
      - b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.
  - C. Leaks and loss in test pressure constitute defects that must be repaired.
  - D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.
- 3.14 RESTORATION OF SURFACES AND/OR STRUCTURES

- A. The Contractor shall restore and/or replace paving, curbing, sidewalks, fences and survey points, or any other disturbed surfaces or structures to a condition equal to that before the work was begun and to the satisfaction of the Engineer. Relative to restoration of surfaces and/or structures, the Contractor shall comply with all requirements of governing agencies including city, town, county and state.

3.15 PROTECTION AND CLEANING

- A. The Contractor shall maintain all pipe installations and drainage structures in a condition such that they will function continuously and shall be kept clean of silt, debris and other foreign matter from the pipe and drainage structure is installed until the project is accepted.

3.16 FINAL INSPECTION

- A. All storm sewers shall be lamed by the Engineer prior to acceptance of the work. Repairs or misalignment shown necessary by the tests shall be corrected at the Contractor's expense. All sewers shall be thoroughly cleaned before being placed into use and shall be kept clean until final acceptance by the Engineer.
- B. Upon completion of the work and before final acceptance by the Owner, the entire drainage system shall be subject to a final inspection in the presence of the Owner and/or Engineer. The work shall not be considered as complete until all requirements for line, grade, cleanliness, and workmanship have been completed.

END OF SECTION