County of Nevada

McCourtney Road Transfer Station Improvements

Construction Documents
Project Manual

Issued for Bids

November 24, 2021

HDR Project No. 10194847

Engineer's Certification

Preparation of this document for **County of Nevada McCourtney Road Transfer Station Improvements** project was done by HDR Engineering, Inc. under the responsible charge of the following:

HDR Engineering, Inc.

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BID SCHEDULE

McCourtney Road Transfer Station Project

(County Project No. 310.208.091)

Base Bid					
No.	**Item**	**Estimated Quantity**	**Unit**	**Unit Price**	**Total**
1	Mobilization and Demobilization	Lump Sum	LS		
2	Phasing Plan	Lump Sum	LS		
3	Traffic Control, temporary detours, labor, materials complete in place throughout project duration	Lump Sum	LS		
4	Sheeting, Shoring, and Bracing as required by Sections 6700-6708 of the Labor Code.	Lump Sum	LS		
5	Locating and pot holing utilities	Lump Sum	LS		
6	Excavation and rough earthwork prior to dynamic compaction measured on a pre-and post-survey	Cubic Yard	CY	5,000	
7	Dynamic Compaction	Lump Sum	LS		
8	Import Fill, moisture conditioning, lime treatment, placement and compaction measured on a pre-import and post import survey	Cubic Yard	CY	31,000	
9	Fire protection Intake and Pump system, new inlet in Surface Impoundment 2, pond liner penetration and repair, wet well, pump assembly, pump assembly foundation and fire protection pump system complete system in place	Lump Sum	LS		
10	Water supply, new groundwater pump and piping to be installed in new groundwater well installed by others, conveyance to water storage tank, water pump and pressure system, enclosure power, connection to existing water system, connection to new water system, complete in place.	Lump Sum	LS		
11	Site finish grading	Lump Sum	LS		
12	Transfer Station foundation, preparation and base rock, reinforcing, concrete slab, loadout tunnel foundation, complete in place	Lump Sum	LS		
13	Mechanical, Electrical and Restroom building, foundation, methane venting system, building enclosure, roof system ladders, complete in place	Lump Sum	LS		

No.	Item	Estimated Quantity	Unit	Unit Price	Total
14	Site Retaining Walls, excavation, forming, reinforcement, concrete, backfilling, complete in place	Lump Sum	LS		
15	Push walls, steel plating, chutes, bollards, complete in place	Lump Sum	LS		
16	Pre Engineered Metal Building (Transfer Station) framing, cladding, stairs, roofing, overall building system complete in place	Lump Sum	LS		
17	Transfer Station fire suppression system, fire riser, complete in place	Lump Sum	LS		
18	Transfer Station loadout scales, display panels, complete in place	Lump Sum	LS		
19	Mechanical systems, restrooms, plumbing, sewer system, septic tanks, pump stations, misting system, ventilation systems and all other mechanical system complete in place	Lump Sum	LS		
20	Electrical System, power supply and distribution, conduits, wiring, complete in place	Lump Sum	LS		
21	Fire water distribution system, connection to fire pump, connection to new fire riser, fire hydrants, connections to existing PRA building, connections to existing fire distribution system, complete in place	Lump Sum	LS		
22	Cleaning and Lining existing triple 24 In Diameter CMP, debris removal, cleaning, preparation, lining, connection to existing and new facilities, complete in place				
23	Site storm drainage system, inlets, grates, excavations, pipes, backfill, system complete in place				
24	Entrance plaza, scales, scale foundations, bollards, scale houses, scale house foundations, cover canopies, conduits, power and related improvements complete in place.	Lump Sum	LS		
25	Asphalt Pavement, base rock, pavement restoration, complete in place.	Square Foot	SF	123,000	
26	Site Concrete Pavement, base rock, reinforcement, concrete pavement, complete in place	Square Feet	SF	26,000	
27	Erosion control, stormwater pollution prevention, and site stabilization.	Lump Sum	LS		
28	Signage temporary and permanent	Lump Sum	LS		
29	Monthly Schedule Update	Lump Sum	LS		
30	Permit Fees and Inspection Allowance	Allowance	NA		$80,000
31	All other Improvements not listed above per the MRTS Improvement	Lump Sum	LS		

No.	Item	Estimated Quantity	Unit	Unit Price	Total
	complete as specified and shown excluding all work listed in other bid items.				

Bid amount of each of the above Bid items must be filled in and completed.

Bid items shall be as specified in Section 01 22 00, **MEASUREMENT AND PAYMENT**.

Total Base Bid for determining the lowest responsible bidder (the summation of Bid items 1 through 31):_____

_____

_____(dollars in words)
_____(dollars in numbers)

NOTE #1 In case of an inconsistency or conflict between the item prices and the total submitted by the bidder, the item prices shall govern.

*** **END OF SECTION** ***

DIVISION 01

GENERAL REQUIREMENTS

SECTION 01 11 00
SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Location and description of Work and prior uses of the Site.
   2. Construction Contracts for this Project.
   3. Others retained by Owner for the Project.
   4. Work by others under Owner's control on other projects.
   5. Work by others not under Owner's control.
   6. Work by Owner.
   7. Sequence and progress of Work.
   8. Contractor's use of the Site.
   9. Easements and rights-of-way.
   10. Partial utilization by Owner.
   11. Utility owners.

B. Related Requirements:
   1. Include, but are not limited to, the following:
      a. Section 01 14 19 - Use of Site
      b. Section 01 11 20 Job Condition

1.2 LOCATION AND DESCRIPTION OF WORK

A. The Work is located in Nevada County California, and extends from the entrance to the McCourtney Road Transfer Station at Wolf Mountain Road to the eastern end of the truck staging area, east of the two surface impoundments located at the closed McCourtney Road Landfill site.

B. Work to be performed under this Contract includes, but is not limited to, constructing a new waste transfer station, entrance roads, scale plaza, water supply, fire suppression system, waste water conveyance system, removal and pavement of the existing entrance scale facility, removal and pavement of the administrative support area, and all other Work required in accordance with the Contract Documents.

C. The Work is located at the McCourtney Road Transfer Station site, 14741 Wolf Mountain Road in the unincorporated portion of Nevada County, California .

D. The Project includes constructing the Work broadly described below, in accordance with the Contract Documents, with all related appurtenances. Work shown on the Drawings, or indicated in the Specifications, or indicated elsewhere in the Contract Documents is part of the Work, regardless of whether indicated below. The Work includes, but is not limited to, the following:

- Minor grading and surface improvements to the area east of the surface impoundments to enable the use of the current trailer/bin storage area to be used as the green/yard waste receiving and transfer, construction and demolition (C&D) materials receiving and transfer, and related uses.
- Site earthwork and preparation including initial grading in preparation of dynamic compaction, dynamic compaction, importation, placement, moisture conditioning and compaction of soils and related earthwork improvements.

- Construction of a new Transfer Station consisting of an approximately 48,000 square foot pre-engineered metal building to replace the existing Public Receiving Area (PRA) building and to serve as the receiving area for both self-hauled commercial municipal solid waste as well as recyclables and other materials as necessary,
- Installation of roadways encircling the new Transfer Station
- An expansion of the site entrance road and installation of new entrance and exit scale facilities to provide access to the new transfer station as well as continued access to the existing recycling, buy-back and Household Hazardous Waste (HHW) features,
- Earthwork and utility improvements necessary to serve a new Administration trailer to be provided by others. New utilities to include power, water, sewerage, telecommunications and conduits for video and data communications between the scale plaza, new Transfer Station, existing southerly most scale, existing HHW and CRV buyback areas.
- Removing the existing fire suppression pump and related system.
- Providing temporary fire suppression system required by the Fire Department during construction of the new facilities.
- Installation of a new groundwater well pump, conveyance to a new storage tank and pressurization system, connection to the existing domestic water distribution system and new distribution system to new facilities.
- Installation of a new diesel fueled fire suppression system including a new intake, wet well, fire pumping system, piping, alarms and controls.
- Repurposing of the existing PRA building to serve as the Organics receiving and transfer building,
- Removal of the existing northerly entrance scale and scale house facility and pavement or all-weather treatment of this area to be used for green/yard waste and/or C&D materials receiving and transfer.
- Retention of the existing southerly most entrance scale and installation of utilities for future installation of a keypad entry activated entrance arm barrier opener and utilities connecting scale weights to the admin trailer.
- Installation of new or repaved asphalt surfaces.
- Installation of a new pump and piping system from a new groundwater well (to be installed by others), new water storage tank, pressurization system and water distribution system
- Installation of a new water supply to the upper pad parking area that is repurposed as a new construction & demolition receiving area.

E. Contracting Method: The Project will be constructed under a single prime construction Contract.

F. Hazardous Environmental Conditions:
   1. To the best of Owner's knowledge, information, and belief, the prior use of the Site included an undocumented fill site as described in the attached geotechnical report. Existing buildings at the Site were constructed in the mid-1990's..
   2. A Hazardous Environmental Condition, described in reports referenced in the Supplementary Conditions, will (or has reasonable potential to) affect the Work.

1.3 CONSTRUCTION CONTRACTS FOR THIS PROJECT

A. Single Prime Construction Contract: The Contract requires all the Work for the Project not expressly allocated to Owner or others in the Contract Documents.

1.4 OTHERS RETAINED BY OWNER FOR THE PROJECT

A. Engineer:
   1. HDR Engineering .

1.5 WORK BY OTHERS UNDER OWNER'S CONTROL - OTHER PROJECTS

A. Other construction contracts have been or will be awarded by Owner that are in close proximity to or border on the Work of this Project. Work under these other contracts is briefly described in this Article.

B. On-going operations of the McCourtney Road by Waste Management :
   1. Principal Work Location: Waste Management Administration Trailer, data and communications cabling to the new scale plaza and existing southerly most entrance scale, and adjacent areas.
   2. Scope: Installation of a new Administration Trailer, installation of data and commutations cabling between the new Administration Trailer, new scale plaza scale house, existing southerly most scale, new Transfer Station and existing PRA cameras, etc.
      a. Project involves: Installation of a new Administration Trailer, installation of data and commutations cabling between the new Administration Trailer, new scale plaza scale house, existing southerly most scale, new Transfer Station and existing PRA cameras, etc.

1.6 WORK BY OTHERS NOT UNDER OWNER'S CONTROL

1.7 WORK BY OWNER

A. Owner will perform the following in connection with the Work:
   1. Operate the facility, all existing valves, flow-control gates, pumps, equipment, and appurtenances that will affect Owner's operations or facility processes, unless otherwise specified or indicated.

1.8 SEQUENCE AND PROGRESS OF WORK

A. Sequencing:
   1. Incorporate sequencing of the Work into the Progress Schedule.
      Sequencing Requirements: Work to be performed such that the continual operation of the existing facility can continue its operations uninterrupted by the construction of the various improvements. Preliminary the phasing in envisioned as following however, the Contractor is responsible for implementation of a phasing plan as described in Section Z.:
      a. Phase 1 is anticipated to consist of earthwork, utilities, pavement and completion of the new PRA, load-out and perimeter roadways. These improvements could be constructed while without interfering with current operations of the exiting entrance facilities and existing PRA building; however, the existing green waste and C&D activities will need to be relocated to free that site are for the improvements. Prior to commencing construction, the existing green waste and C&D materials areas will need to be relocated to a temporary location that need to last for the duration of construction of the project. It is expected that the current trailer storage area on the pad to the east of MRTS, past the leachate ponds, will serve as the temporary location of these areas. Relocation work will include preparing roadway access that routes vehicles to that area from around the north side of the existing PRA.

         The Phase 1 improvements are anticipated to account for the majority of the cost. Earthwork to provide the surface for the new entrance road and scale facility will occur on the north side of the existing PRA. Earthwork to provide the surface for the new PRA would occur in the existing green waste and C&D areas.

         Phase 1 includes the following components:

- A temporary boundary could be constructed around the existing PRA and recycling area to protect on-going operations while Phase 1 improvements are constructed.
- Install temporary water system to the upper trailer parking pad to enable use of the area as the green waste and C&D receiving area.
- Current green waste and C&D areas could be temporarily moved to current trailer storage area. This would allow for the site to be vacant for the construction of the new Transfer Station/PRA. This includes a new temporary access road around the north side of the existing PRA.
- The existing low area north and east of the existing recycling area are to be filled to raise the grade as well as to reduce the length of slope between the new Phase 1 grading and the existing site circulation. Some of the area currently used for recycling storage will need to be streamlined in order to accommodate this southwestern portion of Phase 1 construction.
- The new Transfer Station foundation, building, aprons, paving, subsurface utilities and related components could be constructed and will be ready for use by the end of Phase 1 construction.

b. Phase 2 could begin when the County accepts the new Transfer Station and authorizes the site operator to begin to use it. Phase 2 would consist of widening and redirecting the existing entrance road from Wolf Mountain Road to a new three-way intersection west of the existing PRA building. A new roadway directing traffic to a new entrance/exit scale facility located north of the existing PRA will be constructed. The new entrance/exit scale facility will consist of a total of two new scale houses and four new scales. From the new three-way intersection, a road directing traffic to the existing HHW and Recycle area will be constructed.

Phase 2 includes the following components:

- The new entrance road and new Transfer Station could be constructed as illustrated in the Phase 2 site circulation plan. Four new scales and two new scale houses are to be installed.
- The new entrance road improvements would extend to the new Transfer Station facility constructed in Phase 1 above, connecting at the three-way intersection located at the northwest corner of the new PRA.
- After the new Transfer Station is operational, the old PRA will be re-purposed to become the organics diversion facility.
- Existing scales and scale house would be utilized with the new Transfer Station for a temporary duration. After the new scale facility is open and operational, the northerly most existing scale and scale house can be removed. The southerly most existing scale will remain operational.
- The Site Operator can be allowed to accept the delivery of a new Admin building which could be delivered and installed by the Site Operator.
- After the existing scales, scale house and admin building have been removed and the area prepared for operations, the green waste and C&D activities can be moved to the new permanent location south of the existing PRA building.

B. Requirements for sequencing and coordinating with Owner's operations, including maintenance of facility operations during construction, and requirements for tie-ins and shutdowns, are in Section 01 14 16 - Coordination with Owner's Operations.

1.9 CONTRACTOR'S USE OF SITE

A. Use of Site - General:
   1. Limits on Contractor's use of the Site are indicated in Section 01 14 19 - Use of Site, and as may be shown on the Drawings.
   2. Contractors shall share use of the Site with the waste facility contracted operator, Waste Management Inc and others specified in Articles 1.3 through 1.6 (inclusive) of this Section.
   3. Relocate stored materials and equipment that interfere with operations of Owner, other contractors, and others performing work for Owner.
   4. Comply with restrictions set forth in Section 01 14 19 - Use of Site.

B. Owner will occupy the Site jointly with Contractor during construction for performance of Owner's typical operations. Coordinate with Owner in all construction operations to minimize conflicts between Contractor and Owner's employees and others under Owner's control. If the Site is a treatment facility or other production facility, Owner will have Owner's suppliers for deliveries of chemicals and other items accessing the Site from time to time, possibly on a daily basis.

1.10 EASEMENTS AND RIGHTS-OF-WAY

A. Easements and Rights-of-Way - General:
   1. Easements and rights-of-way required for the permanent improvements included in the Work will be provided by Owner in accordance with the General Conditions and Supplementary Conditions.
   2. Confine construction operations within Owner's property, public rights-of-way, easements obtained by Owner, and limits shown, and property for which Contractor has made arrangements directly with property owner(s).
   3. Use care in placing construction tools, machinery and equipment, excavated materials, and materials and equipment to be incorporated into the Work to avoid damaging property and interfering with traffic.
   4. Do not enter private property outside the construction limits without permission from the owner of the property.

B. Within public road Rights-of-Way:
   1. Permits required for the permanent facilities will be obtained by Owner. Contractor shall obtain and pay for work permits and fees for safety and inspection forces to be furnished by the right-of-way owner.
   2. Work performed and Contractor's operations within rights-of-way, including railroad and highway rights-of-way, shall comply with requirements of right-of-way owner and owners of facilities thereon, and with applicable work permits, and orders of authorities having jurisdiction over right-of-way.

1.11 PARTIAL UTILIZATION BY OWNER

A. Prior to Substantial Completion of the entire Work under the Contract, substantially complete the Work as follows:
   1. Work indicted for Milestones.
      a. Substantial completion of the new Transfer Station and related roadways, fire suppression system, water system, sewer system, and electrical system.
      b. Acceptance of the new Transfer Station and related improvements
      c. Substantial completion of the new entrance road and entrance plaza
      d. Substantial completion of the removal of the existing entrance scale and existing administration facilities
      e. Substantial completion of the project
      f. Acceptance of the project.

1.12 UTILITY OWNERS

A. Utilities known to Engineer and that may have Underground Facilities or other facilities in the vicinity of the Work are:
   1. Pacific Gas and Electric:
      a. Electrical power to the facilities.
      b. PG&E Box 997300 Sacramento CA 95899-7300
      c. www.pge.com/MyEnergy .
      d. Telephone: 1 800 468 4743.

	McCourtney Road Transfer Station and Landfill Meters.										
	Meter Number	Building's and Equipment									
MRL	1006864472	Flare									
WM	**1005721830	(MRTS) Scale House, Office, HHW Facility, PRA, PRA Kiosk, C&D Kiosk, Gate House and Sewage Pump.									
MRL	1006534592	PW-1 and Heat Tape (Well used to lower ground water).									
MRL	1009124620	MRLF Office and Restroom, Sewage Pump, Weights & Measures Shop and Lab, DW-1 Pump House (Non Potable Water).									
MRL	1009124643	MRLF Shop.									
MRL	1009124621	PS-2 ,PS-3, Fuel Pumps.									
WM	**1006864471	Fire Suppression System ,Booster pump, Heat Tape, Sump Pump, Step Down Transformer, PS-4 Leachate pump,									
		and both C&D/Yard Waste Kiosks.									
MRL	*1009920360	SI-1, Aerator's,old pump out station, LCRS Vault pump, Step Down Transformer, Leachate Tank Farm,New Pump Out Station									
MRL	1010091161	PS-1			old meter, #	1006864470	replaced on 10-6-2016			service point ID 7835256205	
						52826					
MRL	* **McCourtney Rd Landfill meter**- This meter is the new smart meter installed by PG & E. The old number meter is 881R95										
WM	** **Waste Management Meters**										
	These meter numbers do not include any meters previously held under Waste Management (ie recycle center and or the rural transfer stations)										

   2. ATT :
      a. Waste Management router for data management
      b. Telephone: 530 386 0626

B. Utilities and their owners indicated in the Contract Documents are for Contractor's convenience. Neither Owner nor Engineer will be liable to Contractor or any utility owner for failure to indicate utility, its owner, or complete and correct contact information in the Contract Documents where Contractor's reasonable and ordinarily-exercised diligence would reveal the presence of the utility and its owner. Nothing in the Contract mitigates Contractor's responsibilities under the General Conditions for the protection of the work and property, and Laws and Regulations, including "call before you dig" regulations.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 11 20
JOB CONDITIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Job conditions.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.

1.2 PROJECT CONDITIONS

A. Maintaining Facility Operations: Facility is currently an operating waste, yard waste, construction and demolition (C&D) waste, recycling and household hazardous waste (HHW) receiving and transfer facility. Ensure construction activities do not interfere with Owner's operation of facility.

B. Providing Temporary Fire Suppression: The facility is currently provided fire suppression by way of a fire pump system adjacent to Surface Impoundment number one (SI-1). This fire pump system must be removed as a part of the initial earthwork in preparation of constructing the new Transfer Station in phase 1 of construction. Contractor is responsible for providing temporary fire suppression as required by the Fire Marshall while the existing fire suppression system is removed and until acceptance of the new fire suppression system constructed as a part of this project.

C. Project Phasing: Project construction phasing is for illustration purposes only. Contractor is to provide for project phasing whereby the use of the facility remains continuous throughout the entire construction period of the project.

D. Providing Traffic Circulation and Traffic Control: As noted above the Facility is to remain operational throughout the entire construction activities. Contractor to provide for temporary traffic circulation throughout the site as needed to provide customers an orderly use of the site.

E. Coordination and replacement of water supply system: The facility is currently provided non-potable domestic water by way of a pumped system from existing well DW-1 located near the existing County Maintenance yard, south of the existing waste facility. The project includes converting well PW-1 located on the western flank of the landfill to the source of domestic water, installing a new storage tank and pumping system, and reuse of the existing water distribution system from this new water tank and pumping system. Contractor to coordinate removal of non-potable domestic water supply system with new potable water supply system to minimize downtime of water supply to no more than one week. Contractor to provide site temporary sanitary facilities at each of the existing restrooms during this downtime.

F. Subsurface Soil Conditions: Contractor is advised that portions of the site beneath the new Transfer Station require excavation and dynamic compaction as described in the geotechnical report prepared by NV5.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

END OF SECTION

SECTION 01 13 00
PUBLIC IMPACT MITIGATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Contractual requirements for the protection of the public and the reduction of impacts to the public

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Occupational Safety and Health Administration (OSHA).
   2. Governing Noise Control, Emissions Control, Fugitive Dust Control Bylaw, or similar regulation.

1.3 SUBMITTALS

A. Prepare and submit to Engineer within fourteen (14) days of Notice of Award, and before the Notice to Proceed is issued, a general public impact mitigation plan for the Work.

B. In addition, prepare and submit to Engineer at least fourteen (14) days before starting construction in any particular area, a detailed public impact mitigation plan for that specific area. The plan shall include techniques, sequencing and work procedures that minimize public impact and disruption from the Work.
   1. The Contractor's public impact mitigation plan shall include details on how the work will be implemented and address, as applicable, the following:
      a. Access to the Work Site integrated with traffic management plan for each of the project phases/sequence to retain unfettered operations of the receipt and transfer of wastes;
      b. Vehicular and pedestrian access to residential, commercial, and industrial properties impacted by the work;
      c. Work to be performed outside of normal working hours;
      d. Field fabrication (welding and testing), coating and lining facilities;
      e. Storage of equipment, materials, soil and gravel;
      f. Noise mitigation for equipment and construction processes over 85 dBA;
      g. Air quality mitigation (dust control, diesel emissions);
      h. Preservation or interruption of existing utilities;
      i. Street cleaning;
      j. Site cleanliness and visual impact mitigation; and
      k. Restoration.
   2. Ensure all of its employees, subcontractors and suppliers strictly comply with the reviewed public impact mitigation plan.

C. Provide Engineer a minimum of 5 days notice of any significant change in schedule or methodology that could impact the community. This will allow the Owner sufficient time to notify the community of the change.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION

3.1 GENERAL

A. The Project is located in close proximity on a public access facility. It is of prime importance that the Contractor implements all practical mitigation measures to reduce impact to the site operations during the execution of the Work.

B. Cooperate with the Owner, the various utility companies, suppliers, other contractors, and on site Owner staff.

C. Ensure that its staff, subcontractors and suppliers behave in a professional manner to other contractors, Owner staff and the general public.

3.2 PUBLIC RELATIONS AND COOPERATION

A. The Owner has produced the following communications protocol which outlines the project team's roles and responsibilities. Follow this communications protocol. The Owner is the primary communicator with the public and the media. However, the Contractor will have a role with the public on site as defined below. Refer any media requests to Owner.

B. The Contractor, at the Owner's reasonable request, shall change methods or timing or performing portions of the Work in order to reduce public impacts or address concerns of the public.

C. Work with the Owner to locate noisy, odourous or exhaust producing equipment or activities away from high impact areas.

3.3 PARTNERING

A. Partner with the Owner in addressing local residents' concerns regarding construction work. The Contractor's Project Manager or other senior employee shall attend any public meetings organized by Owner with area residents. The Owner will attempt to schedule such public meetings to coincide with regular construction progress meetings.

B. Be required to make and keep commitments to local residents regarding aspects of the construction work that impact local residents.

C. Address Public Impact Mitigation as a standing agenda item for regular construction progress meetings.

3.4 ACCESS AND PUBLIC SAFETY

A. Effectively warn and protect the public from any danger or harm related to the implementation of the work. This includes appropriate signage and fencing to restrict public access to the construction site.

B. No material or equipment shall be stored where it may interfere with the free and safe passage of public traffic, or in such a manner that it may create a hazard to the public. At the end of each day's work, and at other times when construction operations are suspended for any reason, remove all equipment and other obstructions from that portion of the roadway/sidewalk open for use by public traffic.

C. Provide or construct, and maintain, temporary bridges of approved design across open trenches, temporary piping and wherever necessary, to provide vehicle and/or pedestrian access to residential, commercial, and industrial s properties and road crosswalks.

D. Should the Contractor's work prevent the governing body from clearing snow or removing accumulated rain water, take whatever steps necessary to ensure safe vehicle and pedestrian traffic around and through the Work Site.

3.5 SITE CLEANLINESS

A. The Work Site shall be kept in a clean and neat condition and shall not be unnecessarily encumbered with equipment, materials, or debris.

B. At all times conduct the work in an orderly and tidy manner, and shall at suitable intervals, acceptable to the Owner, remove from the Work Site any accumulation of rubbish or refuse matter. At no time shall any person employed by the Contractor, or by any sub-contractors, discard litter or garbage or recyclables on or adjacent to the Work Site, except into suitable containers provided by the Contractor for this purpose.

C. Ensure that roads, sidewalks, and driveways impacted by the work are clean and swept at the end of the day, or as directed by the Owner.

D. Prevent spillage from vehicles on public or private roads along which excavated spoil, construction materials, or refuse, is hauled, through tarping or other means. Where any such spillage occurs, it shall be promptly cleaned up.

E. Have appropriate equipment readily available for dust and mud control.

F. If the Contractor fails to clean the Work Site to the satisfaction of the Engineer, the Owner may undertake the work and deduct the associated cost from payments due to the Contractor.

3.6 WORK HOURS AT THE WORK SITE

A. Unless otherwise noted or agreed upon by the Owner, the hours of work shall be from 7:00 am to 5:00 pm on any weekday, 7:00 am to 5:00 pm on Saturday. No work on Sunday or a statutory holiday unless approved by the Owner and communicated in advance to the affected public.

B. Schedule noisy work, including, but not limited to, pile driving, jack hammering, vacuum trucks, between 07:00 am and 5:00 pm.

C. Before and after the hours of work avoid nuisance noise including offloading of equipment or materials, warming up of heavy equipment, car stereos, slamming tailgates, backup beepers, workers yelling or any other thing that will generate nuisance noise.

D. Give the Owner one week notice of any Saturday, Sunday or Holiday Work.

E. Project Specific Work Hours Exceptions:
   1. Parts of the work due to project schedule or impacts to site operations may require coordinated work after hours or over weekend periods. Such work shall be scheduled a minimum of one week in advance with approval of the Owner prior to proceeding.
   2. The Owner may consider extended site operation stoppages if it is in the best interest of the project in the Owner's sole opinion. Approval of such stoppages is in accordance with the criteria in this Section.

3.7 SEGREGATION OF THE WORK SITE

A. Provide unimpeded public access to the areas beyond the limits of the Work and prevent the public from entering all areas where Work is being performed.

B. At the end of each working day, or if left unattended, any open excavation shall be securely fenced.

C. Protect the public through means such as bridges, ramps or barricade flashers over hoses and cords, fencing around equipment, or as otherwise directed by the Engineer.

3.8 PARKING

A. The following parking, in order of preference, is available to the Contractor for worker parking throughout the Contract duration and as directed by the Engineer:
   1. Parking which the Contractor can create and maintain at the Work Site in compliance with all other requirements regarding vehicles on the Work Site;
   2. Parking where identified on the Drawings permitted by Owner.

B. Coordinate and cooperate with the Owner in the establishment and assignment of all work parking at the identified locations or any other location authorized by the Owner, all at no extra cost to the Corporation.

C. Where necessary, be responsible for moving employees between parking area(s) and Work Site.

3.9 NOISE

A. Comply with the Nevada County's noise Ordinance or the requirements below whichever is more stringent. Measurement of noise levels for the purpose of checking compliance with this requirement shall be done in accordance with the requirements of the applicable noise bylaw.

B. At no time during specified working hours shall the noise generated by the work, exceed the applicable bylaw limits, or, where no bylaw limits apply, "continuous" noise levels shall not exceed 85 dBA at the nearest property line, where "continuous" noise level is the noise level exceeded for more than 3 minutes in any 15 minute period.

C. Should the Contractor wish to work outside the limits of the noise Ordinance, he shall submit to the Owner an alternative work plan for review and comment. The plan shall indicate the types of equipment that will be required to operate outside the specified limits, proposed locations of the equipment and a description of any noise control measures that will be implemented. Then apply to the County for a variance to the noise Ordinance should it wish to work outside of the applicable limits.

D. Cooperate with the Owner in choosing a location for stationary equipment to minimize noise to the public.

E. Apply to the County for noise variances to allow use of generator, dewatering pumps, dehumidifier or other equipment after hours. If approved, ensure that the noise from any equipment used after hours does not exceed 55 dBA measured at the lesser of: property line, or 15 M or, at the maximum specified by the County and the Owner.

F. The potential for noise impact to the commercial, industrial, and residential properties adjacent to the Work Site and access roads has been predicted based upon anticipated construction activities and equipment. Noise monitoring may be conducted by the Owner throughout the project. If measurements indicate that the required noise levels are not being met, identify and implement noise control measures necessary to comply with applicable bylaws and these contractual requirements.

3.10 EQUIPMENT NOISE LIMITS

A. Prior to mobilization, submit to Engineer a list of all major equipment to be used on the Work Site throughout the Contract which will generate more that 85 dBA. This list shall include make, model and age, plus anticipated noise level based on manufacturer's data and the contractors proposed noise reduction plans. The Engineer will accept or reject the use of specific equipment which produces higher noise levels. With the exception of any equipment specifically accepted by Corporation, the maximum acceptable noise level produced by any individual machine shall be 85 dBA when measured at 15 M from the equipment.

B. The work site shall be laid out to minimize the requirement for trucks and mobile equipment to back up. Back-up alarms shall be adjusted to be clearly audible above the ambient noise level, as required by OSHA but shall be no louder than necessary. Where after hours work is required and approved, OSHA approved alternatives to the use of back-up alarms may be required.

C. The Owner reserves the right to test any equipment on the Work Site at any time to determine if equipment noise emission exceeded the Contract limits. Make any equipment, with operator, available for testing, at or near its working location, at no additional cost to the Corporation.

D. In the event that any equipment does not satisfy the Contract noise level limits, the equipment shall be replaced by a quieter machine or it shall be modified, for example, by providing better exhaust silencing or reducing its governed engine speed, or building a sound enclosure and the

alternate or modified machine may then be re-tested. The cost of any re-testing by the Owner will be charged to the Contractor.

3.11 MAINTENANCE AND USE OF EQUIPMENT

A. Regular maintenance of equipment shall be undertaken to reduce noise and emissions produced by that equipment. This includes, but not limited to, regular greasing of treads, chassis and pivot points, replacement of worn parts, brake checks, mechanical overhauls, attention to exhaust and emission control systems and any special acoustical fixtures.

B. All equipment used on the Work Site shall be equipped with, and operated with, all applicable covers, hoods, shields, and guards in place and latched shut, and all exhaust and emission control systems in place and fully operational. Air-powered equipment such as rock drills and jackhammers shall be equipped with effective mufflers on the air exhausts. The manufacturer's recommendation shall be followed.

C. Equipment, which is not in use, shall be shut down, and not left idling for periods longer than three (3) minutes to reduce noise and negative impacts to air quality.

D. Brakes on trucks shall be adjusted and maintained to avoid objectionable brake "squeal" or noise. Engine brakes shall not be used anywhere on the Work Site or on any access roads, except in an emergency.

E. Operators of excavating equipment shall use minimum power consistent with reasonable operation of equipment, and shall avoid banging of buckets on truck bodies, or other objects.

END OF SECTION

SECTION 01 14 16
COORDINATION WITH OWNER'S OPERATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for coordinating with Owner's operations and Waste Management's operations during the Project.
   2. Requirements for providing waste haulers access for the continued operation of the facility throughout construction.
   3. Requirements for coordinating with the Fire Department to provide temporary fire system while existing fire system has been removed and before new fire system is operational.
   4. Requirements for tie-ins and shutdowns necessary to complete the Work without impact on Owner's operations except as allowed in this Specifications section.

B. Scope:
   1. Contractor shall provide all labor, materials, equipment, tools, and incidentals shown, specified, and required to coordinate with Owner's operations during the Work in accordance with this Specifications section.
   2. Except for shutdowns specified in this Specifications section, perform the Work such that Owner's facilities remain in continuous, satisfactory operation during the Project. Schedule and perform the Work such that the Work does not: impede Owner's production or processes, create potential hazards to operating equipment and personnel, reduce the quality of the facility's products or effluent, cause odors or other nuisances, does not affect the public health, safety, welfare, and convenience, and does not adversely affect the environment resulting in violation of Laws or Regulations.
   3. Work not specifically addressed in this Specifications section or in referenced sections may, in general, be performed, to be completed within the Contract Times, at any time during regular working hours in accordance with the Contract Documents, subject to the requirements in this section.

C. Related Requirements: Include but are not necessarily limited to:
   1. Section 01 11 00 - Summary of Work.
   2. Section 01 73 29 - Cutting and Patching.
   3. Section 01 75 00 - Checkout and Startup Procedures.

1.2 REFERENCES

A. Terminology:
   1. Terminology indicated below are not defined terms and are not indicated with initial capital letters, but when used in this Specifications section have the meaning indicated below:
      a. The term "Owner" is used throughout this section. When the facility is operated or managed by an entity other than Owner, references in this section to "Owner" as the operator or manager of the facility will be interpreted as referring to the facility manager.
      b. A "shutdown" is when a portion of the normal operation of Owner's facility, whether equipment, systems, conduit (including piping and ducting), has to be temporarily suspended or taken out of service to perform the Work.
      c. A "tie-in" is a connection of new Work to existing facilities, including connecting to existing conduits (including piping and ducting), electrical systems, structural elements, process/mechanical elements, and other physical connections. Some tie-ins may require that the tie-in be made without an associated shutdown.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Review construction procedures under other Specifications sections and coordinate Work that will be performed with or before the Work indicated in this Section.

B. Sequencing and Scheduling:
   1. Refer to this Specifications sections articles on phasing, traffic circulation, sequencing, tie-ins, and shutdowns.

1.4 SUBMITTALS

A. Informational Submittals: Submit the following:
   1. Shutdown Planning Submittal:
      a. For each shutdown, submit an inventory of labor, materials, and equipment required to perform the shutdown and tie-in tasks, an estimate of time required to accomplish the complete shutdown including time for Owner to take down and start up existing equipment, systems, or conduits, and written description of steps required to complete the Work associated with the shutdown.
      b. Furnish submittal to Engineer not less than 30 days prior to proposed shutdown start date. Do not start shutdown until obtaining Engineer's acceptance of shutdown planning Submittal.
   2. Shutdown Notification:
      a. After Engineer's acceptance of shutdown planning Submittal and prior to starting the shutdown, submit written notification to Owner and Engineer of date and time each shutdown is to start. Submit notification not less than 72 HRS in advance of each shutdown.

1.5 GENERAL CONSTRAINTS

A. Indicated in the Contract Documents are the sequence and shutdown durations, where applicable, for Owner's equipment, systems, and conduits (including piping and ducting) that are to be taken out of service temporarily for the Work. New materials and equipment may be used by Owner after the specified field quality control activities are successfully completed and the materials or equipment are substantially complete in accordance with the Contract Documents.

B. The following constraints apply to coordination with Owner's operations:
   1. Operational Access: Owner's personnel shall have access to equipment and areas of the facility that remain in operation.
   2. Temporary Partitions and Enclosures: Provide temporary partitions and enclosures necessary to maintain dust-free, heated, and ventilated spaces in areas of the facility that are adjacent to the Work and that must be kept operational.
   3. Schedule and perform equipment and system start-ups in accordance with Section 01 75 00 - Checkout and Startup procedures. Equipment and systems shall not be placed into operation on Friday, Saturday, Sunday, or holidays without prior approval of Owner, unless specifically indicated otherwise in the Contract Documents.
   4. Dead End Valves or Conduits:
      a. Provide blind flanges, watertight bulkheads, or valve at temporary and permanent terminuses of conduits, including piping and ducting.
      b. Blind flanges and bulkheads shall be suitable for the service and braced and blocked, as required, or otherwise restrained as necessary or as required by Engineer.
      c. Temporary valves shall be suitable for their associated service. Where valve is provided at permanent terminus of conduit, including piping or ducting, also provide on downstream side of valve a blind flange with drain/flushing connection.
   5. Owner will assist Contractor in dewatering process tanks, basins, conduits, and other work areas to be dewatered for shutdowns. Maintain clean, dry work area by pumping and properly disposing of fluid and other material that accumulates in work areas.
   6. Draining and Cleaning of Conduits, Tanks, and Basins:

a. Unless otherwise shown or indicated in the Contract Documents, Contractor shall dewater process tanks, basins, conduits (including piping) at beginning of each shutdown. Flush, wash down, and clean tanks, basins, conduits (including piping), and other work areas.
b. Contractor shall remove liquids and solids and dispose of them at appropriate location at the Site as directed by Engineer. Unless otherwise specified or indicated, contents of tanks, basins, and conduits (including piping) undergoing modifications shall be transferred to existing process tanks or conduits at the Site with capacity sufficient to accept such discharges, using hoses, temporary piping, temporary pumps, and other means provided by Contractor. Discharge of fluids across floors is not allowed.
c. If drainage point is not available on the conduit (including piping) to be drained, provide a wet tap using tapping saddle and valve or other method approved by Engineer. Uncontrolled spillage of contents of conduits (including piping) is not allowed.
d. Spillage shall be brought to Engineer's attention immediately, both orally and in writing, and reported in accordance with Laws and Regulations. Contractor shall wash down spillage to floor drains or sumps or other appropriate location and flush the system to prevent clogging and odors. If spillage is not suitable for discharge to the drainage system, such as chemical spills, as determined by Engineer, Contractor shall remove spillage by other means, such as vactor truck, sorbents, or other method acceptable to Engineer.

1.6 SEQUENCE OF WORK

A. Perform the Work in the indicated sequence. Certain phases or stages of the Work may require working 24 HR days or work during hours outside of regular working hours. Work may be accelerated from a later stage to an earlier stage if Owner's operations are not adversely affected by proposed substitute sequence, with Engineer's approval. Stages specified in this article are sequence-dependent.

1.7 TIE-INS

A. Table 01 14 16-A in this Specifications section lists connections by Contractor to existing facilities. Table 01 14 16-A may not indicate all tie-ins required for the Work; Contractor shall perform tie-ins necessary and required to complete the Work as shown or indicated in the Contract Documents, regardless of whether tie-in is indicated in Table 01 14 16-A. For tie-ins not indicated in Table 01 14 16-A, obtain requirements for tie-ins from Engineer by requesting an interpretation or clarification.

1.8 SHUTDOWNS

A. Shutdowns shall be in accordance with Table 01 14 16-B of this Specifications section. Work requiring service interruptions for tie-ins shall be performed during scheduled shutdowns.

B. Work that may interrupt normal operations shall be accomplished at times convenient to Owner unless otherwise indicated in the Contract Documents.

C. If Contractor's operations cause an unscheduled interruption of Owner's operations, immediately re-establish satisfactory operation for Owner.

D. Fines and Penalties Imposed by Authorities Having Jurisdiction:
1. Unscheduled shutdowns or interruptions of continued safe and satisfactory operation of Owner's facilities that result in fines or penalties by authorities having jurisdiction shall be paid solely by Contractor if, in Engineer's opinion, Contractor did not comply with requirements of the Contract Documents, or was negligent in the Work, or did not exercise proper precautions in performing the Work and complying with applicable permits, Laws, and Regulations.
2. Owner or Engineer may deduct as set-offs such amounts from payments due Contractor.

E. Temporary, short-term shutdowns of smaller conduits (including piping and ducting), equipment, and systems may not be included in Table 01 14 16-B. Coordinate requirements for

such shutdowns with Engineer and Owner. Where necessary, obtain Engineer's interpretation or clarification before proceeding.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 SUBSTITUTE PROCEDURES

A. Proposal of Substitute Sequencing, Shutdowns, and Tie-Ins:
   1. As a substitute to the procedures indicated in this Specifications section, Contractor may propose providing additional temporary facilities that can eliminate or mitigate a constraint without additional cost to Owner, provided such additional temporary facilities: do not present hazards to the public, personnel, structures, and equipment; that such additional temporary facilities do not adversely affect Owner's ability to comply with Laws and Regulations, permits, and operating requirements; that such temporary facilities do not generate or foster the generation of odors and other nuisances; and that requirements of the Contract Documents are fulfilled.
   2. Engineer will consider proposals for substitute procedures after the Effective Date of the Contract. All Bids shall be based on the requirements of the Contract Documents, including this section.
   3. Substitution Requests:
      a. When proposing a substitute procedure for a tie-in or shutdown or other requirements of this section, comply with the requirements of the General Conditions and Special Conditions 01 30 00.
      b. When deviation from specified sequence or procedures is proposed, Contractor's proposal shall explain in detail the proposed sequence and procedures and associated effects, including evidence that Owner's operations will not be adversely affected, to an extent greater than originally contemplated in the Contract Documents, by proposed substitution. List benefits of proposed substitution, including benefits to Progress Schedule.

3.2 GENERAL PROVISIONS FOR COORDINATING WITH OWNER'S OPERATIONS

A. When possible, combine multiple tie-ins into a single shutdown to reduce impacts on Owner's operations and processes.

B. Operation of Existing Systems and Equipment during the Work:
   1. Do not shut off or disconnect existing operating systems or equipment, unless accepted by Engineer in writing.
   2. Operation of existing systems and equipment will be by Owner unless otherwise specified or indicated.
   3. Where necessary for the Work, Contractor shall seal or bulkhead Owner-operated gates and valves to prevent leakage that may affect the Work, Owner's operations, or both.
   4. Provide temporary watertight plugs, bulkheads, and line stops as necessary and as required. After completing the Work, remove seals, plugs, bulkhead, and line stops to satisfaction of Engineer.

C. Bypassing:
   1. Diversion of flows around treatment processes is not allowed.

D. Requirements for temporary pumping associated with specific shutdowns are indicated in this Specifications Section.

E. Performing the Work of this section constitutes Contractor's approval of underlying work and field conditions prevailing at the time of the Work.

3.3 PREPARATION

A. Coordinate preparations for removals with requirements of Section 01 73 29 and related provisions as applicable.

B. Shutdowns - General Preparation:
   1. Coordinate shutdowns with Owner and Engineer.
   2. Submit shutdown planning Submittals and shutdown notification Submittals in accordance with this Specifications section's "Submittals" Article.
   3. Furnish at the Site, in close proximity to the shutdown and tie-in work areas, tools, materials, equipment, spare parts, both temporary and permanent, necessary to successfully perform the shutdown. Complete to the extent possible, prefabrication of piping and other assemblies prior to commencing the associated shutdown. Demonstrate to Engineer's satisfaction that Contractor has complied with such requirements before commencing the shutdown.
   4. Engineer shall have no duty to Contractor to advise Contractor of inadequate preparations by Contractor; Contractor is solely responsible for the means, methods, procedures, techniques, and sequences of construction.

C. Shutdowns of Electrical Systems:
   1. Comply with Laws and Regulations, including the National Electric Code.
   2. Contractor shall lock out and tag circuit breakers and switches operated by Owner and shall verify that affected cables and wires are de-energized to ground potential before starting other Work associated with the shutdown.
   3. Upon completion of shutdown Work, remove the locks and tags and advise Engineer or Resident Project Representative (RPR) that facilities are available for use.

3.4 DETAILED SHUTDOWN REQUIREMENTS

A. Shutdown A:
   1. General:
      a. Affected Equipment Operating Prior to Shutdown.
      b. Equipment Operating During Shutdown: In accordance with Table 01 14 16-B of this Specifications section.
      c. Equipment Out of Service During Shutdown: In accordance with Table 01 14 16-B of this section.
      d. Impact on Other Equipment and Processes
      e. Dates: Shutdown shall be accomplished between dates agreed to by Waste Management.
      f. Time: Shutdown shall be performed after working hours or operating shift.
   2. Prior to Shutdown:
      a. Obtain Engineer's acceptance of proposed shutdown planning Submittal and shutdown notification Submittal.
      b. Bring necessary piping, couplings, valves, equipment, and appurtenances to the work areas.
      c. Assist Owner in preparing to take equipment, tanks, basins, and conduits (including piping and ducting) temporarily out of service.
      d. Coordinate other tie-ins to be performed simultaneously.
      e. Install, check, and test the temporary pumping system.
   3. During Shutdown:
      a. Place temporary pumping system into operation.
      b. With Owner, return equipment and system to operation.
   4. Following Shutdown:
      a. Verify functionality of equipment and systems.
      b. Verify operation of new equipment and systems, and verify that joints in conduits (including piping and ducting) are watertight or gastight as applicable.
      c. Repair joints that are not watertight or gastight, as applicable.
      d. Remove temporary pumping system and appurtenances.

END OF SECTION

Table 01 14 16-A Schedule of Tie-Ins					
Tie-In No.	**New Line Size and Service**	**Existing (Connecting) Line Size & Service**	**Tie-In Building/Location**	**Construction Stage**	**Remarks**
1					
2					
3					
4					
5					
6					

Table 01 14 16-B Schedule of Shutdowns				
Shut-down No.	**Process Equipment and Service Lines Out-of-Service During Shutdown**	**Process Equipment In Operation During Shutdown**	**Tie-In Nos.**	**Maximum Duration**
A				
B				
C				
D				

SECTION 01 14 19
USE OF SITE

PART 1 - GENERAL

1.1 SUMMARY

1. Section Includes:Restrictions on Contractor's use of the Site and premises.
2. Restrictions on use of existing buildings and structures, including:
   a. Permanent utilities and sanitary facilities.
   b. Existing elevators.
   c. Existing hoisting equipment.

B. Scope:
1. Contractor shall provide all labor, materials, equipment, tools, and incidentals shown, specified, and required to comply with restrictions on Contractor's use of the Site and other areas.
2. Comply with requirements of the General Conditions, as may be modified by the Supplementary Conditions, regarding the Contractor's use of the Site and other areas.
3. Maintain the site to enable the ongoing and unfettered receipt and transfer of wastes, recyclables, HHW, green waste and C&D waste throughout the project construction duration.

1.2 SUBMITTALS

A. Action Submittals: Submit the following:
1. Shop Drawings:
   a. Site plan showing proposed location of field offices, storage trailers, staging and laydown areas, temporary sanitary facilities, fuel and oil storage, fueling location, bottle gas storage facilities, and other areas Contractor proposes to occupy.

B. Informational Submittals: Submit the following:
1. Notices of Condition:
   a. Notice of condition of Owner's existing hoisting equipment that Contractor proposes to use, together with written evaluation of condition of equipment including condition of equipment's safety devices. If corrective work is necessary or advisable, transmit concurrently with the Submittal Contractor's Change Proposal for remedial work..

1.3 USE OF PREMISES

A. Limit use of premises at the Site to work areas shown or indicated on the Drawings and as specified in this Section. Do not disturb portions of the Site beyond areas of the Work.
1. Limits:
   a. Confine construction operations to the following areas that don't impede the ongoing operations of the site operator, Waste Management

   b. Confine storage of materials and equipment, and locations of temporary facilities to the areas outside of the areas Waste Management occupies for their operation.
      1) Contractor's gang boxes and storage containers for tools in active use in the Work may be kept in reasonable quantity in the work areas as long as such items do not obstruct access to the facilities by Owner or occupants.
      2) Do not store items of any sort, whether temporarily or otherwise, in stairways and ramps, whether existing or under construction.
   c. Do not enter the following areas:
      1) The operating areas occupied by Waste Management
      2) Areas outside of the work areas indicated in Paragraph A.1.a of the "Use of Premises" Article in this Specifications section, and outside of work areas

indicated on the Drawings, including outside the Project areas indicated on the "key plan" in the Drawings.

2. Prohibitions:
   a. Do not use the Site for the following:
      1) Conducting Contractor's business not related to the Project or other work for Owner.
      2) Overnight lodging or other, non-work use of the Site by workers or others for whom Contractor is responsible, whether housed in recreational vehicles, other vehicles, tents, quarters in field offices or Contractor-furnished temporary structures, or in work areas, is unacceptable.
3. Access to Site, Access Roads, Parking Areas, and Haul Routes: use of Wolf Mountain Road as the point of access to the site.

B. Use of Existing Buildings and Structures: Maintain existing buildings and structures in weather-tight condition throughout construction unless otherwise indicated in the Contract Documents. Protect buildings, structures, and occupants during construction.
   1. Use of Existing Utilities, Sanitary Facilities, and First-aid Facilities:

      a. Do not use permanent sanitary facilities, whether provided under the Project or existing prior to the Project, at the Site.
      b. Do not use permanent telephone, Internet, or other communications utilities and facilities at the Site, regardless of whether such services and facilities were provided under the Project or existed prior to the Project, except in cases of emergency.
      c. Do not use Owner's or occupants' first-aid facilities, except in cases of medical emergency. Promptly replenish used items and supplies with items identical to those used.
      d. Contractor may use the hoisting equipment and access ways indicated above for moving materials and equipment during construction. Hoisting equipment shall be available to Owner and occupants at all times unless otherwise arranged with Owner and Engineer. Do not load hoisting equipment beyond posted capacity.

C. Promptly repair damage to premises, including existing structures, finishes, equipment, and other features, caused by construction operations. Upon completion of the Work, restore premises to specified condition; if condition is not specified, restore to pre-construction condition.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 21 00
ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Administrative and procedural requirements for:
      a. Contingency allowances.
      b. Quantity allowances.
      c. Cash allowances.

B. Related Requirements:
   1. Include but are not necessarily limited to the following:

      a. Section 01 29 73 - Schedule of Values.

1.2 REFERENCES

A. Terminology:
   1. Terminology indicated below are not defined terms and are not indicated with initial capital letters, but when used in this section have the following meanings:
      a. "Allowance authorization" or "authorization", whether singular or plural, are Owner's written and signed approval for using a specific allowance item, in a specific authorized amount, for a specific construction task or activity. Allowance authorizations include all associated attachments at the time of Owner's signature and as delivered to Contractor.
      b. "Cash allowance" is a stipulated amount included in the Contract Price, controlled by Owner, for Owner's sole use to upgrade materials or equipment to be furnished by Contractor under the Contract, to be higher-quality or that offer more features for Owner.
      c. "Contingency allowance" is a stipulated amount included in the Contract Price, controlled by Owner, for Owner's sole use to cover unanticipated costs and costs for Work authorized by Owner that is not part of any other bid/pay item in the Contract.
      d. "Quantity allowance" is an item of Unit Price Work that is included in the Contract Price but the location of which is not shown or indicated on the Drawings or other Contract Documents at the time Bids were opened. When authorized, quantity allowances are to be performed at locations to be indicated by Owner or Engineer. Quantity allowances are controlled by Owner and are for Owner's sole use. The terms "quantity allowance", "extra work item", "extra work unit price item", and the like have the same meaning.

1.3 ALLOWANCES – GENERAL

A. This Article applies to all allowance types and all authorized allowance Work performed in accordance with the Contract Documents.

B. All allowances in the Contract are Owner-controlled and for Owner's sole use. Contractor has no right or entitlement to any allowance or part thereof without express, written authorization from Owner.

C. Authorization of Allowances:
   1. Only Owner can authorize use of an allowance. No other entity, including Engineer, Resident Project Representative (RPR, if any), Owner's Site Representative (OSR, if any), or others may authorize use of allowances in place of Owner.

   2. Allowance Authorization Mechanism:

a. To be binding and enforceable, allowance authorizations must be in writing, signed by one of the Owner's employees indicated immediately above.
b. Allowance authorization form is attached to this Section.
c. Allowance authorizations issued in accordance with the procedures set forth in this Section, are binding and enforceable under the Contract, unless promptly contested in writing by Contractor in accordance with this Section.
d. Oral authorizations, authorizations without an appropriate signature, and authorizations not on the proper form, will not be binding or enforceable.

3. Allowance authorizations duly signed by Owner's authorized person may be delivered to Contractor by Engineer, RPR, OSR, or other Owner-authorized representative, and shall be binding and enforceable when so delivered (unless properly contested).
4. Do not perform Work presumed for compensation under an allowance without first obtaining Owner's allowance authorization.
5. Work presumed by Contractor to be under an allowance and performed without: (a) written authorization duly signed by Owner, or (b) Change Order, or (c) Work Change Directive, is not be eligible for payment.

D. Contract Times:
1. Allowance authorizations do not have any effect on, and do not change, the Contract Times. The Contract Times can be changed only via a duly authorized Change Order.
2. Should the Work included in an allowance authorization adversely affect Contractor's ability to comply with the Contract Times, promptly submit Change Proposal (including appropriate supporting documentation), in accordance with the Contract Documents, indicating the associated, specific, proposed effect on each of the Contract Times.

E. Payment for Work Under an Allowance Authorization:
1. Work duly authorized by Owner under an allowance is eligible for payment upon performance of the associated Work, in accordance with the Contract Documents and the associated allowance authorization.
2. When applying for payment for Work under an allowance authorization, the Application for Payment shall include a copy of the associated allowance authorization(s) signed by Owner.
3. When requested by Owner or Engineer, amend the Schedule of Values to indicate Work authorized under contingency allowances or cash allowances.

F. Compensation for Bonds and Insurance:
1. Contractor is not eligible for compensation under an allowance, or for an increase in the Contract Price, for costs associated with insurance, performance bond, payment bond, or warranty bond (when such bond is required by the Contract). Compensation for such costs is included elsewhere in the Contract Price, under other (non-allowance) bid/pay items.

G. Change Orders:
1. A Change Order is not required for authorization of an allowance that is already included in the Contract.
2. Prior to final payment, all allowances with funds remaining (not yet authorized) shall be reduced to the total amount authorized by Owner for that allowance item, via a Change Order.

1.4 CONTINGENCY ALLOWANCES

A. Provisions on contingency allowance(s) are set forth in the General Conditions, as may be modified by the Supplementary Conditions, and in this Section.

B. Owner may authorize use of all or part of a contingency allowance included in the Contract for Work not otherwise covered under one or more other bid/pay items already in the Contract.

C. Procedure for Using Contingency Allowances:
1. Prior to Work being authorized under a contingency allowance, Contractor shall submit complete Change Proposal for the associated Work, in accordance with the Contract Documents.

2. Compensation proposed via the Change Proposal for the contemplated allowance Work shall be complete and sufficient for the entire scope of the contemplated allowance Work, unless expressly indicated otherwise in the Change Proposal or an associated, Owner- or Engineer-issued Proposal Request.
3. Compensation eligible under a contingency allowance includes:
    a. Materials and equipment furnished to Owner or incorporated into the Work; labor; construction equipment and machinery; services, incidentals, and related costs, in accordance with the Contract Documents' provisions for Contract modifications.
    b. Overhead and profit for the associated Work, for Contractor and Subcontractors.
    c. Other costs and expense mutually agreeable to Owner and Contractor.
4. Excluded are costs not mutually agreeable to the parties and costs excluded in accordance with Article 1.3 of this Section.
5. Should Change Proposal indicate, and Owner accept that, change in the Contract Times is necessary, Owner (or Engineer, on Owner's behalf) will issue an appropriate Change Order for signature by the parties, upon mutual agreement to the changed Contract Times.
6. Upon receipt of contingency allowance authorization, when Contractor does not reject or disagree with the authorization, Contractor shall sign allowance authorization form indicating acceptance and return signed form to Owner and Engineer within two days of receipt.
7. Commence performing the allowance Work promptly upon receipt of allowance authorization.
8. Application for Payment for the associated Work may be made in accordance with Article 1.3 of this Section and the Contract's provisions governing progress payments.

1.5 QUANTITY ALLOWANCES

A. In addition to this Section, Contract provisions governing Unit Price Work apply to quantity allowances.

B. Owner may authorize Work under a quantity allowance item only when the contemplated Work is; (1) reasonably within the scope of the associated quantity allowance item, and, (2) the quantity allowance item has available quantity reasonably sufficient for the authorization in accordance with in the General Conditions and applicable Supplementary Conditions.

C. Procedure for Quantity Allowances:
    1. Contractor-furnished Change Proposal is not necessary or required for Owner to authorize use of a quantity allowance already in the Contract.
    2. Owner's allowance authorization to Contractor shall expressly show or indicate:
        a. Locations where the quantity allowance Work is to be provided.
        b. Specific quantity allowance bid/pay item(s) for the associated Work.
        c. Maximum quantity authorized.
    3. If Contractor objects to Owner's direction to perform the associated Work under the authorized item(s) of quantity allowance Unit Price Work, promptly submit Change Proposal in accordance with the Contract Documents, clearly indicating:
        a. Specific work areas and quantity allowance items to which Contractor objects.
        b. Detailed reasons for Contractor's objections to using the quantity allowance(s) for the authorized Work, citing relevant provisions of the Contract to support and substantiate Contractor's position.
        c. Proposed compensation for the work in question and basis therefor.
        d. Proposed change in the Contract Times.
    4. Engineer will respond to such Change Proposal in accordance with the Contract Documents provisions on decisions on Change Proposals.
    5. Upon receipt of quantity allowance authorization, when Contractor does not reject or disagree with the authorization, Contractor shall sign allowance authorization form indicating acceptance and return signed form to Owner and Engineer within two days of receipt.
    6. When Contractor accepts authorization of Work under the associated quantity allowance (whether expressly or by failing to make timely objection in writing), Contractor shall

promptly perform the authorized Work, in accordance with the Contract Documents and the allowance authorization.

7. Application for Payment for the associated Work may be made in accordance with Article 1.3 of this Section and the Contract's provisions for progress payments.

1.6 CASH ALLOWANCES

A. Provisions on cash allowance(s) are in the General Conditions, as may be modified by the Supplementary Conditions, and in this Section. Other provisions relevant to cash allowances may be in the Division 02-49 Specifications for the associated cash allowance Work.

B. When included in the Contract, cash allowances are used for the purpose indicated in Article 1.2 of this Section.

C. Procedure for Cash Allowances:
   1. Timing: At earliest practical date after the Contract Times start to run, notify Engineer of date when final selection and purchase of each material or equipment item to which a cash allowance may apply must be completed to avoid delaying the Work.
   2. Consult with Engineer as necessary in selecting prospective Suppliers to furnish items covered by cash allowances. Furnish to Engineer relevant recommendations regarding installation and other matters associated with potential use of cash allowance items.
   3. To initiate the procedure for Work under a cash allowance, Owner or Engineer will prepare and issue to Contractor a Proposal Request indicating the contemplated upgrades to materials or equipment to be furnished under the Contract. Issuance of such Proposal Request does not, itself, authorize use of any allowance.
   4. Prior to Work being authorized under a cash allowance, Contractor shall submit complete Change Proposal for the associated Work, in accordance with the Contract Documents provisions for Contract modifications.
   5. Compensation proposed via the Change Proposal for the contemplated cash allowance Work shall be complete for the entire scope of the contemplated upgrade or improvement in the subject material or equipment, unless expressly indicated otherwise in the Change Proposal or the associated, Owner- or Engineer-issued Proposal Request.
   6. Compensation eligible for payment under a cash allowance includes:
      a. Cost for upgrading or improving the subject materials or equipment (minus discounts, if any, received by Contractor), as set forth in the Proposal Request and allowance authorization.
      b. Taxes, if any, on the cost of upgrading or improving the subject materials or equipment.
   7. Excluded are costs:
      a. Not mutually agreeable to the parties:
      b. excluded costs indicated in the General Conditions, as may be modified by the Supplementary Conditions; and
      c. excluded by Article 1.3 of this Section.
   8. Change Proposal shall clearly indicate the cost of the associated item as included in the stipulated price(s) elsewhere in the Contract, with appropriate documentation therefor, and the Supplier's documented cost for the proposed upgraded or improved items contemplated for the cash allowance.
   9. Should Change Proposal indicate, and Owner accept that, change in the Contract Times is necessary, Owner (or Engineer, on Owner's behalf) will issue a Change Order, indicating mutually-agreeable changes in the Contract Times, for signature by the parties.
   10. Cash allowance authorization shall clearly indicate the selected features of the subject materials and equipment, authorized Supplier(s), and compensation authorized under the cash allowance.
   11. Upon receipt of cash allowance authorization, when Contractor does not reject or disagree with the authorization, Contractor shall sign allowance authorization form indicating acceptance and return signed form to Owner and Engineer within two days of receipt.
   12. Commence performing the cash allowance Work promptly upon receipt of allowance authorization.

13. Obtain materials and equipment included in cash allowance authorization from only Supplier(s) indicated in the associated cash allowance authorization.
14. Applications for Payment:
    a. Application for Payment for the associated Work may be made in accordance with Article 1.3 of this Section, this Article, and the Contract's progress payment procedures.
    b. When applying for payment for materials or equipment furnished under a cash allowance, submit with the Application for Payment invoices or delivery slips as evidence of actual costs and quantities of materials or equipment furnished and used in fulfilling each cash allowance authorization.
15. Unused Materials Obtained Under Cash Allowance:
    a. After materials or equipment furnished under cash allowance are installed and are substantially complete, return unused materials and equipment to Supplier for credit.
    b. Prepare unused materials or equipment, furnished under a cash allowance, for storage by Owner, when not economically practical to return for credit. Deliver to storage space at the Site designated by Owner.
    c. When unused items obtained under cash allowance cannot be returned for credit and are not desired by Owner, properly dispose of unused materials or equipment at offsite location.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 ATTACHMENTS

A. The following, bound after this Specifications Section's "End of Section" designation, are part of this Specifications Section:
    1. Forms:
        a. Allowance Authorization Form, (one page).

END OF SECTION

ALLOWANCE AUTHORIZATION

Project:		Authorization Number:	
		From:	
To:		Date:	
		Engineer Project No.:	
Re:		Contract For:	

Contractor is authorized to perform the following item(s) of Work and to be eligible to apply for payment under the designated Contract allowance(s) indicated below for the amount indicated below for each item:

1. Allowance Title / Title of Change:

This instrument is not a Change Order and does not modify the Contract Price, nor does it modify the Contract Times.

Original Allowance	$
Allowance Expenditures prior to this Authorization	$
Allowance Balance prior to this Authorization	$
Allowance will be decreased by this Authorization	$
New Allowance Balance	$

RECOMMENDED BY	OWNER APPROVAL
HDR	
Engineer	Owner
By Date	By Date
CONTRACTOR ACCEPTANCE	
Contractor	
By Date	

☐ Attachments

Copies: ☐ Owner ☐ Contractor ☐ Consultants ☐ _____ ☐ _____ ☐ _____ ☐ File

SECTION 01 22 00
MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. General requirements applicable to all bid/pay items.
   2. General provisions on unit prices and quantities.
   3. General provisions on lump sums.
   4. Listing of the various bid/pay items in the Project, together with criteria for measuring Unit Price Work for payment.

B. Related Requirements:
   1. Include but are not necessarily limited to:
      a. Section 01 29 73 - Schedule of Values.

1.2 REQUIREMENTS APPLICABLE TO ALL BID/PAY ITEMS

A. In this Section and elsewhere in the Contract Documents, the terms “bid item”, “pay item”, “bid/pay item”, “Item” followed by a number designation, “this item”, and the like all have the same meaning, and refer to one or more specific elements of the Contract, established for pricing and payment, as indicated in the Bid Form and in the Agreement (or exhibit to the Agreement) at the time the Contract was signed by the parties.

B. This Article applies to all bid/pay items in the Contract.

C. Prices – General:
   1. The bid/pay items listed starting with Article 1.5 of this Section refer to and are the same bid items listed in the Bid Form and included in the Contract, and constitute all bid/pay items for the Work at the time the Contract was signed by the parties.
   2. No direct or separate payment will be made, outside of the bid/pay items in the Contract, for the following: providing miscellaneous temporary or accessory materials or equipment, temporary works, temporary construction facilities, Contractor’s project management, superintendence, and similar costs for Subcontractors or Suppliers; bonds and insurance; schedules and schedule updates; coordination (with: Owner’s operations (including, but not limited to, lockout/tag-out procedures), other contractors, utility owners, owners of transportation facilities, adjacent property owners and occupants, authorities having jurisdiction, Subcontractors and Suppliers, and others with whom Contractor is to coordinate the Work); information technology systems required by the Contract Documents; Submittals; photographic documentation; Project meetings; Contractor’s hazard communication program; Contractor’s compliance with environmental procedures for Constituents of Concern (including spill control and countermeasures plans and implementation); professional services (required for Contractor’s means and methods of construction, and for delegated designs required by the Contract Documents); obtaining and complying with permits and licenses; temporary utilities (including electric power, water supply and disposal, fuel, and communications); temporary lighting; temporary fire protection; temporary enclosures and HVAC; temporary sanitary facilities; temporary first-aid facilities and services; ; Contractor’s field offices and sheds, Engineer’s field offices (when required elsewhere in the Contract Documents); temporary vehicular access and parking (including access to the Site, temporary access roads and parking, onsite traffic controls for construction traffic, and offsite haul routes); traffic control of non-construction vehicular and pedestrian traffic; temporary controls (including temporary erosion and sediment controls, noise control, control of storm water, surface water, and groundwater, pollution controls (including solid waste control, water pollution control, and control of

atmospheric pollution), dust control, pest and rodent controls, odor controls, and other temporary controls required by the Contract Documents); temporary security for the Work; temporary barriers; Project signage (when required elsewhere in the Contract Documents); delivering, handling, and storing materials and equipment to be incorporated into the Work; layouts and surveys for the Work; construction equipment, machinery, tools, and vehicles; safety and protection; Site maintenance during construction; cleaning and removal and disposal of waste and debris; checkout and startup; testing and other quality control activities required by the Contract Documents; record documents, operation and maintenance data; warranties; spare parts and extra materials required by the Contract Documents; instruction of facility personnel as required by the Contract Documents; commissioning (when required elsewhere in the Contract Documents); Contractor's correction period, Contractor's general warranty and guarantee; Contractor's indemnification obligations; other labor, cost, or effort required by the General Conditions and Supplementary Conditions, Division 01 Specifications, and other requirements of the Contract Documents.

3. Price Escalation:
    a. Unless expressly indicated otherwise in the Contract Documents, Owner is not obligated to change the stipulated prices (including lump sums, unit prices, and allowances) that are all or part of the Contract Price because of escalation of costs when there is no corresponding change in the Contract Times.
    b. Changes in the Contract Times do not necessarily entitle Contractor to a change in Contract Price due to escalation.
    c. Should Contractor claim a change in Contract Price for one or more stipulated price pay items without a corresponding change in scope, extent, or quality in the associated Work, prior to receiving any such change in Contract Price, Contractor shall submit with Contractor's associated Change Proposal, documentation satisfactory to Engineer supporting and documenting that Contractor's costs have increased because of delays beyond Contractor's control within the associated change in Contract Times included in such Change Proposal.
4. Compensation for all services, labor, materials, and equipment shall be included in prices stipulated for the lump sum and unit price bid/pay items in the Contract.
5. Each lump sum and unit price in the Contract shall include an amount considered by Contractor as sufficient for all overhead and profit for each separately identified bid/pay item.

D. Contract Price, Payment Procedures, and Related Matters:
1. Contract Price: The Contract Price, as apportioned among bid/pay items in the Contract, is indicated in the Agreement and any associated exhibits thereto and may be modified by Change Order.
2. Payments to Contractor: Refer to the General Conditions (as may be modified by the Supplementary Conditions), the Agreement (including provisions on retainage, if any), and other applicable Contract Documents.
3. Schedule of Values: Refer to the General Conditions (as may be modified by the Supplementary Conditions) and Section 01 29 73 - Schedule of Values.
4. Procedures for Changes in Contract Price: Refer to the General Conditions (as may be modified by the Supplementary Conditions)
5. Defective Work is not eligible for payment.

1.3 GENERAL PROVISIONS ON UNIT PRICES AND QUANTITIES

A. Quantities:
1. Quantities of Unit Price Work indicated in the Bid Form and in the Contract (at the time the Agreement was signed by the parties) are estimates for purposes of pricing and comparison of Bids.
2. Owner does not represent, either expressly or by implication, or agree that the nature of materials encountered below ground surface or in concealed areas, or actual quantities of Unit Price Work required, will correspond with the quantities in the Contract at the time the

Agreement was signed by the parties. Owner reserves the right to increase or decrease quantities, and to eliminate quantities, as Owner may deem necessary or as may be necessary due to Site conditions encountered.

3. Adjustment of Unit Prices Due to Variation in Quantities:
    a. Provisions, if any, regarding adjustment of unit prices due to variations in actual quantities (eligible for payment) from the estimated quantities in the Contract (including quantities at the time the Agreement was signed by the parties and as subsequently modified by Change Order) are in the General Conditions, as may be modified by the Supplementary Conditions.
        1) Engineer's review for possible unit price adjustment, when provision for such adjustment is expressly indicated in the Contract, will be at a time Engineer deems reasonable and proper.
        2) When the Supplementary Conditions establish that, to be eligible for an adjustment in the unit price, a pay item of Unit Price Work must have a total computed, extended price (at the time the Agreement was signed by the parties) equal to or greater than a specified percentage (stipulated in the Supplementary Conditions) of the total Contract Price (at the time the Agreement was signed by the parties), and the total extended price of such pay item does not exceed the stipulated percentage of the Contract Price, then the associated pay item will be paid at the unit price in the Contract without adjustment for variations in actual quantity.
4. Quantities eligible for payment will be actual quantities furnished and installed (as applicable) in accordance with the Contract Documents, within the pay limits shown or indicated, as measured by Engineer (or other entity so empowered in the Contract Documents), and recommended for payment by Engineer.
5. At Contractor's expense, Contractor may independently verify quantities measured by Engineer for payment. Should Contractor disagree with quantities measured and recommended for payment by Engineer, submit appropriate Change Proposal (appealing Engineer's measurements) indicating the specific reasons for Contractor's appeal, with detailed reasons therefor and associated calculations and estimates, in accordance with the Contract Documents.
6. Quantity Overruns:
    a. When the quantity of a pay item of Unit Price Work eligible for payment exceeds the pay item's quantity included in the Contract, Owner will pay for quantities that exceed those in the Contract only while the estimated total payments to Contractor under the Contract will not exceed the Contract Price. Otherwise, a Change Order is required to modify the associated quantity in the Contract, thus changing the Contract Price.
7. Except as may be established elsewhere in the Contract Documents, make no claim for anticipated profit, loss of profit, damages, or additional compensation arising from difference between quantities of Unit Price Work eligible for payment and the estimated quantities in the Contract.

B. Measuring for Payment:
    1. At Engineer's option, Engineer may delegate to Resident Project Representative (RPR) (if any), some or all of Engineer's responsibilities for measuring Unit Price Work eligible for payment.
    2. Unless expressly indicated otherwise in the Contract Documents, measurements will be in United States standard measurements.
    3. Unless indicated otherwise elsewhere in the Contract Documents, quantities of Unit Price Work eligible for payment will be rounded to the nearest whole number.
    4. In the event of conflict between this Section and the measurement criteria in the Specifications of Divisions 02-49, the measurement criteria in this Section will govern. Typical intent when measurement criteria are in both this Section and the associated Division 02-49 Specifications section, is for the criteria to be interpreted together.
    5. Assistance with Measurements:

a. Assist Engineer and Resident Project Representative (RPR) (if any), by providing measuring equipment, labor, and survey personnel necessary to measure quantities eligible for payment.

6. Quantities eligible for payment can be adjusted by Engineer to correct quantities included in Contractor's prior payment requests, and for incomplete or defective Unit Price Work. Such corrections are at Engineer's sole discretion.

1.4 GENERAL PROVISIONS ON LUMP SUM ITEMS

A. Progress payments for Work paid on a lump sum basis will based on Engineer's estimate of the Work (in accordance with the Contract Documents) performed through the end of the associated pay period, based on the Schedule of Values accepted by Engineer in accordance with the Contract Documents.

B. At its sole discretion, Engineer may correct amounts of lump sum Work included in prior payment requests based on improved data or information available to Engineer, or Engineer's knowledge or reasonable belief that Work is incomplete or defective.

1.5 BID/PAY ITEMS – GENERAL CONTRACT

A. Item 1 – General Construction:
   1. Measurement: As set forth in the Contract's provisions regarding the Schedule of Values and progress payment procedures.
   2. Payment: Lump sum payment for this item will be full compensation for completing the Work, as shown and indicated in the Contract Documents not included under other bid/pay items.

B. Item 1 – Mobilization and Demobilization:
   1. Measurement: In accordance with the Contract's provisions on Schedule of Values and progress payments for lump sum Work.
   2. Item Includes:
      a. Work and activities indicated in this provision are intended as illustrative for purposes of scope and payment and do not represent a complete list of all preconstruction activities and Submittals, or all Work or activities required by the contract for mobilization and demobilization.
      b. Mobilization Work paid under this item will include:
         1) Furnishing required performance bond and payment bond.
         2) Furnishing required insurance and associated documentation.
         3) Obtaining Owner's acceptance of proposed Subcontractors and Suppliers and entering into subcontracts and purchase orders needed to start the Work.
         4) Preparing and obtaining Engineer's approval of Shop Drawings required in Section 01 14 19 - Use of Site.
         5) Preparing and obtaining Engineer's acceptance of schedules, including Progress Schedule, Schedule of Submittals, and Schedule of Values.
         6) Preconstruction conference(s) required by the Contract Documents.
         7) Preconstruction photographic documentation.
         8) Establishing Contractor's Site-specific health and safety plan, preconstruction activities needed to start implementing Contractor's safety programs, and verifying status of training of construction workers and personnel and condition of construction equipment, machinery, and tools.
         9) Submitting acceptable emergency contact information
         10) Obtaining required permits needed to start the Work.
         11) Initial establishment of temporary utilities and temporary facilities.
         12) Establishing Contractor's field office and sheds Contractor's storage areas, staging and laydown areas, and other areas necessary to perform the Work.
         13) Initial establishment of construction vehicular access to the Site, parking needed for construction, and offsite haul routes.
         14) Establishing construction equipment, machinery, and tools at the Site.
         15) Providing initial temporary controls.

16) Temporary security needed to start Work at the Site.
17) Temporary fire suppression system from the decommissioning of the existing fire suppression system to the acceptance of the new fire suppression system.
18) Other mobilization acceptable to Engineer.

c. Demobilization Work paid under this item will include:
1) Removal from the Site and adjacent areas of excess materials and equipment.
2) Removal of temporary controls, temporary facilities, temporary barriers, and similar materials and equipment.
3) Removal of temporary access roads and parking areas not part of permanent pavement or otherwise allowed to remain by Owner, including temporary traffic controls established for construction vehicles and equipment.
4) Removal of all field office and sheds, storage areas, staging and laydown areas, and other areas needed to perform the Work and restoration of such areas.
5) Removal from the Site of all construction equipment, machinery, tools, Contractor's containers, temporary fuel storage tanks, and similar items.
6) Closeout of permits on which Contractor is a permittee or co-permittee.
7) Final cleaning.
8) Furnishing required closeout documents.
9) Other costs and effort by Contractor for demobilization.

d. Other cost and Work are under other bid/pay items in the Contract.

3. Payment: Lump sum price for this item will be full compensation for all mobilization and demobilization required and needed for the Contract, not included under other bid/pay items or contracts. No additional compensation will be provided if the Contractor elects to demobilize and then mobilize again between phases.

C. Item 2 – Phasing Plan
- Work under this item includes providing materials, equipment, labor and appurtenances necessary for the preparation of a construction phasing plan that facilitates both efficient execution of the project but also the ongoing operation of the McCourtney Road waste and recycling functions to continue their operations unimpeded by the construction activities necessary to complete the project improvements. This includes submittal of the phasing plan for review and approval by the County and Waste Management, revision and refinement of the phasing plan throughout the project duration.

- Payment: Lump sum price for this item will be full compensation for the Phasing Plan required for the Contract, not included under other bid/pay items or contracts. Progress payments will be made on a percent complete basis.

D. Item 3 – Traffic Control
- Work under this item includes providing materials, equipment, appurtenances necessary and labor for site traffic control as needed for the construction improvements specified including each phase of operation such that the general public is informed of the appropriate continued use of the facility throughout the project duration.

- Payment: Lump sum price for this item will be full compensation for all traffic control required for the Contract, not included under other bid/pay items or contracts. Progress payments will be made on a percent complete basis.

E. Item 4 – Sheeting, Shoring and Bracing as required by Sections 6700-6708 of the Labor Code
- Work under this item includes providing materials, equipment, labor and appurtenances necessary for the installation and removal any sheeting, shoring and bracing as required by Sections 6700- 6708 of the Labor Code.
- Progress Payment must be based on lump sum cost provided in the Bid Form and the substantial completion of work as determined by the Engineer.

F. Item 5 – Locating and Pot holing utilities
- Work under this item includes providing materials, equipment, labor and appurtenances

necessary for the identification of subsurface utilities, including but not limited to pot holing and related efforts in the identification of subsurface utilities throughout the site. Contractor is advised to perform pot holing activities at the beginning of the project. The Contractor will not receive additional compensation for delays of the project for any pot holing that occurs after the initiation of the project.

- Payment: Lump sum price for this item will be full compensation for all Pot holing utilities required for the Contract, not included under other bid/pay items or contracts. Progress payment will be made on a percent complete basis.

G. Item6 – Excavation, and Rough Earthwork
   - Work under this item includes providing materials, equipment, labor and appurtenances necessary for the excavation, backfill and rough earthwork and related efforts to prepare the site for dynamic compaction activities. Costs shall include soil excavation and subgrade preparation, compacted fill where necessary, quality control testing and all appurtenant work.
   - Payment: Lump sum price for this item will be full compensation for all excavation, and rough grading as required for the Contract, not included under other bid/pay items or contracts. Progress payment will be made on a percent complete basis.

H. Item 7 - Dynamic Compaction
   - Work under this item includes providing materials, mobilization and demobilization of equipment, labor and appurtenances necessary for the dynamic compaction of the subsurface soils as described in the Geotechnical Engineering Report, coordination with the Owner, Engineer, Geotechnical Engineer and inspections of the work.
   - Payment: Lump sum price for this item will be full compensation for all Dynamic Compaction required for the Contract, not included under other bid/pay items or contracts. Progress payment will be made on a percent complete basis.

I. Item 9 – Fire Protection Intake and Pump System, wet well, pump assembly, pump assembly foundation, and fire protection system complete in place.
   - Work under this item includes providing materials, equipment, labor and appurtenances necessary for the installation of the fire protection system, new inlet in Surface Impoundment 2, pond liner penetration and repair, wet well, fire pump and jockey pump assembly, pump assembly foundation, piping, communications and fire protection system complete and operating in place.
   - Payment: Lump sum price for this item will be full compensation for all Fire Protection Intake and Pump System, new inlet in Surface Impoundment 2, pond liner penetration and repair, wet well, pump assembly, pump assembly foundation, piping, communications and fire protection system complete and operational in place as required for the Contract, not included under other bid/pay items or contracts. Progress payment will be made on a percent complete basis.

J. Item 10 – Water Supply, new groundwater pump and piping to be installed in a new groudwater well to be installed by others, conveyance to new water storage tank, water pump and pressure system, connection to existing water distribution system, and connections to new water distribution system, new water distribution system, complete in place.
   - Work under this item includes providing materials, equipment, and labor for installation of Water Supply, new groundwater pump and piping to be installed in a new groudwater well to be installed by others, conveyance to new water storage tank, water pump and pressure system, connections to existing water distribution system, connections to new water distribution system, new water distribution system, complete in place.
   - Payment: Lump sum price for this item will be full compensation for Water Supply, new groundwater pump and piping to be installed in a new groundwater well to be installed by others, conveyance to new, water storage tank, water pump and pressure system, connections to existing water distribution system, connections to new water distribution system, new water distribution system, complete in place as required for the Contract, not included under other bid/pay items or contracts. Progress payment will be made on a

percent complete basis.

K. Item 11 – Site finish grading
- Work under this item includes providing materials, equipment, and labor for all site finish grading, complete in place.
- Payment: Lump sum price for this item will be full compensation for all site finish grading as required for the Contract, not included under other bid/pay items or contracts. Progress payment will be made on a percent complete basis.

L. Item 12 – Transfer Station foundation, complete in place
- Work under this item includes providing materials, equipment, and labor for installation of the Transfer Station foundation, preparation and base rock, reinforcing, concrete slab, loadout tunnel foundation, complete in place.
- Payment: Lump sum price for this item will be full compensation for installation of the Transfer Station foundation, preparation and base rock, reinforcing, concrete slab, loadout tunnel foundation as required for the Contract, not included under other bid/pay items or contracts. Progress payment will be made on a percent complete basis.

M. Item 13 – Mechanical, Electrical and Restroom Building
- Work under this item includes providing materials, equipment, and labor for installation of the Mechanical, Electrical and Restroom Building including foundation, methane venting system, building enclosure, doors, roof ladders, complete in place.
- Payment: Lump sum price for this item will be full compensation for installation of the Mechanical, Electrical and Restroom Building including foundation, methane venting system, building enclosure, doors, roof ladders, complete in place as required for the Contract, not included under other bid/pay items or contracts. Progress payment will be made on a percent complete basis.

N. Item 14 – Site Retaining Walls
- Work under this item includes providing materials, equipment, labor and appurtenances necessary for the installation of the Site Retaining Walls in accordance with the Drawings and Specifications including excavation, forming, reinforcement, concrete, backfilling and related work complete in place.
- Payment: Lump sum price for this item will be full compensation for installation of the Site Retaining Walls including excavation, forming, reinforcement, concrete, backfilling and related work complete in place as required for the Contract, not included under other bid/pay items or contracts. Progress payment will be made on a percent complete basis.

O. Item 15 – Push Walls, steel plating, chutes, bollards,
- Work under this item includes providing materials, equipment, labor and appurtenances necessary for the installation of the cast in place concrete Push Walls, hopper walls, steel plating, chutes and bollards and related work complete in place.
- Payment: Lump sum price for this item will be full compensation for installation of the Push Walls, steel plating, chutes and bollards and related work complete in place. as required for the Contract, not included under other bid/pay items or contracts. Progress payment will be made on a percent complete basis.

P. Item 16 – Pre Engineered (Transfer Station) Metal Building, complete in place
- Work under this item includes providing materials, equipment, labor and appurtenances necessary for the installation of Pre-Engineered Metal Building (Transfer Station) in accordance with the Drawings and Specifications including all materials, surface coatings, shipment, erection, framing, cladding, stairs, roofing, ventilation system, fire access system, finished and complete in place.
- Payment: Lump sum price for this item will be full compensation for installation of the Pre Engineered Metal Building (Transfer Station) in accordance with the Drawings and Specifications including all materials, surface coatings, shipment, erection, framing, cladding, stairs, roofing, ventilation system, fire access system, finished and complete in place. Progress payment will be made on a percent complete basis.

Q. Item 17 - Transfer Station fire suppression system, fire riser, complete in place
   - Work under this item includes providing materials, equipment, and labor for installation of Transfer Station fire suppression system, fire riser, complete in place.
   - Payment: Lump sum price for this item will be full compensation for installation of the Transfer Station fire suppression system, fire riser, complete in place required for the Contract, not included under other bid/pay items or contracts. Progress payment will be made on a percent complete basis.

R. Item 18 - Transfer Station loadout scales and display, complete in place
   - Work under this item includes providing materials, equipment, and labor for installation of Transfer Station loadout scales, display panel, wiring and entire system complete in place.
   - Payment: Lump sum price for this item will be full compensation for installation of the Transfer Station loadout scales, display panel, wiring and entire system complete in place. required for the Contract, not included under other bid/pay items or contracts. Progress payment will be made on a percent complete basis.

S. Item 19 – Mechanical systems, restrooms, plumbing, sewer system, septic tanks and pumps, , pump stations, misting system, ventilation systems and all other mechanical system complete in place

   - Work under this item includes providing materials, equipment, and labor for installation of Mechanical systems, restrooms, plumbing, sewer system, septic tanks and pumps, , pump stations, misting system, ventilation systems and all other mechanical system complete in place complete in place.

   - Payment: Lump sum price for this item will be full compensation for installation of the Mechanical systems, restrooms, plumbing, sewer system, septic tanks and pumps, , pump stations, misting system, ventilation systems and all other mechanical system complete in place for the Contract, not included under other bid/pay items or contracts. Progress payment will be made on a percent complete basis.

T. Item 20 – Electrical System, power supply and distribution, conduits, wiring all other mechanical system complete in place
   - Work under this item includes providing materials, equipment, and labor for installation of Electrical System, power supply and distribution, conduits, wiring all other mechanical system complete in place
   - Payment: Lump sum price for this item will be full compensation for installation of the Electrical System, power supply and distribution, conduits, wiring all other mechanical system complete in place for the Contract, not included under other bid/pay items or contracts. Progress payment will be made on a percent complete basis.

U. Item 21 – Fire water distribution system, connection to new fire pump, connection to the new fire riser, fire hydrants, connections to existing PRA building, connections to existing fire distribution system, complete in place
   - Work under this item includes providing materials, equipment, labor and appurtenances necessary for installation of Fire water system, connection to fire pump, fire riser, fire hydrants, fire protection coverage of the new buildings in accordance with the Drawings and Specifications, connections to existing PRA building, connections to existing fire distribution system, complete in place
   - Payment: Lump sum price for this item will be full compensation for installation of the Fire water system, connection to fire pump, fire riser, fire hydrants, connection and coverage of the new buildings, connections to existing PRA building, connections to existing fire distribution system, quality control testing and all appurtenant work complete in place, as required for the Contract, not included under other bid/pay items or contracts. Progress payment will be made on a percent complete basis.

V. Item 22 – Cleaning and Lining existing triple 24 Inch Diameter CMP, including debris removal, cleaning, preparation, lining, connections to existing and new facilities, complete in place.

- Work under this item includes providing materials, equipment, and labor for installation of Lining existing triple 24 Inch Diameter CMP, including debris removal, cleaning, preparation, lining, connections to existing and new facilities, complete in place.
- Payment: Lump sum price for this item will be full compensation for installation of the Lining existing triple 24 Inch Diameter CMP, including debris removal, cleaning, preparation, lining, connections to existing and new facilities, complete in place as required for the Contract, not included under other bid/pay items or contracts. Progress payment will be made on a percent complete basis.

W. Item 23 – Storm Drainage System, inlets, grates, excavations, pipes, backfill complete in place.

- Work under this item includes providing materials, equipment, labor and appurtenances necessary for the installation of the Storm Drainage System, inlets, grates, excavations, pipes, connections to existing system, pumps, power supply, quality control testing and inspections, backfill and all appurtenant work complete in place.

- Payment: Lump sum price for this item will be full compensation for installation of the Storm Drainage System, inlets, grates, excavations, pipes, connections to existing system, pumps, power supply, quality control testing and inspections, backfill and all appurtenant work complete in place. as required for the Contract, not included under other bid/pay items or contracts. Progress payment will be made on a percent complete basis.

X. Item 24 – Entrance Plaza, scales, scale houses, scale house foundations, cover canopy, conduits, power and related improvements complete in place.
- Work under this item includes providing materials, equipment, labor and appurtenances necessary for the installation of the Entrance Plaza, scales, scale houses, scale house foundations, bollards, cover canopy, conduits, power and related improvements, complete in place.
- Payment: Lump sum price for this item will be full compensation for installation of the Entrance Plaza, scales, scale houses, scale house foundations, bollards, cover canopy, conduits, power and related improvements, for the Contract, not included under other bid/pay items or contracts. Progress payment will be made on a percent complete basis.

Y. Item 25 – Asphalt pavement, base rock, pavement restoration, complete in place.
- Work under this item includes providing materials, equipment, labor and appurtenances necessary for the installation of the Asphalt pavement, base rock, pavement restoration, complete in place in accordance with the Drawings and Specifications.
- Payment: Lump sum price for this item will be full compensation for installation of the Asphalt pavement, base rock, pavement restoration, for the Contract, not included under other bid/pay items or contracts. Progress payment will be made on a percent complete basis.

Z. Item 26 – Site Concrete pavement, base rock, pavement restoration, complete in place.

- Work under this item includes providing materials, equipment, labor and appurtenances necessary for the installation of the Site Concrete pavement, base rock, pavement restoration, complete in place in accordance with the Drawings and Specifications. Concrete pavement, base rock, pavement restoration, for the Contract, not included under other bid/pay items or contracts.

- Payment: Lump sum price for this item will be full compensation for installation of the Site. Progress payment will be made on a percent complete basis.

AA. Item 27 - Erosion control
- Work under this item includes providing materials, equipment, labor and appurtenances necessary for the installation of the Erosion Control, storm water pollution control, and site stabilization throughout the project duration and complete in place in accordance with the Drawings and Specifications. .
- Payment: Lump sum price for this item will be full compensation for installation of

Erosion Control, storm water pollution control, and site stabilization throughout the project duration and complete in place as required for the Contract, not included under other bid/pay items or contracts. Progress payment will be made on a percent complete basis.

BB. Item 28 – Signage: temporary and permanent

- Work under this item includes providing materials, equipment, labor and appurtenances necessary for the installation of Signage including temporary signage throughout the project duration and permanent signage at the completion of the project, complete in place.
- Payment: Lump sum price for this item will be full compensation for installation of the Signage: temporary throughout the project duration and permanent at the completion of the project, complete in place as required for the Contract, not included under other bid/pay items or contracts. Progress payment will be made on a percent complete basis.

CC. Item 29 – Monthly Schedule update

- Work under this item includes providing materials, equipment, and labor for monthly schedule updates.
- Payment: Lump sum price for this item will be full compensation for monthly schedule updates for the Contract, not included under other bid/pay items or contracts. Progress payment will be made on a percent complete basis.

DD. Item 30 – Permit Fees and Inspection

- Work under this item includes providing materials, equipment, and labor for securing permits, payment of fees and inspections.
- Payment: an Allowance for this item will be full compensation for monthly permits, payment of fees and inspections as required for the Contract, not included under other bid/pay items or contracts.

EE. Item 31 – All other improvements not listed above per the MRTS improvements complete as specified excluding work listed on other bid items.

- Work under this item includes providing materials, equipment, and labor for installation of All other improvements not listed above per the MRTS improvements complete as specified excluding work listed on other bid items complete in place in accordance with the Drawings and Specifications.
- Payment: Lump sum price for this item will be full compensation for installation of All other improvements not listed above per the MRTS improvements complete as specified excluding work listed on other bid items the, for the Contract, not included under other bid/pay items or contracts. Progress payment will be made on a percent complete basis.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 25 13
PRODUCT SUBSTITUTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. The procedure for requesting the approval of substitution of a product that is not equivalent to a product which is specified by descriptive or performance criteria or defined by reference to one or more of the following:
      a. Name of manufacturer.
      b. Name of vendor.
      c. Trade name.
      d. Catalog number.
   2. Substitutions are not "or-equals."
   3. This Specification Section does not address substitutions for major equipment.

B. Related Specification Sections include but are not necessarily limited to:
   1. Nevada County Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.

C. Request for Substitution - General:
   1. Base all bids on materials, equipment, and procedures specified.
   2. Certain types of equipment and kinds of material are described in specifications by means of references to names of manufacturers and vendors, trade names, or catalog numbers.
      a. When this method of specifying is used, it is not intended to exclude from consideration other products bearing other manufacturer's or vendor's names, trade names, or catalog numbers, provided said products are "or-equals," as determined by Engineer.
   3. Other types of equipment and kinds of material may be acceptable substitutions under the following conditions:
      a. Or-equals are unavailable due to strike, discontinued production of products meeting specified requirements, or other factors beyond control of Contractor; or,
      b. Contractor proposes a cost and/or time reduction incentive to the Owner.

1.2 QUALITY ASSURANCE

A. In making request for substitution or in using an approved product, Contractor represents that they:
   1. Have investigated proposed product, and have determined that it is adequate or superior in all respects to that specified, and that it will perform function for which it is intended.
   2. Will provide same guarantee for substitute item as for product specified.
   3. Will coordinate installation of accepted substitution into Work, to include building modifications if necessary, making such changes as may be required for Work to be complete in all respects.
   4. Waives all claims for additional costs related to substitution which subsequently arise.

1.3 DEFINITIONS

A. Product: Manufactured material or equipment.

1.4 PROCEDURE FOR REQUESTING SUBSTITUTION DURING BIDDING PERIOD

A. See Nevada County Procurement Requirements, Instructions to Bidders.

1.5 PROCEDURE FOR REQUESTING SUBSTITUTION AFTER AWARD OF CONTRACT

A. Substitution will only be considered under the conditions stated herein.

B. Written request through Contractor only.

C. Transmittal Mechanics:
   1. Follow the transmittal mechanics prescribed for Shop Drawings in Specification Section 01 33 00.
      a. Product substitution will be treated in a manner similar to "deviations," as described in Specification Section 01 33 00.
      b. List the letter describing the deviation and justifications on the transmittal form in the space provided under the column with the heading DESCRIPTION.
         1) Include in the transmittal letter, either directly or as a clearly marked attachment, the items listed in Paragraph D below.

D. Transmittal Contents:
   1. Product identification:
      a. Manufacturer's name.
      b. Telephone number and representative contact name.
      c. Specification Section or Drawing reference of originally specified product, including discrete name or tag number assigned to original product in the Contract Documents.
   2. Manufacturer's literature clearly marked to show compliance of proposed product with Contract Documents.
   3. Itemized comparison of original and proposed product addressing product characteristics including but not necessarily limited to:
      a. Size.
      b. Composition or materials of construction.
      c. Weight.
      d. Electrical or mechanical requirements.
   4. Product experience:
      a. Location of past projects utilizing product.
      b. Name and telephone number of persons associated with referenced projects knowledgeable concerning proposed product.
      c. Available field data and reports associated with proposed product.
   5. Data relating to changes in construction schedule.
   6. Data relating to changes in cost.
   7. Samples:
      a. At request of Engineer.
      b. Full size if requested by Engineer.
      c. Held until substantial completion.
      d. Engineer not responsible for loss or damage to samples.

1.6 APPROVAL OR REJECTION

A. Written approval or rejection of substitution given by the Engineer.

B. Engineer reserves the right to require proposed product to comply with color and pattern of specified product if necessary to secure design intent.

C. In the event the substitution is approved, the resulting cost and/or time reduction will be documented by Change Order in accordance with the General Conditions.

D. Substitution will be rejected if:
   1. Submittal is not through the Contractor with his stamp of approval.
   2. Request is not made in accordance with this Specification Section.
   3. In the Engineer's opinion, acceptance will require substantial revision of the original design.
   4. In the Engineer's opinion, substitution will not perform adequately the function consistent with the design intent.

E. Reimburse Owner for the cost of Engineer's evaluation whether or not substitution is approved.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

END OF SECTION

EXHIBIT A

Substitution Request Form
(One Item per each Form)

Project:	Date:
Substitution Requestor:	
Contractor:	

Specification Section No:	Paragraph No. (i.e. 2.1.A.1.c):	Specified Item:

Proposed Substitution:

Provide Product Data Sheets, Manufacturer's written installation instructions, drawings, diagrams, or any other information as an attached to this Form that will demonstrate the proposed substitution is an Approved Equal.

In the lines provided state differences between proposed substitutions and specified item. Differences include but are not limited to interrelationship with other items; materials, equipment, function, utility, life cycle costs, applied finished, appearances, and quality.

_____
_____
_____

In the lines provided demonstrate how the proposed substitution is compatible with or modifies other systems, parts, equipment or components of the Project and Work under the Contract
:

_____
_____
_____

In the lines provided, describe what effect the proposed substitution has on dimensions indicated on the Drawings and previously reviewed Shop Drawings?

_____
_____
_____

In the lines provided, describe what effect the proposed substitution has on the Construction Schedule and Contract Time.

_____
_____
_____

In the lines provided, describe what effect the proposed substitution has on the Contract Price. This includes all direct, indirect, impact and delay costs.

_____
_____
_____

Manufacturer's guarantees of the proposed and specified items are:

☐ Same ☐ Different (explain on attachment)

The undersigned state that the function, utility, life cycle costs, applied finishes, appearance and quality of the proposed substitution are equal or superior to those of the specified item.

For use by Project Representative:

☐ Accepted ☐ Accepted as Noted

☐ Not Accepted ☐ Received Too Late

_____
(Date)

_____
(Telephone)

_____
(Contractor's Signature)

_____
(Contractor's Firm)

_____
(Firms Address)

_____

Comments:

_____

_____

_____

SECTION 01 26 13
REQUESTS FOR INFORMATION (RFI)

PART 1 - GENERAL

1.1 SUMMARY

A. This Section defines the process for handling Requests for Information (RFI).

B. RFIs are intended to provide clarifications and interpretations of the Contract Documents and maintain progress of Work.

C. RFIs are not intended for general communication, requesting substitutions, requesting proposed changes, resolution of nonconforming work, or coordination between contractors.

D. Requirements of the Contract Documents:
   1. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation-RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise.
   2. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work thereunder.
   3. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents.
      a. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.
   4. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly give written notice to Owner and Contractor that Engineer is unable to provide a decision or interpretation.
   5. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in the General Conditions.

1.2 RFI SUBMITTAL PROCEDURE

A. All RFIs shall be submitted on the form included with this Section, or on mutually agreeable forms.

B. When needed, the RFI shall include backup information to clarify the request.
   1. Backup information can include verified field measurements, quantities, dimensions, photos showing existing conditions, and any other information that will assist the Engineer or Owner in reviewing and responding to the RFI.

C. Within ten (10) working days of receipt of RFI, Engineer will return a response to the RFI, request additional information, or will provide a schedule of when a response will be issued.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION

3.1 REQUESTS FOR INFORMATION

A. Review of Contract Documents and Field Conditions:

1. Before starting each portion of Work, carefully study and compare drawings, specifications and other contract documents, coordination drawings, shop drawings, prior correspondence or documentation relative to that portion of Work, and any other information furnished by Engineer and Owner.
2. Evaluate field conditions and take field measurements related to that portion of Work.
3. Any inconsistencies discovered in the above review of the contract documents and field conditions should be submitted to the Engineer in an RFI.

B. Contractor's Responsibilities:
   1. When interpretation, clarification or explanation of portion of Construction Documents is needed by Contractor or its Subcontractor, Vendor or Supplier, the request shall be processed through the Contractor.
      a. Review the RFI for completeness, quality, proper referencing drawings, specification or other contract documents.
      b. When submitting RFI's generated from subcontractors, suppliers, and others, make every attempt to validate, resolve or respond to RFI by thoroughly researching and reviewing Contract Documents and field conditions before transmitting to the Engineer.
      c. If the RFI is not clear, concise, complete and easily understood, do not submit the RFI to Engineer for response.
   2. Follow these procedures in developing an RFI:
      a. List relevant Contract Documents when seeking information being requested.
         1) Reference all applicable Contract Drawings by sheet number.
         2) Specifications by section and paragraph number
         3) Reference any other relevant documents.
      b. Clearly state any additional information needed so request can be fully understood, including sketches, photos or other reference material.
      c. Suggest any reasonable solutions and recommendations which will aid in determining a solution or response.
      d. Any critical RFI's requiring a rapid response shall clearly indicate such with an explanation as to why RFI is critical.
      e. Priority for responses shall be indicated when multiple RFI's are submitted within short period of time.
   3. A response to RFI shall not be considered a notice to proceed with a change that may revise the Contract Sum or Contract Time, unless authorized by Owner in writing.
   4. If response to RFI is determined incomplete, it shall be resubmitted with reason response is unacceptable and any necessary additional information within five (5) days of time of receipt of response to RFI.
   5. RFI Submittal Format:
      a. Request for information shall be submitted to Engineer on RFI form provided at end of this section, or form provided by Engineer in electronic format, or in similar format acceptable to Engineer.
      b. RFI form shall be electronically completed and emailed to Engineer's designated representative in electronic format. Attachments shall be in electronic text or PDF file format. Photo attachments may be in JPG format.

C. RFI Submittal Numbering:
   1. RFI's shall be assigned unique numbers in sequential order (1, 2, 3, 4, etc.).
   2. A resubmitted RFI or a previously answered RFI requiring revising or further clarification shall be submitted using original RFI number proceeded by ".1 IN to indicate revision one of RFI (i.e.: RFI No. 34.1 for revision 1 to RFI No. 34).

D. Invalid RFI
   1. Engineer may return RFI without response for following reasons:
      a. Request is unclear or incomplete.
      b. Request was answered in a previous RFI.
      c. Requested information is readily available in the Construction Documents.
      d. Request is related to construction means, methods or techniques.

e. Request is related to health or safety measures.
f. Request is due to Contractor's lack of adequate coordination.
g. Issue relates to coordination between Subcontractors.
h. Request is a "Substitution Request."
i. Request is a "Contractor Proposed Change."
j. Request is due to non-conformance.

2. Should the invalid RFIs continue to be provided, the Owner may deduct the cost of the Engineer's time to process, review and return the RFI's.

END OF SECTION

EXHIBIT A

Request for Information Form

Contractor's RFI No. _____ Engineer's RFI No. _____

Contract: _____

Contractor: _____

Owner: _____ Owner's Contract No._____

Engineer **HDR Engineering, Inc.** Engineer's Contract No._____

THIS REQUEST BY:_____ cc to:_____
(Name of the Contractor's Representative)

REFERENCE: DIVISION _____ SECTION _____ PLAN SHEET NO. _____

_____

_____

_____

_____

_____

ATTACHMENTS _____

INTERPRETATION BY: _____Date: _____
_____, 20____
(Name of the Engineer's Representative)

_____

_____

_____

_____

_____

ATTACHMENTS_____

The General Conditions (GCs) specify that once the Engineer provides a response to a Contractor's RFI, that determination shall be final and binding on the Contractor unless the Contractor delivers to the Owner written notice of a change in the work within a certain period of time of receipt of that determination. See the GCs for further clarification.
cc to: _____
_____

SECTION 01 29 73
SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Administrative and procedural requirements for the Schedule of values.

B. Scope:
   1. Contractor shall prepare and submit to Engineer for acceptance a Schedule of Values that allocates cost to each item of the Work for which compensation is on a lump sum basis, Schedule of Value list of line items shall correspond to each aspect of the Work, establishing in detail the portion of the Contract Price allocated to each component of the Work.
   2. Upon request of Engineer, promptly furnish data and information that substantiates and supports the amounts indicated in the Schedule of Values.
   3. Submit preliminary Schedule of Values to Engineer for initial review. Contractor shall incorporate Engineer's comments into the Schedule of Values and resubmit to Engineer. Engineer may require corrections and re-submittals until Schedule of Values is acceptable.
   4. Schedule of Values may be used as a basis for negotiating price of changes, if any, in the Work.

1.2 SUBMITTALS

A. Informational Submittals: Submit the following:
   1. Submit to Engineer the Schedule of Values in the form and quantity required in Section 01 33 00 - Submittals,
   2. Content of Schedule of Values Submittals shall be in accordance with Article 1.3 of this Specifications section.
   3. Timing of Submittals:
      a. Submit preliminary Schedule of Values within time limit indicated in the General Conditions.
      c. Submittal of the Schedule of Values for acceptance by Engineer shall be in accordance with the General Conditions. Engineer will not accept Applications for Payment without an acceptable Schedule of Values.
      d. When required by Engineer, promptly submit updated Schedule of Values to include cost breakdowns for changes in the Contract Price.

1.3 SCHEDULE OF VALUES FORMAT AND CONTENT

A. Organization and Major Elements of Schedule of Values.
   1. Prepare Schedule of Values on the "progress estimate" or "continuation sheets", as applicable.
   2. Include in Schedule of Values itemized list of Work for each major work area included in the Work, for each lump sum payment item included in the Contract.
   3. Organization in Accordance with Specification Sections:
      a. Within each work area, organize the Schedule of Values by the various Specifications section numbers and titles included in the Contract Documents.
      b. Label each row in the Schedule of Values with the appropriate Specifications section number. Include an amount for each row in the Schedule of Values.
      c. List sub-items of major materials, equipment, or systems, as appropriate or when requested by Engineer.

B. Requirements for preliminary Schedule of Values Submittal and the Schedule of Values Submittal for acceptance by Engineer are:

1. Subcontracted Work:
    a. Schedule of Values shall indicate division of Work between Contractor and each Subcontractor.
    b. Line items for Work to be performed by each Subcontractor shall include the word, "(SUBCONTRACTED)" and the name of the Subcontractor once the associated subcontract is signed and effective.
2. Apportionment between Materials and Equipment, and Installation: Schedule of Values shall include separate apportionment of costs for:
    a. Cost of materials and equipment to be incorporated into the completed construction.
    b. Cost of delivery, handling, and storage of materials and equipment to be incorporated into the completed construction.
    c. Cost of temporary materials (such as excavation supports, scaffolding, and other temporary materials), and their associated delivery, handling, and storage costs, if any.
    d. Cost of rentals of construction equipment and machinery, whether owned by Contractor or Subcontractor or leased from a third-party equipment rental entity.
    e. Cost of installing materials and equipment.
    f. Travel and subsistence costs, if any.
    g. Other costs used in preparing the Bid by Contractor and each Subcontractor.
3. Sum of individual line item amounts indicated on the Schedule of Values shall equal the total of associated bid/payment item. Sum of bid/payment item totals in the Schedule of Values shall equal the total lump sum component of the Contract Price.
4. Overhead and Profit:
    a. Include in each line item a directly proportional amount of Contractor's overhead and profit in the Contract Price.
    b. Do not include overhead and profit as separate line item(s).
5. Allowances: Include separate line item for each allowance.
6. Unit Price Work: Separately indicate items of Unit Price Work in the overall Schedule of Values. Where the required form includes a separate worksheet or page for Unit Price Work, indicate all items of Unit Price Work on such worksheet or page of the form.
7. Bonds and Insurance Costs:
    a. Include line item for bonds and insurance in payment in amount not exceeding 2.0 PCT of the Contract Price.
    b. When greater than the amount stipulated immediately above is proposed by Contractor in the Schedule of Values, submit to Engineer documentation substantiating the proposed amounts. Submit to Engineer such documentation when otherwise requested by Engineer.
    c. When Contractor has furnished bonds and evidence of insurance acceptable to Owner and in accordance with the Contract Documents, entire amount for bonds and insurance may be applied for in the first Application for Payment.
8. "Site Overhead" and Administrative Cost Elements:
    a. Include in the Schedule of Values relevant line items and amounts for work and services required by the General Conditions and specific Division 01 Specifications sections, such as:
        1) Superintendence and supervision costs and other costs.
        2) Itemized list of Work by work area, as applicable, for costs associated with coordination with the Owner's operations, including required sequencing, as set forth in the Contract Documents.
        3) Construction Progress Schedule and scheduling, schedule updates, time impact analyses, and preparation of recovery schedules.
        4) Construction photographic documentation.
        5) Permits (when applicable).
        6) Temporary utilities and temporary facilities.
        7) Field offices (monthly rental and maintenance) and storage facilities (excluding costs of establishment and removal, which are part of mobilization and demobilization).

8) Site maintenance, such as temporary controls (dust, air pollution, water pollution, solid waste control, pest and rodent control, temporary erosion and sediment controls, and others), snow and ice removal, and similar activities.
9) Field engineering and surveying.
10) Progress cleaning and cleaning for Substantial Completion.
11) Record documents (preparation, maintenance, and submittal).
    a) If adequate record documents are maintained, up to 50 PCT of the value of the record documents line item will be eligible for payment, spread evenly over those progress payments in which construction at the Site is performed.
    b) Remainder of Project record documents line item will be eligible for payment when complete record documents are submitted in accordance with the Contract Documents. If record documents submitted are unsatisfactory to Engineer, amount may be reduced via set-offs in accordance with the Contract Documents.
12) Other items required by Engineer.

b. Include such items in Applications for Payment on payment schedule acceptable to Engineer
c. Such line items in the Schedule of Values shall exclude any and all costs associated with Contractor's permanent place(s) of business, personnel stationed at permanent office(s), salaries and bonuses of executive and administrative personnel not directly performing work on the Project, and general business expenses, all of which are part of Contractor's overhead costs.

9. Mobilization and Demobilization: In accordance with Section 01 71 14 - Mobilization and Demobilization.
10. Mobilization and Demobilization:
    a. Include separate line items under each appropriate lump sum bid/payment item for mobilization and demobilization.
    b. Document for Engineer the activities included in mobilization and demobilization line items.
    c. Mobilization includes: obtaining permits; negotiating, preparing, and signing subcontracts and purchase orders, attending preconstruction conference(s) and initial scheduling conference(s); establishing temporary utilities and temporary facilities; establishing field offices, storage sheds, and staging and laydown areas; establishing major temporary equipment and machinery at the Site; establishing temporary access roads and parking; preparing and initial implementation of spill prevention control and countermeasures plans; initial establishment of temporary environmental controls, including initial temporary erosion and sediment controls; and similar work required for Contractor to mobilize for Work at the Site, not included under other line items of the Schedule of Values. Obtain Engineer's concurrence for other costs included under mobilization.
    d. Mobilization will be limited to 6 PCT of the Contract Price, and will be paid in six equal payments, each of 1 PCT of total amount for mobilization. Should Contractor propose mobilization in an amount greater than the limit indicate in this paragraph or on an alternative schedule from that indicated in this paragraph, submit to Engineer for acceptance information and documentation sufficient to support and substantiate the proposed amount and payment schedule for mobilization.
    e. Demobilization includes: closing out permits obtained by Contractor; final closeout of remaining subcontracts and purchase orders, attending the final inspection; terminating temporary utilities; removing remaining temporary facilities; removing field offices, storage sheds, and staging and laydown areas and performing final restoration of such areas; removing major temporary equipment and machinery from the Site; removing temporary access roads and parking; and similar work required for Contractor to fully demobilize from the Site, not included under other line items of the Schedule of Values.
    f. Demobilization shall be not less than 2 PCT of the Contract Price and shall be included with the Application for Payment following Substantial Completion, or other schedule acceptable to Engineer.

11. Costs for Submittals, field quality control activities, and training of operations and maintenance personnel shall be as follows, unless otherwise accepted by Engineer:
    a. Submittals: Up to 8.0 PCT of cost (including all associated overhead and profit) of each equipment item, exclusive of transportation and installation costs associated therewith, may be allocated to preparation of Shop Drawings, Samples ,and other Submittals required for release for purchase, fabrication, or delivery (as applicable) and may be included in the Application for Payment following Engineer's approval of Shop Drawings (and acceptance of other Submittals, as applicable) required for fabricating or purchasing for that item for the Work.
    b. Field Quality Control: Up to 3.0 PCT of total cost of each item (including all associated overhead and profit), including materials and equipment, and installation, may be apportioned to specified or required field quality control activities (including required testing and inspections) and included in the Application for Payment following Engineer's acceptance of the associated written field quality control report Submittal(s).
    c. O&M Manual Submittals and Training: Up to a total of 4.0 PCT of equipment cost (including all associated overhead and profit), exclusive of transportation and installation costs, may be apportioned to operations and maintenance manuals and training of operations and maintenance personnel, which may be included in the Application for Payment following completion of training for the associated item.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 30 00
SPECIAL CONDITIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Administrative and procedural requirements for:
      a. Indication of applicable building codes and related codes.
      b. Project signs.
      c. Contractor's field office.
      d. Engineer's field office.
      e. Project photographic documentation.
      f. Adjacent properties and facilities.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. References in the Contract Documents to local code(s) means the following:
      a. National Electric Code in effect at the location of the Project.
      b. NFPA 101 – Life Safety Code.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. PEMB: per 01 33 00
      b. Entrance Scale booths: per 01 33 00
      c. Project Signage: Location, materials, mounting hardware or mounting method, layout, and colors of required Project signage.
      d. Engineer's Field Office: Proposed location, type of construction, size, and layout of Engineer's field office.
   2. Phasing Plan:
      a. Phasing: Proposed project phasing to enable the continued unfettered use of the site by Waste Management to continue its operation of receiving and transferring wastes, HHW, green waste, and C&D materials
      b. Site Traffic Circulation: Proposed traffic circulation for each phase of the project demonstrating traffic patterns for each type of user to the facility (commercial/franchise waste trucks, self-haul vehicles, transfer vehicles, etc.)
   3. Project Data:
      a. Manufacturer's published literature and product data for Engineer's field offices:
         1) Furniture and furnishings.
         2) Office equipment.
         3) Safety items and first-aid kit.
         4) Proposed communications service(s).

B. Informational Submittals: Submit the following:
   1. Project Photographic Documentation:
      a. Preconstruction photographic documentation.
      b. Progress photographic documentation, submitted at the frequency indicate in this Specifications section.
      c. Final photographic documentation.

1.4 PROJECT SIGNS

A. Within 10 days after date the Contract Times start to run provide and maintain a Project sign in accordance with this Specifications section. Signage other than the required Project sign and traffic/site access control signage is not allowed without Owner's written approval.

B. Project Sign Materials:
   1. Project sign shall be:
      a. Furnished by an experienced professional sign company.
      b. Structurally adequate and suitable for exterior application.
      c. Sign panels shall be constructed using a 4 FT and 8 FT, 3/4 IN new A-B Grade, exterior type, APA MDO plywood both sides.
      d. Materials shall be new and of good quality.
   2. Paint shall be exterior quality, as specified in the Specifications of Division 09 or as a minimum, primer and finish coat: exterior, semi-gloss, enamel. Colors for the sign and structure, framing, sign surfaces, and graphics shall be as shown on the Drawings.
   3. Prior to furnishing the sign, submit the Project sign layout Submittal required in this section. Sign layout Submittal shall indicate sign text, font, arrangement, logo(s (if any), and colors of text, logos, and sign background.

C. Information to be indicated on the Project sign includes:
   1. Site name.
   2. Project name (including Owner's project number or contract designation).
   3. Owner's name.
   4. Engineer's company name.
   5. Contractor's company name.

D. Installation of Project Sign:
   1. Install sign as shown in the Drawings.
   2. Mount sign to resist wind loads as required by authorities having jurisdiction and other loads reasonably imposed on the sign, but not less than sustained wind velocity of 50 MPH with gusts of 75 MPH.
   3. Prior to installing sign, submit mounting design to Engineer.
   4. Install sign level and plumb. Unless otherwise required by the Contract Documents, all angles shall be at 90 DEG.

E. Maintenance and Removal:
   1. Keep Project sign clean and legible until the sign is removed from the Site.
   2. Repair sign when necessary.
   3. Remove Project sign entirely from the Site following Substantial Completion and prior to requesting final inspection.
   4. Remove signs, framing, supports, and foundations to a depth of at least 2 FT below finished grade at the sign.
   5. Restore area of sign to condition as required by the Contract Documents. If not expressly required otherwise, restore landscaping and pavement and site improvements to condition equal to or exceeding that at the time the Contract Times started to run.

1.5 CONTRACTOR'S FIELD OFFICE

A. Establish at the Site the Contractor's field office, structurally sound and in accordance with Laws and Regulations, sufficient for Contractor's needs at the Site.

B. Equipment: Telephone, copier/scanner, and (as deemed necessary by Contractor) appropriate computer equipment.

C. Contractor's personnel will be reasonably present at Contractor's office during working days.

D. At Contractor's field office, maintain complete file of the Contract Documents, Submittals approved or accepted (as applicable) by Engineer, interpretations and clarifications issued by Engineer, copies of Contractor's daily field reports, all necessary and required safety data sheets, copies of documents comprising Contractor's safety program, record documents required by the

Contract Documents and other files of field operations deemed appropriate by Contractor and as required by the Contract Documents.

E. Remove field office from Site following Substantial Completion of all the Work and prior to final inspection of the completed Work.

1.6 ENGINEER'S FIELD OFFICE

A. Separate from Contractor's field office.

B. General Construction:
   1. New or reconditioned mobile office trailer .
   2. Baked enamel aluminum siding.
   3. 3-1/2 IN foil-backed fiberglass insulation throughout.
   4. Interior paneling.
   5. Vinyl tile flooring.
   6. 8 FT high acoustic tile ceiling.
   7. Two private office areas, one at each end of trailer, one reception-conference room area, and private washroom.
   8. Windows:
      a. Minimum two per room, excepting washroom, with one each on opposing walls.
      b. Combination screen-storm windows.
      c. Provide horizontal louver blinds on each window.
   9. Nominal 45 FT long and 10 FT wide.
   10. Two exterior doors (with cylinder deadbolt locks) with outer screens, exterior lights and exterior stairs and railings.
   11. A sketch of interior configuration with up to four doors will be provided by the Engineer.
   12. Trailers, once sited, must be securely tied down and grounded.

C. Electrical System:
   1. All fixtures, outlets, and wiring of Underwriters Laboratories, Inc. (UL) approved devices.
   2. All circuits protected by circuit breakers; fuses are not acceptable.
   3. Electrical system shall meet requirements of the latest National Electric Code (NEC).
   4. System suitable for 220 V, 3 PH service.
   5. Any transformers or other devices required to match this supply to the mobile office shall be provided and connected.
   6. Provide a circuit breaker for the incoming service.
   7. Each interior room except the washroom shall have at least four, 110 V duplex electrical convenience outlets.

D. Central Combination Electric Heating, Air-Conditioning System:
   1. Fan-forced air.
   2. Thermostatically controlled.
   3. Individual room units are not acceptable.
   4. Freeze protect and insulate all piping.
   5. System sized to maintain 75 DEGF constant temperature in each room.

E. Lighting System:
   1. Fluorescent type producing 100 foot-candles at desk top height.
   2. Ample ceiling fixtures provided to ensure adequate lighting throughout.

F. Standard Washroom:
   1. Flush toilet, sink, hot and cold running water.
   2. Electric water heater.
   3. Mirror.
   4. Electric ceiling or wall vent.
   5. Sound insulated partitions.

G. Furnishings:

1. Full width built-in desk at ends of both end offices, with a nominal depth of 30 IN and overhead book shelves 12 IN deep.
2. One desk 36 x 72 IN long with locking lap drawer.
3. One plan table 39 x 72 x 36 IN wide, with one locking equipment drawer.
4. One plan table 39 x 84 IN x 36 FT wide, with one locking equipment drawer.
5. One L-shaped secretary desk with main desk 36 x 72 x 36 IN high with locking lap drawer, side drawer, and hanging file drawer.
    a. The desk shall have a typewriter leaf with a typing paper filing cabinet.
6. Two 30 x 72 IN folding tables.
7. One built-in work and computer table in secretary's office.
8. One 48 x 60 IN liquid marking board with minimum four-color set of compatible markers.
9. One 48 x 60 IN cork bulletin board.
10. Four four-drawer legal size filing cabinets.
11. Two cushioned swivel arm chairs.
12. One cushioned secretarial chair, Labofa Model 4525514.
13. Two conference chairs.
14. 12 folding chairs.
15. Two nominal 3 FT plan racks that hold a 30 IN minimum of six, 200 sheet sets of 30 x 42 IN Drawings.
16. Three sets of bookcases, each composed of three shelves 36 IN long and 12 IN wide.
    a. The units shall be a minimum of 3 FT high.
17. Three standard size waste paper baskets.
18. One Emerson Model OR300A, 2.7 CUFT refrigerator.

H. Communications:
1. Provide telephone service including four lines and four sets.
2. High-speed internet service.

I. Field Office Equipment:
1. One all-in-one printer-copier-scanner.
2. One three-hole punch, Master Products Series 25.
3. One stapler, Swingline 113.
4. Three Acco 20 staplers.
5. Three scotch tape dispensers.
6. Six wire in and out baskets.
7. Three two-hole punch, Wilson-Jones Model 202B.
8. One Eagle Zepher 84 date stamp.
9. Electric pencil sharpener, Panasonic Model KP-77.

J. Safety Equipment:
1. One 10 LB ABC dry powder fire extinguisher, upright and fully charged, in an easily accessible location.
2. One OSHA, “Employee Right to Know” Poster, prominently displayed.
3. One first aid kit.
4. One weather radio.

K. Maintenance:
1. Provide all maintenance and upkeep of trailer and equipment.
    a. Equipment breakdowns shall be repaired promptly by Contractor.
2. Janitorial service.
    a. Weekly:
        1) Floor sweeping using dust suppressing compound.
        2) Wet mopping with floor detergent.
    b. Inclement weather: Conduct weekly requirements on daily basis.
    c. Monthly: Wash windows and clean window blinds.
3. Pay all utilities costs.
4. Maintain at least until acceptance of the entire work by the Owner or until otherwise suspended by the Engineer.

L. Removal of Engineer's Field Office:
   1. Remove field office from the Site following Substantial Completion and prior to final completion.
   2. Jointly agree with Engineer and Resident Project Representative (RPR) on the date for closure of Engineer's field office, disconnection of utilities, removal of field office equipment, and physical removal of the field office and restoration of the field office area.
   3. Completely remove Engineer's field office, all appurtenances, and associated site work such as walkways or sidewalks to the field office, temporary parking areas, temporary utilities serving the field office, and field office structure.
   4. Restore area of the field office to conditions required by the Contract Documents. If not expressly required by the Contract Documents, restore area of field office to condition equal to or better than that at the time the Contract Times started to run.

1.7 PROJECT PHOTOGRAPHIC DOCUMENTATION

A. Contractor shall furnish photographic documentation as required and as directed by Engineer or Resident Project Representative (if any). Required under this Article is "still" photographs only.

B. Types of Construction Photographic Documentation Required:
   1. Preconstruction photographs, sufficient to document preconstruction conditions of the site, buildings, and structures, and facilities. Obtain and submit to Engineer prior to performing any mobilization or Work at the Site.
   2. Construction progress photographs. Obtain at frequency of not less than monthly. Obtain not less than 20 photographs each time the photographer is onsite for the purpose of obtaining construction progress photographic documentation. Submit to Engineer within five days of the date the associated progress photograph was taken.
   3. Final photographs, all taken after completion of the Work and demobilization from the Site, and prior to submittal of Contractor's final Application for Payment.

C. Construction Photography - General:
   1. Photographer Qualifications:
      a. Prior to obtaining any required construction photographic documentation, indicate to Engineer in writing the name and qualifications of the proposed photographer.
      b. Use the same photographer for the entire Project. Do not replace photographer without notifying Engineer and submitting qualifications of the proposed new photographer. Engineer may reject the qualifications of a proposed photographer.
   2. Obtain required photographic documentation using a digital camera of not less than 16 megapixel resolution.
   3. Photographs shall be digital and submitted to Engineer on a monthly basis. Each photograph shall be JPG, TIFF, or PNG files. Each electronic file of a photograph shall be titled with the date and brief description of the view; for example: "2022-10-25 – MRTS scale house foundation 01..jpg".
   4. All photographs shall be in color, properly lit and illuminated, and adequately framed to fully illustrate the subject of the photograph.
   5. Schedule and coordinate photographer with Engineer, RPR, and OSR, as applicable. Locations at which photographs are taken and view shall be mutually agreeable to Contractor and Engineer, RPR, or OSR as applicable.

1.8 ADJACENT PROPERTIES AND FACILITIES

A. Contractor shall be obtain and pay for any and all waivers or alternate arrangements necessary for transporting materials and equipment to the Site.

B. Access, Traffic Control, and Parking:
   1. Maintain conditions of access road to site such that access is not hindered as the result of construction related deterioration.
   2. Do not permit driving across or transporting materials or equipment across areas outside the construction limits shown on the Drawings.

3. Provide traffic control devices and personnel necessary to ensure a safe interface of construction traffic with business traffic to and from adjacent sites.
4. Provide access routes for emergency vehicles at all times.
5. Provide daily sweeping of hard-surface roadways to remove soils tracked onto roadway.
6. Provide on-site parking for all staff to limit interference with adjacent properties and businesses.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 ATTACHMENTS

A. The following, attached following this Specifications section's "End of Section" designation, are part of this section:
   1. Sketches:
      a. Sketch number: Title (X pages).

END OF SECTION

SECTION 01 31 19
PROJECT MEETINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Preconstruction, progress and other project meetings.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.

1.2 PRECONSTRUCTION MEETING

A. Meet with the Owner and Engineer for a pre-construction conference at a time mutually agreed upon after the contract is awarded, but before any work is performed,

B. The Engineer will schedule a meeting of the Owner, Contractor, Contractor's Subcontractors, and their respective representatives.
   1. The purpose of the meeting will be to clarify construction contract administration procedures, to establish lines of authority and communication and identify duties and responsibilities of the parties.

C. The Engineer will schedule the pre-construction conference after receipt of the Contractor's draft proposed schedule.

D. Agenda:
   1. Procedural and Administrative:
      a. Personnel and Teams:
         1) Designation of roles and personnel.
         2) Limitations of authority of personnel, including personnel who will sign Contract modifications and make binding decisions.
         3) Subcontractors and Suppliers iBn attendance.
         4) Authorities having jurisdiction.
      b. Procedures for communications and correspondence, including electronic communication protocols.
      c. Copies of the Contract Documents and availability.
      d. The Work and Scheduling:
         1) General scope of the Work.
         2) Contract Times, including Milestones (if any).
         3) Phasing and sequencing.
         4) Preliminary Progress Schedule.
         5) Critical path activities.
      e. Safety:
         1) Responsibility for safety.
         2) Contractor's safety representative.
         3) Emergency procedures and accident reporting.
         4) Emergency contact information.
         5) Confined space entry permits.
         6) Hazardous materials communication program.
         7) Impact of Project on public safety.
      f. Permits.
      g. Review of insurance requirements and insurance claims.
      h. Coordination:
         1) Coordination of Subcontractors and Suppliers.

2) Construction coordinator (for projects with multiple prime construction contracts).
3) Coordination with Owner's operations.
4) Progress meetings – schedule and frequency.
5) Coordination meetings.

i. Submittals:
   1) Current critical Submittals:
      a) Preliminary Schedule of Submittals.
      b) Other schedules (Progress Schedule, Schedule of Values).
      c) Preconstruction photographic documentation.
      d) List of proposed Subcontractors and Suppliers.
      e) List of emergency contact information.
      f) Notice of elements of Contractor's safety program with which Owner and Engineer are to comply.
      g) Site use plan.
      h) Form of Contractor's site superintendent's daily reports.
   2) Work not eligible for payment without approved or accepted Submittals (as applicable).
   3) Submittal procedures.
      a) Compliance with accepted Schedule of Submittals.
      b) Actions required of Contractor prior to furnishing Shop Drawings and other Submittals
      c) Contractor's Submittal approval stamp required; Contractor's coordination of Submittals.
      d) Furnishing of Submittals.
      e) Submittal types and meaning of Engineer's action on each
      f) Resubmittals—responsibility for, limitations on quantity.
   4) Identification of initial, critical Shop Drawings and product data.
   5) Construction photographic documentation.

j. Substitutes and "Or-Equals":
   1) Product options.
   2) Procedures for proposing "or-equals".
   3) Procedures for proposing substitutes.

k. Contract Modification Procedures:
   1) Requests for interpretation.
   2) Written clarifications.
   3) Field Orders.
   4) Proposal Requests.
   5) Change Proposals.
   6) Work Change Directives.
   7) Change Orders.
   8) Differing site conditions or discovery of Hazardous Environmental Condition.
   9) Substantiating and documenting Change Proposals and Claims.
   10) Claims.

l. Progress Payment:
   1) Owner's Project financing and funding, as applicable.
   2) Owner's tax-exempt status.
   3) Preliminary Schedule of Values
   4) Procedures for measuring for payment (Unit Price Work).
   5) Retainage.
   6) Progress payment procedures; documents to accompany Applications for Payment.
   7) Payment for stored items not yet installed.
   8) Date of Owner's payments; payment is due.

m. Subcontractors and Suppliers:
   1) List of proposed Subcontractors and Suppliers; monthly updates.
   2) Coordination and management.
   3) Subcontracts and purchase orders.

4) Diversity Business Enterprises (MBE, WBE, DBE, VBE, etc.) – when applicable:
   a) Goals.
   b) Progress reports.
   c) Requests for waivers.

n. Testing and inspections:
   1) Owner-hired and contractor-hired.
   2) Identification of Owner-hired testing entity and special inspectors.
   3) Responsibility for advising testing entity and special inspectors of need for services.
   4) Results of code-required special inspections and tests.
   5) Prompt remedy of apparent defects.
   6) Notice of defective Work.
   7) Remedy of defective Work.
   8) Defective Work not eligible for payment.
   9) Covering up defective Work.
   10) Cost responsibility for defective Work and retesting/re-inspection.

o. Disposal of demolition materials.

p. Record documents.

q. Preliminary discussion of Contract closeout:
   1) Procedures for Substantial Completion.
   2) Partial utilization procedures; property insurance.
   3) Contract closeout requirements.
   4) Correction period; duration of Contractor's general warranty and guarantee.
   5) Duration of bonds and insurance.

2. Authorities Having Jurisdiction (if not covered in a separate meeting):
   a. Municipal licenses.
   b. Municipal permits required.
      1) Permits required and status.
      2) Inspections for building code official.
      3) Code-required special inspections and tests (if not covered in Administrative and Procedures part of meeting).
   c. Right-of-way work permits; status of occupancy permit(s).
   d. Environmental permits:
      1) Spill prevention control and countermeasures plan (40 CFR 112).
3. Site Mobilization (if not covered in a separate meeting):
   a. Working days, working hours, and overtime.
   b. Use of Site and other areas; use of existing facilities.
   c. Field offices, storage trailers, and staging areas.
   d. Temporary facilities.
   e. Temporary utilities and limitations on utility use (where applicable).
   f. Utility company coordination (if not done as a separate meeting).
   g. Access to Site, access roads, and parking for construction vehicles.
   h. Traffic controls.
   i. Temporary controls:
      1) Erosion and sediment control; storm water pollution prevention plans.
      2) Dust control and air pollution control (including emissions control).
      3) Water control (storm water, surface water, groundwater).
      4) Water pollution control; spill prevention control and countermeasures plan.
      5) Solid waste control.
      6) Pest control.
      7) Other temporary controls.
   j. Security; temporary security fencing (where required).
   k. Storage of materials and equipment to be incorporated into the Work.
   l. Protection of the Work and property; protective barriers.
   m. Field engineering:
      1) Reference points and benchmarks.

2) Surveys and layouts.
3) Professional services for Contractor's means and methods (not delegated design).
4) Contractor's site superintendent's daily records and submittal requirements.

n. Site maintenance during the Project:
1) Progress cleaning; removal of trash and debris.
2) Maintenance and cleaning of existing access roads and parking areas.

o. Restoration.

4. Next meeting.
5. Site visit, as necessary.

E. The Engineer will compile meeting minutes from the transcribed record of the meeting and electronically distribute copies to all participants.

F. Pre-Construction Conference Submittals:
1. The names and telephone numbers of Contractor's Superintendent and Office Manager.
2. List of personnel authorized to sign change orders and receive progress payments.
3. The name, address and telephone numbers of two or more persons employed by the Contractor who can be reached at any time of the day or night to handle emergency matters.
4. A list of all subcontractors that will work on the project, a description of work they will perform, and a contact list for each subcontractor with phone numbers and address.
5. A list of materials suppliers and products over $100.
6. A draft proposed Construction Schedule.
7. Material Safety Data Sheets for all hazardous chemical products to be used by the Contractor on this project.
8. Temporary Erosion and Sediment Controls Plan.
9. Traffic Control Plan.

1.3 PROGRESS MEETINGS

A. Weekly progress meetings will be held a location determined by the Engineer, unless otherwise arranged.

B. Attendees will include the Owner, Engineer, Contractor, subcontractors, and suppliers' representatives as may be needed, other Contractors working at the site, and other interested or affected parties.

C. Preliminary Agenda: Be prepared to discuss in detail the topics indicated below. Revised agenda, if any, will be furnished to Contractor prior to associated progress meeting(s). Progress meeting agenda may be modified by Engineer during the Project as necessary.
1. Review, comment, and amendment (if necessary) of minutes of previous progress meeting.
2. Review of progress since the previous progress meeting.
3. Planned progress through next progress meeting.
4. Review of Progress Schedule:
   a. Review of the Contract Times; Contractor's ability to comply with Contract Times.
   b. Identification of critical path activities.
   c. Schedules for fabrication and delivery of materials and equipment.
   d. Corrective measures, if necessary, including recovery schedule(s).
5. Submittals:
   a. Review status of critical Submittals.
   b. Review revisions to Schedule of Submittals.
6. Contract Modifications:
   a. Requests for interpretation.
   b. Written clarifications.
   c. Field Orders.
   d. Proposal Requests.
   e. Change Proposals.
   f. Work Change Directives.
   g. Change Orders.
   h. Claims.

7. Applications for progress payments:
    a. Status and deadline for submittal.
    b. Stored materials and equipment; observation by Engineer or RPR; documents required.
    c. Set-offs to which Owner is entitled (as applicable).
    d. Other matters related to progress payments.
8. Problems, conflicts, and observations.
9. Quality standards, testing, and inspections.
10. Coordination between Project participants.
11. Site management issues, including vehicular access and parking, traffic control, security, status of temporary controls and temporary utilities, site maintenance and cleaning, and other Site matters.
12. Safety and protection.
13. Permits.
14. Construction photographic documentation.
15. Record documents status.
16. Completion matters (as appropriate):
    a. Status of checkout, startup, field quality control activities.
    b. Status of training of facility O&M personnel and O&M manuals.
    c. Partial utilization; inspection for Substantial Completion.
    d. Punch list status (as applicable).
    e. Other closeout matters (if any).
17. Other business.

D. Bring a four-week look ahead schedule to each meeting, including the following items:
1. Work completed last week.
2. Work anticipated for the next two weeks ("Look Ahead").
3. Subcontractors on site the prior week.
4. Subcontractors scheduled on site for the next two weeks.
5. Contract document deficiencies or questions noted during prior week.
6. Anything that could impede the progress of the work or affect the critical path on the project schedule.
7. Corrective measures and procedures planned to regain planned schedule, cost or quality assurance, if necessary.
8. Report of any accidents, and any site safety issues that need to be addressed.

E. Other Agenda items to be discussed:
1. Review and revise as necessary and approve minutes of previous meetings.
2. Status of submittals of equipment and shop drawings.
3. Identify problems that impede planned progress.
4. Other current business.

F. Revision of Minutes:
1. Unless published minutes are challenged in writing prior to the next regularly scheduled progress meeting, they will be accepted as properly stating the activities and decisions of the meeting.
2. Persons challenging published minutes shall reproduce and distribute copies of the challenge to all indicated recipients of the particular set of minutes.
3. Challenge to minutes shall be settled as priority item of "old business" at the next regularly scheduled meeting.

G. Minutes of Meeting:
1. The Engineer will compile minutes of each project meeting and will furnish electronic copies to the Contractor.

1.4 OTHER MEETINGS

A. Other meetings will be required to facilitate progress of the Work. These include, but are not limited to the following:
1. Pre-Installation Conferences:

a. Coordinate and schedule with Engineer for each material, product or system specified.
    1) Conferences to be held prior to initiating installation, but not more than two weeks before scheduled initiation of installation.
    2) Conferences may be combined if installation schedule of multiple components occurs within the same two week interval.
    3) Review manufacturers recommendations and Contract Documents Specification Sections.

2. Facility Startup Planning and Coordination Meeting. See Section 01 75 00.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 33 00
SUBMITTALS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Mechanics and administration of the submittal process for:
      a. Shop Drawings.
      b. Samples.
      c. Informational submittals.
   2. General content requirements for Shop Drawings.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Construction Progress Schedule submittal requirements
   4. Operations and Maintenance Manual submittal requirements are specified in Specification Section 01 33 04.
   5. Technical Specification Sections identifying required submittals.

1.2 DEFINITIONS

A. Action Submittals:
   1. Action Submittals require an explicit, written approval or other appropriate action by Engineer before Contractor may release the associated item(s) for raw materials procurement, fabrication, production, and shipment.
   2. Unless otherwise indicated in the Contract Documents, Action Submittals include the following:
      a. Shop Drawings.
      b. Product data.
      c. Samples.
      d. Testing plans for quality control activities required by the Contract Documents.
      e. Delegated Designs: Design drawings, design specifications, calculations, reports, and other instruments of service sealed and signed by design professional retained by Contractor, Subcontractor, or Supplier for a portion of the completed Work as part of the completed Project. Engineer's approval or other appropriate action on such delegated design Submittals will be only for the limited purposes set forth in the General Conditions.

B. Informational Submittals:
   1. Informational Submittals are Submittals, other than Action Submittals, required by the Contract Documents. Explicit response from Engineer is not required when such Submittal is acceptable and Engineer's acceptance thereof will be indicated in the Engineer's Submittals log. When Informational Submittal does not indicate full compliance with the Contract Documents, Engineer will indicate the non-compliance in a written response to Contractor.
   2. Representative types of informational submittal items include but are not limited to:
      a. Phasing Plan
      b. Traffic Control Plan
      c. Dynamic compaction Plan
      d. Installed equipment and systems performance test reports.
      e. Manufacturer's installation certification letters.
      f. Instrumentation and control commissioning reports.
      g. Warranties.

h. Service agreements.
i. Construction photographs.
j. Survey data.
k. Work plans.
l. Shop Drawings, product data, Samples, and testing plans, submitted as a requirement of for delegated designs, bearing the Submittal approval stamp of associated design professional retained by Contractor, Subcontractor, or Supplier.

3. For-Information-Only submittals upon which the Engineer is not expected to conduct review or take responsive action may be so identified in the Contract Documents.

1.3 SUBMITTAL SCHEDULE

A. Schedule of Shop Drawings:
1. Submitted and approved within 20 days of receipt of Notice to Proceed.
2. Account for multiple transmittals under any specification section where partial submittals will be transmitted.

B. Shop Drawings: Submittal and approval prior to 30 PCT completion of project.

C. Informational Submittals:
1. Reports and installation certifications submitted within seven days of conducting testing, installation, or examination.
2. Submittals showing compliance with required qualifications submitted 20 days prior to any work beginning using the subject qualifications.

D. The submittal schedule shall include the following columns as a minimum:

Submittal Section	Submittal Description	Planned Submittal Date	Submittal Need Date	Actual Submittal Date	Actual Return Date	Disposition

1.4 PREPARATION OF SUBMITTALS

A. General:
1. All submittals and all pages of all copies of a submittal shall be completely legible.
2. Submittals which, in the Engineer's sole opinion, are illegible will be returned without review.
3. Minimize extraneous information for equipment and products not relevant to the submittal.
4. Contractors or vendors written comments on the submittal drawings shall be in green

B. Shop Drawings, Product Data, and Samples:
1. Scope of any submittal and letter of transmittal:
a. Limited to one Specification Section.
b. Submittals with more than one Specification section included will be rejected.
c. Do not submit under any Specification Section entitled (in part) "Basic Requirements" unless the product or material submitted is specified, in total, in a "Basic Requirements" Specification Section.
2. Numbering letter of transmittal:
a. Include as prefix the Specification Section number followed by a series number, "-xx", beginning with "01" and increasing sequentially with each additional transmittal for that Specification Section.
b. If more than one submittal under any Specification Section, assign consecutive series numbers to subsequent transmittal letters.
3. Describing transmittal contents:
a. Provide listing of each component or item in submittal capable of receiving an independent review action.
b. Identify for each item:

1) Manufacturer and Manufacturer's Drawing or data number.
2) Contract Document tag number(s).
3) Unique page numbers for each page of each separate item.

c. When submitting "or-equal" items that are not the products of named manufacturers, include the words "or-equal" in the item description.

4. Contractor certification of review and approval:
   a. Contractor's review and approval certification stamp shall be applied either to the letter of transmittal or a separate sheet preceding each independent item in the submittal.
      1) Stamp may be either a wet ink stamp or electronically embedded.
      2) Clearly identify the person who reviewed the submittal and the date it was reviewed.
      3) Shop Drawing submittal stamp shall read "(Contractor's Name) has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review and approval as stipulated in the General Conditions."

OR

   b. Execute Exhibit AA, Contractor's Submittal Certification form, to indicate Contractor has reviewed and approved the submittal contents.
      1) Clearly identify the person who reviewed the submittal and the date it was reviewed."
   c. Submittals containing multiple independent items shall be prepared with each item listed on the letter of transmittal or on an index sheet for all items listing the discrete page numbers for each page of each item, which shall be stamped with the Contractor's review and approval stamp.
      1) Each independent item shall have a cover sheet with the transmittal number and item number recorded.
         a) Provide clear space of 3 IN SQ for Engineer stamping.
      2) Individual pages or sheets of independent items shall be numbered in a manner that permits the entire contents of a particular item to be readily recognized and associated with Contractor's certification.
5. Resubmittals:
   a. Number with original Specification Section and series number with a suffix letter starting with "A" on a (new) duplicate transmittal form.
   b. Do not increase the scope of any prior transmittal.
   c. Provide cover letter indicating how each "B", "C", or "D" Action from previous submittal was addressed and where the correction is found in the resubmittal.
   d. Account for all components of prior transmittal.
      1) If items in prior transmittal received "A" or "B" Action code, list them and indicate "A" or "B" as appropriate.
         a) Do not include submittal information for items listed with prior "A" or "B" Action in resubmittal.
      2) Indicate "Outstanding-To Be Resubmitted At a Later Date" for any prior "C" or "D" Action item not included in resubmittal.
         a) Obtain Engineer's approval to exclude items.
6. For 8-1/2 x 11 IN, 8-1/2 x 14 IN, and 11 x 17 IN size sheets, provide five copies of each submittal for Engineer plus the number required by the Contractor.
   a. The number of copies required by the Contractor will be defined at the Preconstruction Conference, but shall not exceed three.
   b. All other size sheets:
      1) Submit one reproducible transparency or high resolution print and one additional print of each Drawing until approval is obtained.
      2) Utilize mailing tube; do not fold.
      3) The Engineer will mark and return the reproducible to the Contractor for reproduction and distribution.
7. Do not use red color for marks on transmittals.
   a. Duplicate all marks on all copies transmitted, and ensure marks are photocopy reproducible.

b. Engineer will use red marks or enclose marks in a cloud.

8. Transmittal contents:
   a. Coordinate and identify Shop Drawing contents so that all items can be easily verified by the Engineer.
   b. Provide submittal information or marks defining specific equipment or materials utilized on the Project.
      1) Generalized product information, not clearly defining specific equipment or materials to be provided, will be rejected.
   c. Identify equipment or material project use, tag number, Drawing detail reference, weight, and other Project specific information.
   d. Provide sufficient information together with technical cuts and technical data to allow an evaluation to be made to determine that the item submitted is in compliance with the Contract Documents.
   e. Do not modify the manufacturer's documentation or data except as specified herein.
   f. Submit items such as equipment brochures, cuts of fixtures, product data sheets or catalog sheets not exceeding 11 x 17 IN pages.
      1) Indicate exact item or model and all options proposed by arrow and leader.
   g. When a Shop Drawing submittal is called for in any Specification Section, include as appropriate, scaled details, sizes, dimensions, performance characteristics, capacities, test data, anchoring details, installation instructions, storage and handling instructions, color charts, layout Drawings, rough-in diagrams, wiring diagrams, controls, weights and other pertinent data in addition to information specifically stipulated in the Specification Section.
      1) Arrange data and performance information in format similar to that provided in Contract Documents.
      2) Provide, at minimum, the detail specified in the Contract Documents.
   h. If proposed equipment or materials deviate from the Contract Drawings or Specifications in any way, clearly note the deviation and justify the said deviation in detail in a separate letter immediately following transmittal sheet. Any deviation from plans or specifications not depicted in the submittal or included but not clearly noted by the Contractor may not have been reviewed. Review by the Engineer shall not serve to relieve the Contractor of the contractual responsibility for any error or deviation from contract requirements.

9. Samples:
   a. Identification:
      1) Identify sample as to transmittal number, manufacturer, item, use, type, project designation, tag number, Specification Section or Drawing detail reference, color, range, texture, finish and other pertinent data.
      2) If identifying information cannot be marked directly on sample without defacing or adversely altering samples, provide a durable tag with identifying information securely attached to the sample.
   b. Include application specific brochures, and installation instructions.
   c. Provide Contractor's review and approval certification stamp or Contractor's Submittal Certification form as indication of Contractor's checking and verification of dimensions and coordination with interrelated work.
   d. Resubmit revised samples of rejected items.

C. Informational Submittals:
   1. Prepare in the format and detail specified in Specification requiring the informational submittal.

1.5 TRANSMITTAL OF SUBMITTALS

A. Shop Drawings and Samples:
   1. Transmit all submittals to:

HDR

2365 Iron Point Road, Suite 300
Folsom, CA 95630
Attn: Tim Raibley

2. Utilize two copies of attached Exhibit A to transmit all Shop Drawings and samples.
3. All submittals must be from Contractor.
   a. Submittals will not be received from or returned to subcontractors.

B. Informational Submittals:
1. Transmit under Contractor's standard letter of transmittal or letterhead.
2. Submit in triplicate or as specified in individual Specification Section.
3. Transmit to:

HDR
2365 Iron Point Road, Suite 300
Folsom, CA 95630
Attn: Tim Raibley

C. Electronic Transmission of Submittals:
1. Transmittals shall be made electronically.
   a. Use HDR's Project Tracker Collaboration System (PTCS) and copy with email.
   b. Protocols and processes will be determined at the Pre-Construction Conference.
2. Provide documents in Adobe Acrobat Portable Document Format (PDF), latest version.
3. Do not password protect or lock the PDF document.
4. Drawings or other graphics must be converted to PDF file format from the original drawing file format and made part of the PDF document.
   a. Scanning of drawings is to be used only where actual file conversion is not possible and drawings must be scanned at a resolution of 300 DPI or greater.
   b. Required signatures may be applied prior to scanning for transmittal.
5. Electronic drawings shall be formatted to be at full-scale (or half-scale when printed to 11x17).
   a. Do not reduce drawings by more than 50 PCT in size.
   b. Reduced drawings shall be clearly marked "HALF-SIZE" and shall scale accurately at that size.
6. Rotate sheets that are normally viewed in landscape mode so that when the PDF file is opened the sheet is in the appropriate position for viewing.
7. Create bookmarks in the bookmarks panel for the cover, the Table of Contents, and each major section of the document.
8. Using Adobe Acrobat Standard or Adobe Acrobat Professional, set the PDF document properties, initial view as follows:
   a. Select File →Properties→Initial View.
   b. Select the Navigation tab: Bookmarks Panel and Page.
   c. Select the Page layout: Single Page.
   d. Select the Magnification: Fit Page.
   e. Select Open to page: 1.
   f. Set the file to open to the cover page with bookmarks to the left, and the first bookmark linked to the cover page.
9. Set the PDF file "Fast Web View" option to open the first several pages of the document while the rest of the document continues to load.
   a. To do this:
      1) Select Edit→Preferences→ Documents→Save Settings.
      2) Check the Save As optimizes for Fast Web View box.
10. File naming conventions:
   a. File names shall use the convention (XXXXXX-YY-Z.PDF) where XXXXXX is the Specification Section number, YY is the Shop Drawing Root number and Z is an ID number used to designate the associated volume.

11. Labeling:
    a. As a minimum, include the following labeling on all electronic media:
        1) Project Name.
        2) Equipment Name and Project Tag Number.
        3) Project Specification Section.
        4) Manufacturer Name.
        5) Vendor Name.
12. Binding:
    a. Include labeled electronic media in a protective case.
        1) Bind protective case in three-ring binder, inserted at the front of the Final paper copy submittal.
        2) Protective case(s) to have means for securing electronic media to prevent loss (e.g., zip case, flap and strap, or equivalent).

1.6 ENGINEER'S REVIEW ACTION

A. Shop Drawings and Samples:
1. Items within transmittals will be reviewed for overall design intent and will receive one of the following actions:
    a. A - FURNISH AS SUBMITTED.
    b. B - FURNISH AS NOTED (BY ENGINEER).
    c. C - REVISE AND RESUBMIT.
    d. D - REJECTED.
    e. E - ENGINEER'S REVIEW NOT REQUIRED.
2. Submittals received will be initially reviewed to ascertain inclusion of Contractor's approval stamp.
    a. Submittals not stamped by the Contractor or stamped with a stamp containing language other than that specified herein will not be reviewed for technical content and will be returned rejected.
3. In relying on the representation on the Contractor’s review and approval stamp, Owner and Engineer reserve the right to review and process poorly organized and poorly described submittals as follows:
    a. Submittals transmitted with a description identifying a single item and found to contain multiple independent items:
        1) Review and approval will be limited to the single item described on the transmittal letter.
        2) Other items identified in the submittal will:
            a) Not be logged as received by the Engineer.
            b) Be removed from the submittal package and returned without review and comment to the Contractor for coordination, description and stamping.
            c) Be submitted by the Contractor as a new series number, not as a re-submittal number.
    b. Engineer, at Engineer’s discretion, may revise the transmittal letter item list and descriptions, and conduct review.
        1) Unless Contractor notifies Engineer in writing that the Engineer’s revision of the transmittal letter item list and descriptions was in error, Contractor’s review and approval stamp will be deemed to have applied to the entire contents of the submittal package.
4. Submittals returned with Action "A" or "B" are considered ready for fabrication and installation.
    a. If for any reason a submittal that has an "A" or "B" Action is resubmitted, it must be accompanied by a letter defining the changes that have been made and the reason for the resubmittal.
    b. Destroy or conspicuously mark "SUPERSEDED" all documents having previously received "A" or "B" Action that are superseded by a resubmittal.
5. Submittals with Action "A" or "B" combined with Action "C" (Revise and Resubmit) or "D" (Rejected) will be individually analyzed giving consideration as follows:

a. The portion of the submittal given "C" or "D" will not be distributed (unless previously agreed to otherwise at the Preconstruction Conference).
    1) One copy or the one transparency of the "C" or "D" Drawings will be marked up and returned to the Contractor.
        a) Correct and resubmit items so marked.
b. Items marked "A" or "B" will be fully distributed.
c. If a portion of the items or system proposed are acceptable, however, the major part of the individual Drawings or documents are incomplete or require revision, the entire submittal may be given "C" or "D" Action.
    1) This is at the sole discretion of the Engineer.
    2) In this case, some Drawings may contain relatively few or no comments or the statement, "Resubmit to maintain a complete package."
    3) Distribution to the Owner and field will not be made (unless previously agreed to otherwise).

6. Failure to include any specific information specified under the submittal paragraphs of the Specifications will result in the submittal being returned to the Contractor with "C" or "D" Action.
7. Calculations required in individual Specification Sections will be received for information purposes only, as evidence calculations have been stamped by the professional as defined in the specifications and for limited purpose of checking conformance with given performance and design criteria. The Engineer is not responsible for checking the accuracy of the calculations and the calculations will be returned stamped "E. Engineer's Review Not Required" to acknowledge receipt.
8. Furnish required submittals with sufficient information and accuracy to obtain required approval of an item with no more than three submittals. Engineer will record Engineer's time for reviewing a fourth or subsequent submittal of a Shop Drawings, sample, or other item requiring approval, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.
9. Transmittals of submittals which the Engineer considers as "Not Required" submittal information, which is supplemental to but not essential to prior submitted information, or items of information in a transmittal which have been reviewed and received "A" or "B" action in a prior submittal, will be returned with action "E. Engineer's Review Not Required."
10. Samples may be retained for comparison purposes.
    a. Remove samples when directed.
    b. Include in bid all costs of furnishing and removing samples.
11. Approved samples submitted or constructed, constitute criteria for judging completed work.
    a. Finished work or items not equal to samples will be rejected.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

EXHIBIT A

Shop Drawing Transmittal No. _____-_____

(Spec Section) (Series)

Project Name:		Date Received:	
Project Owner:		Checked By:	
Contractor:	HDR Engineering, Inc.	Log Page:	
Address:	Address:	HDR No.:	
		Spec Section:	
		Drawing/Detail No.:	
Attn:	Attn:	1st. Sub	ReSub.
Date Transmitted:	Previous Transmittal Date:		

Item No.	No. Copies	Description	Manufacturer	Mfr/Vendor Dwg or Data No.	Action Taken*

Remarks:

* The Action designated above is in accordance with the following legend:

A - Furnish as Submitted

B - Furnish as Noted

C - Revise and Submit
1. Not enough information for review.
2. No reproducibles submitted.
3. Copies illegible.
4. Not enough copies submitted.
5. Wrong sequence number.
6. Wrong resubmittal number.
7. Wrong spec. section.
8. Wrong form used.
9. See comments.

D - Rejected

E - Engineer's review not required
1. Submittal not required.
2. Supplemental Information. Submittal retained for informational purposes only.
3. Information reviewed and approved on prior submittal.
4. See comments.

Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Any deviation from plans or specifications not depicted in the submittal or included but not clearly noted by the Contractor may not have been reviewed. Review by the Engineer shall not serve to relieve the Contractor of the contractual responsibility for any error or deviation from contract requirements.

Comments:

By Date

Distribution: Contractor | File | Field | Owner | Other

EXHIBIT AA

Contractor's Submittal Certification

Shop Drawing Transmittal No.: _____

Contract/Project Name: _____

_____

Company Name: _____

has

1. reviewed and coordinated this Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

2. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

3. determined and verified the suitability of all materials offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

4. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

☐ This Submittal **does not** contain any variations from the requirements of the Contract Documents.

☐ This Submittal **does** contain variations from the requirements of the Contract Documents. A separate description of said variations and a justification for them is provided in an attachment hereto identified as:

"Shop Drawing Transmittal No. _____Variation and Justification Documentation"

Insert picture file or electronic signature of Authorized Representative

_____ _____

Authorized Representative Date

SECTION 01 33 04
OPERATION AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Administration of the submittal process for Operation and Maintenance Manuals.
   2. Content requirements for Operation and Maintenance Manuals.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. General submittal requirements are specified in Specification Section 01 33 00 - Submittals.
   4. Technical Specification Sections identifying required Operation and Maintenance Manual submittals.

1.2 DEFINITIONS

A. Equipment Operation and Maintenance Manuals:
   1. Contain the technical information required for proper installation, operation and maintenance of process, electrical and mechanical equipment and systems.

B. Building Materials and Finishes Operation and Maintenance Manuals:
   1. Contain the information required for proper installation and maintenance of building materials and finishes.

1.3 SUBMITTALS

A. List of all the Operation and Maintenance Manuals required by the Contract as identified in the Technical Specification Sections. These may be referred to as "Operation and Maintenance Data" submittals.

B. Operation and Maintenance Manuals:
   1. Draft and final electronic copies.
   2. Final paper copies: One.

1.4 SUBMITTAL SCHEDULE

A. List of Required Operation and Maintenance Manuals:
   1. Submit list with Specification Section number and title within 90 days after Notice to Proceed.

B. Draft Operation and Maintenance Manuals:
   1. Submit approvable draft manuals in electronic format (PDF) within 30 days following approval of the respective Shop Drawing.
      a. Include placeholders or fly sheet pages where information is not final or is missing from the draft manual.
   2. All Draft Operation and Maintenance Manuals shall be received by no later than 50 PCT project completion.

C. Final Operation and Maintenance Manuals:
   1. Final approval of Operation and Maintenance Manuals in electronic format (PDF) must be obtained 45 days prior to equipment start-up.
   2. Provide paper copies and Electronic Documents (in portable document format, PDF files) by Electronic Means in electronic format (PDF), a minimum of 30 days prior to equipment start-up.
   3. Issue addenda to Final Approved Operation and Maintenance Manual to include:

a. Equipment data that requires collection after start-up, for example but not limited to HVAC balancing reports, electrical switchgear, automatic transfer switch and circuit breaker settings.
b. Equipment field testing data.
c. Equipment start-up reports.

1.5 PREPARATION OF SUBMITTALS

A. General:
1. All pages of the Operation and Maintenance Manual submittal shall be legible.
a. Submittals which, in the Engineer's sole opinion, are illegible will be rejected without review.
2. Identify each equipment item in a manner consistent with names and identification numbers used in the Contract Documents, not the manufacturer's catalog numbers.
3. Neatly type any data not furnished in printed form.
4. Operation and Maintenance Manuals are provided for Owner's use, to be reproduced and distributed as training and reference materials within Owner's organization.
a. This requirement is:
1) Applicable to both paper copy and electronic files.
2) Applicable to materials containing copyright notice as well as those with no copyright notice.
5. Notify supplier and/or manufacturer of the intended use of Operations and Maintenance Manuals provided under the Contract.

B. Operation and Maintenance Manual Format and Delivery:
1. Draft electronic submittals:
a. Provide manual in Adobe Acrobat Portable Document Format (PDF), latest version.
b. Create one (1) PDF file for each equipment Operation and Maintenance Manual.
c. Do not password protect or lock the PDF document.
d. Scanned images of paper documents are not acceptable. Create the Operation and Maintenance Manual PDF file from the original source document.
e. Drawings or other graphics must be converted to PDF file format from the original drawing file format and made part of the PDF document.
f. Scanning of drawings is to be used only where actual file conversion is not possible and drawings must be scanned at a resolution of 300 DPI or greater.
g. Rotate sheets that are normally viewed in landscape mode so that when the PDF file is opened the sheet is in the appropriate position for viewing.
h. Create bookmarks in the bookmarks panel for the Operation and Maintenance Manual cover, the Table of Contents and each major section of the Table of Contents.
i. Using Adobe Acrobat Standard or Adobe Acrobat Professional, set the PDF document properties, initial view as follows:
1) Select File →Properties→Initial View.
2) Select the Navigation tab: Bookmarks Panel and Page.
3) Select the Page layout: Single Page Continuous.
4) Select the Magnification: Fit Page.
5) Select Open to page: 1.
6) Set the file to open to the cover page of the manual with bookmarks to the left, and the first bookmark linked to the cover page.
7) Window Options: Check the "Resize window to initial page" box.
j. Set the PDF file "Fast Web View" option to open the first several pages of the document while the rest of the document continues to load.
1) To do this:
a) Select Edit→Preferences→ Documents→Save Settings.
b) Check the "Save As optimizes for Fast Web View" box.
k. PDF file naming convention:
1) Use the Specification Section number, the manufacturer's name and the equipment description, separated by underscores.

2) Example: 46 51 21_Sanitaire_Coarse_Bubble_Diffusers.pdf.
3) Do not put spaces in the file name.

2. Final electronic submittals:
   a. Submit two copies as Electronic Documents (in portable document format, PDF files) by Electronic Means.
   b. Labeling:
      1) Provide the following printed labeling on all electronic media:
         a) Project name.
         b) Specification Section.
         c) Equipment names and summary of tag(s) covered.
         d) Manufacturer name.
         e) Date (month, year).
   c. Binding:
      1) Include labeled electronic media in a protective case.
         a) Bind protective case in three-ring binder, inserted at the front of the Final paper copy submittal.
         b) Protective case(s) to have means for securing electronic media to prevent loss (e.g., zip case, flap and strap, or equivalent).
3. Final paper copy submittals:
   a. Quantity: Provide two copies.
   b. Paper: 8.5 x 11 IN or 11 x 17 IN bright white, 20 LB paper with standard three-hole punching.
   c. 3-Ring Binder:
      1) Provide D-ring binder with clear vinyl sleeves (i.e. view binder) on front and spine.
      2) Insert binder title sheet with the following information under the front and spine sleeves:
         a) Project name.
         b) Specification Section.
         c) Equipment names and summary of tag(s) covered.
         d) Manufacturer name.
         e) Date (month, year).
      3) Provide plastic sheet lifters prior to first page and following last page.
   d. Drawings:
      1) Provide all drawings at 11 x 17 IN size, triple folded and three-hole punched for insertion into manual.
      2) Where reduction is not practical to ensure readability, fold larger drawings separately and place in three-hole punched vinyl envelopes inserted into the binder.
      3) Identify vinyl envelopes with drawing numbers.
   e. Use plastic coated dividers to tab each section of each manual in accordance with the Table of Contents.

C. Equipment Operation and Maintenance Manual Content:
   1. Provide a cover page as the first page of each manual with the following information:
      a. Manufacturer(s) Name and Contact Information.
      b. Vendor's Name and Contact Information.
      c. Date (month, year).
      d. Project Owner and Project Name.
      e. Specification Section.
      f. Project Equipment Tag Numbers.
      g. Model Numbers.
      h. Engineer's Name.
      i. Contractor's Name.
   2. Provide a Table of Contents for each manual.
   3. Provide Equipment Record sheets as follows:
      a. Printed copies of the Equipment Record (Exhibits B1, B2 and B3), as the first tab following the Table of Contents.

1) For Instrumentation and Control equipment, International Society of Automation (ISA) Data Sheets will be acceptable in lieu of the Equipment Record sheets.

b. Exhibits B1-B3 are available as Fillable PDF Form documents from the Engineer.

c. Each section of the Equipment Record must be completed in detail; simply referencing the related equipment Operation and Maintenance Manual sections for nameplate, maintenance, spare parts or lubricant information is not acceptable.

d. For equipment involving separate components (for example, a motor and gearbox), a fully completed Equipment Record is required for each component.

e. Submittals that do not include the Equipment Record(s) will be rejected without further content review.

4. Provide a printed copy of the Manufacturer's Field Services report as required by Specification Section 01 75 00 following the Equipment Record sheets.

5. Provide the following detailed information, as applicable:

a. Use equipment tag numbers from the Contract Documents to identify equipment and system components.

b. Equipment function, normal and limiting operating characteristics.

c. Instructions for assembly, disassembly, installation, alignment, adjustment, and inspection.

d. Operating instructions for start-up, normal operation, control, shutdown, and emergency conditions.

e. Maintenance instructions, including lubrication instructions if applicable

f. Troubleshooting guide.

g. Mark each sheet to clearly identify specific products and component parts and data applicable to the installation for the Project; delete or cross out information that does not specifically apply to the Project.

h. Parts lists:

1) A parts list and identification number of each component part of the equipment.

2) Exploded view or plan and section views of the equipment with a detailed parts callout matching the parts list.

3) A list of recommended spare parts.

4) List of spare parts provided as specified in the associated Specification Section.

5) A list of any special storage precautions which may be required for all spare parts.

i. General arrangement, cross-section, and assembly drawings.

j. Electrical diagrams, including elementary diagrams, wiring diagrams, connection diagrams, and interconnection diagrams.

k. Factory and field test data and performance curves (if applicable).

l. As-constructed fabrication or layout drawings and wiring diagrams.

m. Copy of the equipment manufacturer's warranty meeting the requirements of the Contract.

n. Copy of any service contracts provided for the specific piece of equipment as part of the Contract.

6. Additional information as required in the associated equipment or system Specification Section.

7. Include in Submittal the final, configured control setpoints and similar configurable parameters provided in the equipment.

D. Building Materials and Finishes Operation and Maintenance Manual Content:

1. Provide a cover page as the first page of each manual with the following information:

a. Manufacturer(s) Name and Contact Information.

b. Vendor's Name and Contact Information.

c. Date (month, year).

d. Project Owner and Project Name.

e. Specification Section.

f. Model Numbers.

g. Engineer's Name.

h. Contractor's Name.

2. Provide a Table of Contents for each manual.
3. Building products, applied materials and finishes:
    a. Include product data, with catalog number, size, composition and color and texture designations.
    b. Provide information for ordering custom manufactured products.
4. Necessary precautions:
    a. Include product MSDS for each approved product.
    b. Include any precautionary application and storage guidelines.
5. Instructions for care and maintenance:
    a. Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods and recommended schedule for cleaning and maintenance.
6. Moisture protection and weather exposed products:
    a. Include product data listing, applicable reference standards, chemical composition, and details of installation.
    b. Provide recommendations for inspections, maintenance and repair.
7. Additional requirements as specified in individual product specifications.

E. National Fire Protection Association 70 (National Electrical Code) Documentation:
1. Assemble documented calculations of Arc-Fault Current, Equipment Available Fault Current and Short Circuit Current Rating (SCCR) provided as part of equipment submittals into one O&M manual volume.

1.6 TRANSMITTAL OF SUBMITTALS

A. Operation and Maintenance Manuals.
1. Transmit all submittals to:
    a. The address specified in Specification Section 01 33 00 - SUBMITTALS.
2. Transmittal form: Use Operation and Maintenance Manual Transmittal, Exhibit A.
3. Transmittal numbering:
    a. Number each submittal with the Specification Section number followed by a series number beginning with "-01" and increasing sequentially with each additional transmittal, followed by "-OM" (for example: 43 23 14-01-OM).
4. Submit draft and final Operation and Maintenance Manual in electronic format (PDF) to Engineer, until manual is approved.

1.7 ENGINEER'S REVIEW ACTION

A. Draft Electronic (PDF) Submittals:
1. Engineer will review and indicate one of the following review actions:
    a. A - ACCEPTABLE
    b. B - FURNISH AS NOTED
    c. C - REVISE AND RESUBMIT
    d. D - REJECTED
2. Submittals marked as Acceptable or Furnish As Noted will be retained; however, the transmittal form will be returned with a request for the final paper and electronic documents to be submitted.
3. Copies of submittals marked as Revise and Resubmit or Rejected will be returned with the transmittal form marked to indicate deficient areas.
4. Resubmit until approved.

B. Final Paper Copy Submittals:
1. Engineer will review and indicate one of the following review actions:
    a. A - ACCEPTABLE
    b. D - REJECTED
2. Submittals marked as Acceptable will be retained with the transmittal form returned as noted.
3. Submittals marked as Rejected will be returned with the transmittal form marked to indicate deficient areas.

4. Resubmit until approved.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

EXHIBIT A

Operation and Maintenance Manual Transmittal _____-_____ - OM

(Spec Section) (Series) .

Project Name:		Date Received:
Project Owner:		Checked By:
Contractor:	Owner:	Log Page:
Address:	Address:	HDR No.:
Attn:	Attn:	1st. Sub. ReSub.
Date Transmitted:	Previous Transmittal Date:	

No. Copies	Description of Item	Manufacturer	Dwg. or Data No.	Action Taken*

Remarks:

To:

From:

HDR Engineering, Inc.

Date:

* The Action designated above is in accordance with the following legend:

A - Acceptable, provide one (1) additional paper copy and two (2) Electronic Documents (in portable document format, PDF files) by Electronic Means for final review.

B - Furnish as Noted

C - Revise and Resubmit

This Operation and Maintenance Manual Submittal is deficient in the following area:

1. Equipment Records.
2. Functional description.
3. Assembly, disassembly, installation, alignment, adjustment & checkout instructions.
4. Operating instructions.
5. Lubrication & maintenance instructions.
6. Troubleshooting guide.
7. Parts list and ordering instructions.
8. Organization (binder, binder titles, index & tabbing).
9. Wiring diagrams & schematics specific to installation.
10. Outline, cross section & assembly diagrams.
11. Test data & performance curves.
12. Tag or equipment identification numbers.
13. Inclusion of all components & subcomponents.
14. Other - see comments.

D - Rejected

Comments:

By Date

Distribution: Contractor File Field Owner Other

EXHIBIT B1

Equipment Record

Equipment Data and Spare Parts Summary

Project Name	Specification Section:
Equipment Name	Year Installed:
Project Equipment Tag No(s).	
Equipment Manufacturer	Project/ Order No.
Address	Phone
Fax / Web Site / E-mail	
Local Vendor/Service Center	
Address	Phone
Fax / Web Site / E-mail	

MECHANICAL NAMEPLATE DATA

Equip.		Serial No.		
Make		Model No.		
ID No.	Frame No.	HP	RPM	Cap.
Size	TDH	Imp. Sz.	CFM	PSI
Other:				

ELECTRICAL NAMEPLATE DATA

Equip.			Serial No.					
Make			Model No.					
ID No.	Frame No.	HP	V.	Amp.	HZ	PH	RPM	SF
Duty	Code	Ins. Cl.	Type	NEMA	C Amb.	Temp. Rise	Rating	
Other:								

SPARE PARTS PROVIDED PER CONTRACT

Part No.	Part Name	Quantity

RECOMMENDED SPARE PARTS

Part No.	Part Name	Quantity

EXHIBIT B2

Equipment Record

Recommended Maintenance Summary

Equipment Description	Project Equip. Tag No(s).	

RECOMMENDED BREAK-IN MAINTENANCE (FIRST OIL CHANGES, ETC.)	INITIAL COMPLETION * FOLLOWING START-UP							
	D	W	M	Q	S	A	RT	Hours

RECOMMENDED PREVENTIVE MAINTENANCE	PM TASK INTERVAL *							
	D	W	M	Q	S	A	RT	Hours

***** **D = Daily** **W = Weekly** **M = Monthly** **Q = Quarterly** **S = Semiannual** **A = Annual** **Hours = Run Time Interval**

EXHIBIT B3

Equipment Record

Lubrication Summary

Equipment Description	Project Equip. Tag No(s).

Lubricant Point

Lubricant Type		Manufacturer	Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point

Lubricant Type		Manufacturer	Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point

Lubricant Type		Manufacturer	Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point

Lubricant Type		Manufacturer	Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point

Lubricant Type		Manufacturer	Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point

Lubricant Type		Manufacturer	Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

SECTION 01 35 05
ENVIRONMENTAL PROTECTION AND SPECIAL CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Minimizing the pollution of air, water, or land; control of noise, the disposal of solid waste materials, and protection of deposits of historical or archaeological interest.

B. Related Specification Sections include but are not necessarily limited to:
   1. Nevada County Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.

1.2 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Prior to the start of any construction activities submit:
      a. A detailed proposal of all methods of control and preventive measures to be utilized for environmental protection.
      b. A drawing of the work area, haul routes, storage areas, access routes and current land conditions including trees and vegetation.
      c. A copy of the NPDES permit for storm water discharges from construction activities.
      d. A copy of the approved pollution prevention plan.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION

3.1 INSTALLATION

A. Employ and utilize environmental protection methods, obtain all necessary permits, and fully observe all local, state, and federal regulations including 62.701 FS.

B. Land Protection:
   1. Except for any work or storage area and access routes specifically assigned for the use of the Contractor, the land areas outside the limits of construction shall be preserved in their present condition.
      a. Confine construction activities to areas defined for work within the Contract Documents.
   2. Manage and control all borrow areas, work or storage areas, access routes and embankments to prevent sediment from entering nearby water or land adjacent to the work site.
   3. Restore all disturbed areas including borrow and haul areas and establish permanent type of locally adaptable vegetative cover.
   4. Unless earthwork is immediately paved or surfaced, protect all side slopes and backslopes immediately upon completion of final grading.
   5. Plan and execute earthwork in a manner to minimize duration of exposure of unprotected soils.
   6. Except for areas designated by the Contract Documents to be cleared and grubbed, do not deface, injure or destroy trees and vegetation, nor remove, cut, or disturb them without approval of the Engineer.
      a. Any damage caused by the Contractor's equipment or operations shall be restored as nearly as possible to its original condition at no additional cost to the Owner.

C. Surface Water Protection:
   1. Apply for and obtain a permit from the local environmental agency for storm water discharges.
   2. Prepare pollution prevention plan that has been approved by the local environmental agency.
   3. Utilize, as necessary, erosion control methods to protect side and backslopes, minimize and the discharge of sediment to the surface water leaving the construction site as soon as rough grading is complete.
      a. These controls shall be maintained until the site is ready for final grading and landscaping or until they are no longer warranted and concurrence is received from the Engineer.
      b. Physically retard the rate and volume of run-on and runoff by:
         1) Implementing structural practices such as diversion swales, terraces, straw bales, silt fences, berms, storm drain inlet protection, rocked outlet protection, sediment traps and temporary basins.
         2) Implementing vegetative practices such as temporary seeding, permanent seeding, mulching, sod stabilization, vegetative buffers, hydroseeding, anchored erosion control blankets, sodding, vegetated swales or a combination of these methods.
         3) Providing Construction sites with graveled or rocked access entrance and exit drives and parking areas to reduce the tracking of sediment onto public or private roads.
   4. Discharges from the construction site shall not contain pollutants at concentrations that produce objectionable films, colors, turbidity, deposits or noxious odors in the receiving stream or waterway.

D. Solid Waste Disposal:
   1. Collect solid waste on a daily basis.
   2. Disposal of degradable solid waste to the active Transfer Station onsite is allowable. All loads must cross the onsite scales prior to disposal. For the purposes of this section, degradable solid wastes shall include all ancillary waste materials that do not meet the Nevada County Solid Waste Division's definition of Construction and Demolition Debris (C&D).
   3. Provide disposal of nondegradable solid waste to an approved solid waste disposal site or in an alternate manner approved by Engineer and regulatory agencies.
   4. No building materials wastes or unused building materials shall be buried, dumped, or disposed of on the site.

E. Fuel and Chemical Handling:
   1. Store and dispose of chemical wastes in a manner approved by regulatory agencies.
   2. Take special measures to prevent chemicals, fuels, oils, greases, herbicides, and insecticides from entering drainage ways.
   3. Do not allow water used in onsite material processing, concrete curing, cleanup, and other waste waters to enter a drainage way(s) or stream.
   4. Provide containment around fueling and chemical storage areas to ensure that spills in these areas do not reach waters of the state.

F. Control of Dust:
   1. The control of dust shall mean that no construction activity shall take place without applying all such reasonable measures as may be required to prevent particulate matter from becoming airborne so that it remains visible beyond the limits of construction.
      a. Reasonable measures may include paving, frequent road cleaning, planting vegetative groundcover, or application of water.
   2. Utilize methods and practices of construction to eliminate dust in full observance of agency regulations.
   3. The Engineer will determine the effectiveness of the dust control program and may request the Contractor to provide additional measures, at no additional cost to Owner.

G. Burning:

1. Do not burn material on the site.
2. If the Contractor elects to dispose of waste materials by burning, make arrangements for an off-site burning area and conform to all agency regulations.

H. Control of Noise:
1. Control noise by fitting equipment with appropriate mufflers.
2. Constrain dynamic compaction to the days and hours of the day specified in the approved CEQA MMNP.

I. Completion of Work:
1. Upon completion of work, leave area in a clean, natural looking condition.
2. Ensure all signs of temporary construction and activities incidental to construction of required permanent work are removed.
3. Grade, fill and seed all disturbed areas.

J. Historical Protection:
1. If during the course of construction, evidence of deposits of historical or archaeological interests is found, cease work affecting find and notify Engineer.
   a. Do not disturb deposits until written notice from Engineer is given to proceed.
2. The Contractor will be compensated for lost time or changes in construction to avoid the find based upon normal change order procedures.

END OF SECTION

SECTION 01 42 13
STANDARD ABBREVIATIONS AND SYMBOLS

PART 1 - GENERAL

1.1 UNITS OF MEASUREMENT

A. Units of measurement abbreviations are defined on the drawings.

1.2 TERMINOLOGY

A. Abbreviations associated with terminology are defined in the Drawings, with the following exceptions:
   1. Typical equipment abbreviations are listed in 01 61 03 - Equipment - Basic Requirements.
   2. Piping system abbreviations are listed in 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.

1.3 ORGANIZATIONS AND STANDARDS

A. Organizations associated with industry reference standards are defined in each Specification Section.

END OF SECTION

SECTION 01 45 33
SPECIAL INSPECTIONS AND TESTING PROGRAM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Contractor responsibilities for special inspection and testing.
   2. Special Inspection program and reporting requirements.
   3. Attachment A to this Specification Section includes the Submittal of Special Inspections.
   4. Attachment B to this Specification Section includes Special Inspector qualifications, reporting requirements, and material specific inspections and tests.
      a. This information is included to assist the Contractor in understanding the Owner-provided Services so that those services may be factored into the Contractor's pricing and schedule.
      b. The Service Provider(s) responsible for the Owner-provided Services will be selected after Contract award.

B. Purpose:
   1. This Document was developed to address the requirements of the 2019 California Building Code including:
      a. One or more special inspectors will be hired by the Owner or the Owner's Representative to provide inspections during constructions on the types of work listed under CBC Sections 1704 and 1705; and on Sheets 00S002 and 00S003
   2. A Statement of Special Inspections will be submitted to the Building Code Official as a condition for permit issuance. This statement is included as Attachment A to this Specification. Attachment B includes a complete list of materials and work requiring special inspections, the inspections to be performed and a list of the minimum qualifications of the individuals, approved agencies or firms intended to be retained for conducting such inspections.

C. Related Requirements: Include but are not necessarily limited to the following:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Drawing Sheet No. 0S001 thru 0S003.

1.2 DEFINITIONS

A. Special Inspector: Representative of the Owner approved inspection agency designated for that portion of the work.

B. Testing Agency: Approved agency, not affiliated or hired by the Contractor, which is responsible for the materials testing requirements of the project including but not limited to concrete cylinder breaks, soils testing, and masonry materials testing.

C. Statement of Special Inspections: Document provided to the Building Code Official outlining special inspections and tests to be done on the project and frequency of required test.

D. Soils Engineer or Geotechnical Engineer: For the purposes of Special Inspection "Soils Engineer," "Geotechnical Engineering," and "Special Inspector" shall be interchangeable as pertains to the Division 31 specifications.

E. NICET: National Institute for Certification in Engineering Technologies.

1.3 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with testing agency personnel, special inspector, and agents of the Building Code Official and provide access to the work.

1. Providing access to the work shall include all labor and safe facilities including stairways, ladders, manlifts, lighting, ventilation, etc. to perform inspections and tests as listed in the specifications for the duration of the inspections or tests involved.
2. Provide means to obtain and handle samples taken on site.

B. Attend a pre-construction meeting to coordinate and clarify inspection and testing procedures, requirements.

C. Notify special inspector and/or testing agency of work to be inspected/tested minimum of 24 HRS prior.

D. Work for which special inspections are required shall remain accessible and exposed for the purposes of special inspections until completion of required special inspections.

E. Any portion of work that is not in conformance shall be corrected and re-inspected. Such portions of the work shall not be covered or concealed until authorized by Owner's Representative.

F. Work to be inspected should be complete at time of inspector's arrival on-site.

G. Work requiring special inspection shall be inspected by the Contractor Quality Control Manager for compliance with the Contract Document so as to be ready for special inspection.

H. Payment for Special Inspection services will be in accordance with the following:
1. Payment described below is for the Testing Agency and Special Inspector costs and does not include the Contractor's costs listed in Paragraph 1.3 A.
2. After Contractor Quality Control Manager verifies Work in compliance with the Contract Documents and provides notification, inspector arrives at site and performs inspection within the timeframe defined in Item 4 below.
    a. Inspection reveals work is satisfactory.
    b. Owner pays all costs associated with this inspection.
3. After Contractor Quality Control Manager verifies Work in compliance with the Contract Documents and provides notification, inspector arrives at site and performs inspection within the timeframe defined in Item 4 below.
    a. Inspection reveals work is deficient.
    b. Contractor corrects deficiencies within timeframe defined in Item 4) below.
    c. Work is re-inspected and work is satisfactory.
    d. Owner pays all costs associated with this inspection.
4. After Contractor Quality Control Manager verifies Work in compliance with the Contract Documents and provides notification, inspector arrives at site and work is not ready for inspection when inspector arrives.
    a. Inspector will remain on-site for a maximum of two (2) HRS awaiting the completion of the work.
    b. If work is not ready for inspection at the end of this period, inspector will be dismissed until Contractor requests re-inspection.
    c. All costs associated with this inspection trip will be charged to the Contractor.
5. After Contractor Quality Control Manager verifies Work in compliance with the Contract Documents and provides notification, inspector arrives at site and performs inspection within the timeframe defined above.
    a. Inspection reveals work is deficient.
    b. Contractor attempts to correct deficiencies within two (2) HR timeframe and calls for re-inspection.
    c. Work is re-inspected and found to still be deficient.
    d. Inspector will be dismissed.
    e. All costs associated with this inspection trip will be charged to the Contractor.
6. Owner will pay for "passing" soils on the Project. Costs of corrective actions and cost of failed test areas requiring retesting are the sole responsibility of the Contractor. For additional specific payment requirements for soils see the respective Division 31 Section.

I. Special Inspection is intended to be an independent quality assurance. Special Inspections shall not relieve the Contractor of any quality assurance, quality control, workmanship, or warranty responsibilities. Contractor's own personnel shall review and inspect all work for conformance with Contract Documents prior to calling for special inspection.

J. The testing firm shall be staffed with experienced personnel, properly equipped and fully qualified to perform the tests in accordance with the specified standards. Contractor's QA/QC Plan shall include documentation demonstrating that the testing firm and its personnel are properly accredited by the appropriate authority.

K. The Owner's Representative has the right to inspect work performed by the independent testing firm. This may include inspection of the independent testing firm's internal quality assurance records (quality assurance manual, equipment calibrations, proficiency sample performance, etc.).

1.4 REPORTING DUTIES AND AUTHORITY

A. A pre-construction meeting to coordinate and clarify inspection, testing, and procedural requirements will be held per Specification Section 01 30 00 - Special Conditions.
   1. The meeting is to be attended by:
      a. Owner.
      b. Owner's Representative.
      c. Building Code Official or designee.
      d. Testing Agency and Special Inspectors.
      e. General Contractor.
      f. Contractor Quality Control Manager.
      g. Appropriate Sub-contractor(s).

B. Special Inspector shall report all deficient work to the Owner's Representative and Contractor as soon as possible.
   1. Deficient work that has been covered up or concealed prior to re-inspection shall be reported to the Owner's Representative and the Building Code Official.

C. Special Inspector does not have authority to stop work or modify the requirements of the Contract Documents.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

END OF SECTION

ATTACHMENT A TO SECTION 01 45 33
SUBMITTAL OF SPECIAL INSPECTIONS

Statement Date: _____

Project Name: _____
Project Address: _____
Owner: _____
Registered Design Professional in Responsible Charge (DPRC): _____

The Statement of Special Inspections (Statement) is submitted as a condition for permit issuance in accordance with the Special Inspection requirements of the Building Code. The Special Inspection program is outlined in Specification Section 01 45 33 and Attachments A and B. A detailed explanation of the requirements for Special Inspections and Testing can be found in specification Section 01 45 33 of the Project Manual in conjunction with the Technical Specifications for each material.

Bi-weekly Special Inspection reports will be submitted to the DPRC and the Building Official. Discovered discrepancies will be brought to the immediate attention of the Contractor for correction. If the discrepancies are not corrected, the discrepancies will be brought to the attention of the DPRC and the Building Official. Only documents that are prepared and signed or sealed by the Special Inspectors (SI) are valid.

The Special Inspector is responsible for verifying all information on each document prior to signing or sealing and directly forwarding it to the DPRC and Building Official. The Special Inspector is responsible for verifying all inspectors under his supervision maintain current certifications during the course of the project. At the conclusion of each individual Special Inspection type, the Special Inspector will complete a Final Report.

The Special Inspection program does not relieve the Contractor or any other entity of any contractual duties, including quality control, quality assurance, or safety. The Contractor is solely responsible for construction means, methods, and job site safety. Failure to adhere to the Special Inspection program as outlined herein may result in a stop work notice being issued by the Building Official.

Respectfully submitted,
Design Professional in Responsible Charge,

_____
Type or Print Name

_____ License # _____
Expires: _____

_____ _____
Signature Date

END OF ATTACHMENT A

ATTACHMENT B TO SECTION 01 45 33

SPECIAL INSPECTIONS, INSPECTOR QUALIFICATIONS AND REPORTING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Specification Sections include but are not necessarily limited to:
1. Section 03 05 05 - Concrete Testing and Inspection.
2. Section 03 11 13 - Formwork
3. Section 03 15 19 – Anchorage to Concrete.
4. Section 03 21 00 – Reinforcement
5. Section 03 31 31 – Concrete Mixing, Placing, Jointing, and Curing
6. Section 03 35 00 – Concrete Finishing and Repair of Surface Defects
7. Section 05 50 00 - Metal Fabrications.
8. Section 07 84 00 – Firestopping.
9. Section 09 22 16 - Non-structural Metal Framing
10. Section 13 34 19 - Metal Building Systems
11. Section 31 23 00 - Earthwork.

1.2 QUALIFICATIONS

A. Qualifications stated here are the minimum recommended by the Engineer. If the Building Code Official has more stringent qualifications, the more stringent qualifications will take precedence.

B. All Special Inspections and Testing to be done under the direction of a Professional Engineer or Registered Architect registered in the State of California herein referred to as Registered Professional for Special Inspections (RPSI).

C. Soil, masonry, concrete, mortar, grout, steel and aluminum related testing.
1. The Testing Agency shall have a minimum of ten (10) years-experience in the testing of these materials.
2. The Testing Agency's technician(s) conducting this testing:
   a. Shall have a minimum of five (5) years-experience in the testing of soil, concrete, mortar, grout, steel and aluminum as appropriate.
3. Concrete related work:
   a. International Code Council certification for Reinforced Concrete and American Concrete Institute Concrete Field Testing Technician – Grade 1.

D. Special Structural Inspections:
1. Professional Engineers or Architects, licensed in the State of California, may perform special inspections in accordance with their license qualifications.
2. Other individuals, working under the direct supervision of a licensed engineer and meeting the following qualifications, may perform special inspections.
3. Soils related work:
   a. NICET Level II Certification in geotechnical engineering technology/construction; or
   b. Registered Geologist; or
   c. Engineer Intern under the direct supervision of a Licensed Professional Engineer.
4. Concrete related work:
   a. International Code Council certification for Reinforced Concrete Special Inspector or American Concrete Institute Concrete Construction Special Inspector.
   b. Alternatively, may be an Engineer Intern under the direct supervision of a Licensed Professional Engineer.
5. Precast concrete erection related work:
   a. Engineer Intern under the direct supervision of a Licensed Professional Engineer.
6. Precast concrete erection welding:

a. American Welding Society as a Certified Welding Inspector; or
b. International Code Council Structural Steel and Welding Certification and American Welding Society Qualified and one (1) year of related experience; or
c. NDT Level II or III Certificate (for non-destructive testing only).

7. Masonry related work:
   a. Shall be certified by the International Code Council or American Concrete Institute for structural masonry and one year of related experience.
   b. Alternatively, may by an Engineer Intern with a minimum of two years appropriate training.
8. Steel and aluminum related work:
   a. Frame and material verification per American Institute of Steel Construction Code of Standard Practice or Aluminum Association Specifications, as appropriate.
   b. Welding:
      1) American Welding Society as a Certified Welding Inspector; or
      2) International Code Council Structural Steel and Welding Certification and American Welding Society Qualified and one (1) year of related experience; or
      3) NDT Level II or III Certificate (for non-destructive testing only).
   c. High strength bolting:
      1) International Code Council Structural Steel and Welding Certification and one (1) year related experience.
      2) Alternatively, may be an Engineer Intern with appropriate training.
9. Fire resistive coating (intumescent paint) related work:
   a. International Code Council Spray-Applied Fireproofing Certification and (3) years of related experience; or
   b. International Code Council Fire Inspector 1 Certification and (3) years of related experience.
10. Other equivalent certifications will not be acceptable unless approved by the Engineer.

1.3 REPORTING DUTIES AND AUTHORITY

A. Reporting requirements for special inspector per 2016 CBC for Building System Related Work.
   1. Comply with requirements of CBC Section 1704.1.2.
   2. Provide written documentation of all inspections and testing.
      a. Include exact location of work.
      b. If testing of specimens is included, include detailed information on storage and curing of specimens prior to testing.
   3. Furnish inspection and test reports to the Contractor, the Engineer's Project Manager and the Owner's Representative.
      a. Indicate that work inspected was done in conformance with approved construction documents.
      b. Immediately report any discrepancies in writing to the Contractor for correction.
      c. If the discrepancies are not corrected in a timely fashion, notify the Owner's Representative and Engineer.
   4. Issue an electronic report summarizing all inspections, corrective action notifications and resolution of discrepancies and non-conforming work every two (2) weeks (14 calendar days).
      a. Copy will be available to:
         1) Owner's Representative.
         2) Engineer.
         3) The Building Code Official.
         4) Contractor.
   5. At the end of the Project, the RPSI shall compile all test reports for each inspected material and for each Special Inspector and summarize into a single PDF and submit to the Owner's Representative, Engineer and Building Code Official.
      a. Final summary report to be signed and sealed by a Registered Professional for Special Inspections stating:
         1) The required Special Inspections have been performed.

2) All discrepancies have been resolved except as specifically stated in the summary report.

B. Special Inspector shall report all deficient work to the Owner's Representative, Engineer and, Contractor as soon as possible.
   1. Deficient work that has been covered up or concealed prior to re-inspection shall be reported to the Engineer and the Building Code Official.

C. Special Inspector does not have authority to stop work or modify the requirements of the Contract Documents.

1.4 MATERIAL SPECIFIC SPECIAL INSPECTIONS AND TESTS

A. Material specific requirements for special inspection and testing are listed on the Contract Drawings.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS ATTACHMENT)

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS ATTACHMENT)

END OF ATTACHMENT B

SECTION 01 61 03
EQUIPMENT - BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements of this Specification Section apply to all equipment provided on the Project including those found in other Divisions even if not specifically referenced in individual "Equipment" Articles of those Specification Sections.

B. Related Sections include but are not necessarily limited to:
   1. Nevada County Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 01 81 10 - Wind and Seismic Design Criteria
   4. Section 03 15 19 - Anchorage to Concrete
   5. Section 03 31 30 - Concrete, Materials and Proportioning.
   6. Section 05 50 00 - Metal Fabrications.
   7. Section 07 92 00 - Joint Sealants.
   8. Section 09 96 00 - High Performance Industrial Coatings.
   9. Section 10 14 00 - Identification Devices.
   10. Section 26 05 09 - Motors.
   11. Section 40 05 00 - Pipe and Pipe Fittings: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Bearing Manufacturers Association (ABMA).
   2. American Gear Manufacturers Association (AGMA).
   3. ASTM International (ASTM):
      a. E1934, Standard Guide for Examining Electrical and Mechanical Equipment with Infrared Thermography.
      b. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
   4. Hydraulic Institute (HI):
      a. 9.6.4, Centrifugal and Vertical Pumps for Vibration Measurements and Allowable Valves.
   5. International Electrotechnical Commission (IEC).
   6. Institute of Electrical and Electronics Engineers, Inc. (IEEE).
   7. International Organization for Standardization (ISO):
      a. 1940, Mechanical Vibration - Balance Quality Requirements for Rotors in a Constant (Rigid) State - Part 1: Specification and Verification of Balance Tolerances.
      b. 21940-11, Mechanical Vibration - Rotor Balancing - Part 11: Procedures and Tolerances for Rotors with Rigid Behavior.
   8. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. ICS 6, Enclosures for Industrial Control and System.
      c. MG 1, Motors and Generators.
   9. InterNational Electrical Testing Association (NETA):
      a. ATS, Acceptance Testing Specification for Electrical Power Distribution Equipment and Systems.
   10. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC):
   11. National Institute for Certification in Engineering Technologies (NICET).
   12. National Institute of Standards and Technology (NIST).
   13. Occupational Safety and Health Administration (OSHA):

a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.

14. Underwriters Laboratories, Inc. (UL).
    a. 508, Standard for Safety Industrial Control Equipment.
    b. 508A, Standard for Safety Industrial Control Panels.
    c. 698A, Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations.
15. Vibration Institute.

B. Natural frequency analysis firm:
1. An independent firm, whose sole or principal part of its business is the calculation of and analysis of natural frequencies of rotating equipment.
2. Minimum of 10 years experience.
3. Employs a registered professional engineer who has experience in finite element analysis, rotordynamic analysis and experimental modal analysis.
    a. Minimum five (5) years combined field testing and data analysis experience.
    b. Qualified Vibration Category III certification from the Vibration Institute.

C. Vibration Testing Program:
1. Testing firm:
    a. An independent firm performing, as the sole or principal part of its business for a minimum of 10 years, the inspection, testing, calibration, and adjusting of systems.
    b. Must have an established monitoring and testing equipment calibration program with accuracy traceable in an unbroken chain, according to NIST.
2. Field personnel:
    a. Minimum of three (3) years field experience covering all phases of field vibration testing and data gathering.
    b. Qualified Vibration Category II certification from the Vibration Institute.
3. Analysis personnel:
    a. Minimum five (5) years combined field testing and data analysis experience.
    b. Qualified Vibration Category III certification from the Vibration Institute.

D. Infrared Thermography Testing Program:
1. Testing firm:
    a. An independent firm performing, as the sole or principal part of its business for a minimum of 10 years, the inspection, testing, calibration, and adjusting of systems.
    b. Must have an established monitoring and testing equipment calibration program with accuracy traceable in an unbroken chain, according to NIST.
2. Field personnel:
    a. Minimum of one (1) year field experience covering all phases of field thermography testing and data gathering.
    b. Supervisor certified by NETA or NICET.
3. Analysis personnel:
    a. Minimum three (3) years combined field testing and data analysis experience.
    b. Supervisor certified by NETA or NICET.

E. Electrical Equipment and Connections Testing Program:
1. Testing firm:
    a. An independent firm performing, as the sole or principal part of its business for a minimum of 10 years, the inspection, testing, calibration , and adjusting of systems.
    b. Must have an established monitoring and testing equipment calibration program with accuracy traceable in an unbroken chain, according to NIST.
2. Field personnel:
    a. Minimum of one (1) year field experience covering all phases of electrical equipment inspection, testing, and calibration.
    b. Relay test technician having previous experience with testing and calibration of relays of the same manufacturer and type used on project and proficient in setting and testing the types of protection elements used.

c. Supervisor certified by NETA or NICET.
3. Analysis personnel:
a. Minimum three (3) years combined field testing and data analysis experience.
b. Supervisor certified by NETA or NICET.

F. Miscellaneous:
1. A single manufacturer of a "product" shall be selected and utilized uniformly throughout Project even if:
a. More than one (1) manufacturer is listed for a given "product" in Specifications.
b. No manufacturer is listed.
2. Equipment, electrical assemblies, related electrical wiring, instrumentation, controls, and system components shall fully comply with specific NEC requirements related to area classification and to NEMA 250 and NEMA ICS 6 designations and defined in the Electrical specifications.
3. Variable speed equipment applications: The driven equipment manufacturer shall have single source responsibility for coordination of the equipment and VFD system and verify their compatibility.

1.3 DEFINITIONS

A. Product: Manufactured materials and equipment.

B. Major Equipment Supports - Supports for Equipment:
1. Located on or suspended from elevated slabs with supported equipment weighing 2000 LBS or greater, or;
2. Located on or suspended from roofs with supported equipment weighing 500 LBS or greater, or;
3. Located on slab-on-grade or earth with supported equipment weighing 5000 LBS or more.

C. Equipment:
1. One (1) or more assemblies capable of performing a complete function.
2. Mechanical, electrical, instrumentation or other devices requiring an electrical, pneumatic, electronic or hydraulic connection.
3. Not limited to items specifically referenced in "Equipment" articles within individual Specifications.

D. Installer or Applicator:
1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
2. Installer and applicator are synonymous.

1.4 SUBMITTALS

A. Shop Drawings:
1. General for all equipment:
a. See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
b. Data sheets that include manufacturer's name and complete product model number.
1) Clearly identify all optional accessories that are included.
c. Acknowledgement that products submitted comply with the requirements of the standards referenced.
d. Manufacturer's delivery, storage, handling, and installation instructions.
e. Equipment identification utilizing numbering system and name utilized in Drawings.
f. Equipment installation details:
1) Location of anchorage.
2) Type, size, and materials of construction of anchorage.
3) Anchorage setting templates.
4) Manufacturer's installation instructions.
g. Equipment area classification rating.
h. Shipping and operating weight.

i. Equipment physical characteristics:
    1) Dimensions (both horizontal and vertical).
    2) Materials of construction and construction details.
j. Equipment factory primer and paint data.
k. Manufacturer's recommended spare parts list.
l. Equipment lining and coatings.
m. Equipment utility requirements include air, natural gas, electricity, and water.
n. Ladders and platforms provided with equipment:
    1) Certification that all components comply fully with OSHA requirements.
    2) Full details of construction/fabrication.
    3) Scaled plan and sections showing relationship to equipment.

2. Mechanical and process equipment:
    a. Operating characteristics:
        1) Technical information including applicable performance curves showing specified equipment capacity, rangeability, and efficiencies.
        2) Brake horsepower requirements.
        3) Copies of equipment data plates.
    b. Piping and duct connection size, type and location.
    c. Equipment bearing life certification.
    d. Equipment foundation data:
        1) Equipment center of gravity.
        2) Criteria for designing vibration, special or unbalanced forces resulting from equipment operation.

3. Electric motor:
    a. Motor manufacturer and model number.
    b. Complete motor nameplate data.
    c. Weight.
    d. NEMA design type.
    e. Enclosure type.
    f. Frame size.
    g. Winding insulation class and temperature rise.
    h. Starts per hour.
    i. Performance data:
        1) Motor speed-torque curve superimposed over driven machine speed-torque curve during start-up acceleration and at rated terminal voltage a minimum permissible or specified terminal voltage for all motors over 15 HP.
        2) Time-current plots with acceleration versus current and thermal damage curves at the operating and ambient temperatures and at rated terminal voltage and minimum permissible or specified terminal voltage for all motors over 15 HP.
        3) Guaranteed minimum efficiencies at 100 PCT, 75 PCT, and 50 PCT of full load
        4) Guaranteed minimum power factor at 100 PCT, 75 PCT, and 50 PCT of full load.
        5) Locked rotor and full load current at rated terminal voltage and minimum permissible or specified terminal voltage.
        6) Starting, full load, and breakdown torque at rated terminal voltage and minimum permissible or specified terminal voltage.
    j. Bearing data and lubrication system.
    k. Natural frequency calculations for:
        1) Completed assembly including but not limited to the equipment base, rotating piece of equipment, and the rotating piece of equipment driver.
        2) Individual piece of rotating equipment.
        3) Equipment driver and connected gear reducer, if applicable.
    l. Thermal protection system including recommended alarm and trip settings for winding and bearing RTD’s.
    m. Maximum permissible capacitor (kVAC) that can be connected to the motor.
    n. Recommended size of power factor correction capacitors to improve power factor to 0.95 lagging when operated at full load.

o. Fabrication and/or layout drawings:
    1) Dimensioned outlined drawing.
    2) Connection diagrams including accessories (strip heaters, thermal protection, etc.).
p. Certifications:
    1) When utilized with a reduced voltage starter, certify that motor and driven equipment are compatible.
    2) When utilized with a variable frequency controller, certify motor is inverter duty and the controller and motor are compatible.
        a) Include minimum speed at which the motor may be operated for the driven machinery.
q. Electrical gear:
    1) Unless specified in a narrow-scope Specification Section, provide the following:
        a) Equipment ratings: Voltage, continuous current, kVa, watts, short circuit with stand, etc., as applicable.
    2) Control panels:
        a) Panel construction.
        b) Point-to-point ladder diagrams.
        c) Scaled panel face and subpanel layout.
        d) Technical product data on panel components.
        e) Panel and subpanel dimensions and weights.
        f) Panel access openings.
        g) Nameplate schedule.
        h) Panel anchorage.
        i) Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70. Include any required calculations.

4. Systems schematics and data:
    a. Provide system schematics where required in system specifications.
        1) Acknowledge all system components being supplied as part of the system.
        2) Utilize equipment, instrument and valving tag numbers defined in the Contract Documents for all components.
        3) Provide technical data for each system component showing compliance with the Contract Document requirements.
        4) For piping components, identify all utility connections, vents and drains which will be included as part of the system.
5. For factory painted equipment, provide paint submittals in accordance with Section 09 96 00.
6. Qualifications for:
    a. Natural frequency analysis firm and personnel.
    b. Vibration testing firm and personnel.
    c. Infrared thermography testing firm and personnel.
    d. Electrical equipment and connections testing firm and personnel.
7. Equipment Monitoring and Testing plans, in accordance with PART 3 of this Specification Section:
    a. Natural frequency analysis and calculations.
    b. Vibration testing.
    c. Thermography testing.
    d. Electrical equipment and connection testing.

B. Contract Closeout Information:
    1. Operation and Maintenance Data:
        a. See Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

C. Informational Submittals:
    1. Sample form letter for equipment field certification.
    2. Certification that equipment has been installed properly, has been initially started up, has been calibrated and/or adjusted as required, and is ready for operation.

3. Certification for major equipment supports that equipment foundation design loads shown on the Drawings or specified have been compared to actual loads exhibited by equipment provided for this Project and that said design loadings are equal to or greater than the loads produced by the equipment provided.
4. Field noise testing reports if such testing is specified in narrow-scope Specification Sections.
5. Notification, at least one (1) week in advance, that motor testing will be conducted at factory.
6. Certification from equipment manufacturer that all manufacturer-supplied control panels that interface in any way with other controls or panels have been submitted to and coordinated with the supplier/installer of those interfacing systems.
7. Motor test reports.
8. Certification prior to Project closeout that electrical panel drawings for manufacturer-supplied control panels truly represent panel wiring including any field-made modifications.
9. Provide three (3) bound final written reports documenting natural frequency testing, vibration monitoring and testing for specified equipment.
    a. Include the acceptance criteria of all equipment tested.
    b. Provide individual tabbed sections for information associated with each piece of tested equipment.
10. Preliminary field quality control testing format to be used as a basis for final field quality control reporting.
11. Testing and monitoring reports in accordance with PART 3 of this Specification Section.
12. Certification that driven equipment and VFD are compatible.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
    1. Motors:
        a. Baldor.
        b. General Electric.
        c. Hyundai Heavy Industries.
        d. Marathon Electric.
        e. Rockwell - Reliance.
        f. Siemens.
        g. TECO-Westinghouse.
        h. Toshiba U.S.
        i. U.S. Motors, Nidec Motor Corporation.
        j. WEG.
    2. Mechanical variable speed drives:
        a. Reeves.
        b. U.S. Motors (VariDrive).

B. Submit request for substitution in accordance with Section 01 25 13.

2.2 MANUFACTURED UNITS

A. Electric Motors:
    1. Where used in conjunction with adjustable speed AC or DC drives, provide motors that are fully compatible with the speed controllers.
    2. Design for frequent starting duty equivalent to duty service required by driven equipment.
    3. Design for full voltage starting.
    4. Design bearing life based upon actual operating load conditions imposed by driven equipment.
    5. Size for altitude of Project.
    6. Furnish with stainless steel nameplates which include all data required by NEC Article 430.

7. Use of manufacturer's standard motor will be permitted on integrally constructed motor driven equipment specified by model number in which a redesign of the complete unit would be required in order to provide a motor with features specified.
8. AC electric motors less than 1/3 HP:
    a. Single phase, 60 Hz, designed for the supply voltage shown on the Drawings.
    b. Permanently lubricated sealed bearings conforming to ABMA standards.
    c. Built-in manual reset thermal protector or integrally mounted manual motor starter with thermal overload element with stainless steel enclosure.
9. AC electric motors 1/3 to 1 HP:
    a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
    b. Permanently lubricated sealed bearings conforming to ABMA standards.
        1) For single phase motors, provide built-in manual reset thermal protector or integrally mounted manual motor starter with thermal overload element.
10. AC electric motors 1-1/2 to 10 HP:
    a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
    b. Permanently lubricated sealed bearings conforming to ABMA standards.
    c. For vertical motors provide 15 year, average-life thrust bearings conforming to ABMA standards.
11. AC electric motors greater than 10 HP:
    a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
    b. Oil or grease lubricated antifriction bearings conforming to ABMA standards.
        1) Design bearing life for 90 PCT survival rating at 50,000 HRS of operation for motors up to and including 100 HP.
        2) For motors greater than 100 HP, design bearing life for 90 PCT survival rating at 100,000 HRS of operation.
    c. For vertical motors provide 15 year, average-life thrust bearings conforming to ABMA standards.
12. Severe duty motor to have the following minimum features:
    a. All cast iron construction.
    b. Gasketed conduit box.
    c. Epoxy finish for corrosion protection.
    d. Hydroscopic varnish on windings for corrosion protection.
    e. Drain plug and breather.

B. NEMA Design Squirrel Cage Induction Motors:
1. Provide motors designed and applied in compliance with NEMA and IEEE for the specific duty imposed by the driven equipment.
2. Motors to meet NEMA MG 1 (NEMA Premium) efficiencies.
3. Do not provide motors having a locked rotor kVA per HP exceeding the NEMA standard for the assigned NEMA code letter.
4. For use on variable frequency type adjustable speed drives, provide:
    a. Induction motors that are in compliance with NEMA MG 1, Part 31.
    b. Nameplate identification meeting NEMA MG 1 Part 31 requirements.
    c. Insulated drive end bearing on all motors.
    d. Insulated non-drive end bearings, at a minimum, on all motors with horizontal shaft 100 HP and larger.
    e. An insulated bearing carrier on the non-drive end for vertical shaft motors 100 HP and larger.
    f. Shaft grounding ring on all motors:
        1) Factory installed, maintenance free, circumferential, bearing protection ring with conductive microfiber shaft contacting material.
        2) Electro Static Technology AEGIS SGR Bearing Protection Ring or approved equal.
    g. Have the following minimum turndown ratio without the use of additional cooling, such as a blower, to provide continuous supply of cooling air over the motor.
        1) Variable torque: 10:1.

2) Constant torque: 6:1.

5. Design motor insulation in accordance with NEMA standards for Class F insulation with Class B temperature rise above a 40 DEGC ambient.
6. Design motors for continuous duty.
7. Size motors having a 1.0 service factor so that nameplate HP is a minimum of 15 PCT greater than the maximum HP requirements of the driven equipment over its entire operating range.
   a. As an alternative, furnish motors with a 1.15 service factor and size so that nameplate HP is at least equal to the maximum HP requirements of the driven equipment over its entire operating range.
8. Motor enclosure and winding insulation application:
   a. The following shall apply unless modified by specific Specification Sections:

MOTOR LOCATION	MOTOR ENCLOSURE / WINDING INSULATION
Unclassified Indoor Areas	DPFG (for horizontal motors), WP-I (for vertical motors) Standard Insulation, TEFC, Standard Insulation
Wet indoor Areas	TEFC, Standard Insulation TEFC, Encapsulated Windings WP-II (for vertical motors)
Wet outdoor Areas	TEFC, Extra Dip and Bake for Moisture TEFC Encapsulated Windings WP-II (for vertical motors)
Corrosive Areas	TEFC, Severe/ Chemical Duty
Class I, Division 1 Areas	Explosion Proof, Approved for Class I Division 1 Locations
Class II, Division 1 Areas	Explosion Proof, Approved for Class II Division 1 Locations
Class I or Class II, Division 2 Areas	Explosion Proof, Approved for Division 1 Locations or TEFC with maximum external frame temperature compatible with the gas or dust in the area, Extra Dip and Bake for moisture.

NOTE: Provide TENV motors in the smaller horsepower ratings where TEFC is not available.

9. Provide oversize conduit box complete with clamp type grounding terminals inside the conduit box.
10. Balance motors to ISO G2.5 level.
    a. Submit prior to shipping to OEM or job site.

C. Submersible Motors: Refer to individual narrow-scope Specification Sections for submersible motor requirements.

D. V-Belt Drive:
1. Provide each V-belt drive with sliding base or other suitable tension adjustment.
2. Provide V-belt drives with a service factor of at least 1.6 at maximum speed.
3. Provide staticproof belts.

E. Mechanical Variable Speed Drives:
1. Oil-lubricated shaft-mounted reduction gear drive capable of 300 PCT shock load and providing a 1.5 service factor in accordance with AGMA.
2. Secure drive to equipment base.
3. Flexible coupling between drive shaft and equipment shaft.

F. Vibration Isolators:
1. Provide all equipment subject to vibration with restrained spring type vibration isolators or pads according to the manufacturer's written recommendation.

G. Space Heaters:
1. Silicone rubber strip type, 120 V rated.
2. Provided on:
   a. All motors 10 HP and larger mounted outdoors.
   b. Indoor motors in humid environments as indicated.

2.3 COMPONENTS

A. Gear Drives and Drive Components:
   1. Size drive equipment capable of supporting full load including losses in speed reducers and power transmission.
   2. Provide nominal input horsepower rating of each gear or speed reducer at least equal to nameplate horsepower of drive motor.
   3. Design drive units for 24 HR continuous service, constructed so oil leakage around shafts is precluded.
   4. Utilize gears, gear lubrication systems, gear drives, speed reducers, speed increasers and flexible couplings meeting applicable standards of AGMA.
   5. Gear reducers:
      a. Provide gear reducer totally enclosed and oil lubricated.
      b. Utilize antifriction bearings throughout.
      c. Provide worm gear reducers having a service factor of at least 1.20.
      d. Furnish other helical, spiral bevel, and combination bevel-helical gear reducers with a service factor of at least 1.50.

2.4 ACCESSORIES

A. Guards:
   1. Provide each piece of equipment having exposed moving parts with full length, easily removable guards, meeting OSHA requirements.
   2. Interior applications:
      a. Construct from expanded galvanized steel rolled to conform to shaft or coupling surface.
      b. Utilize non-flattened type 16 GA galvanized steel with nominal 1/2 IN spacing.
      c. Connect to equipment frame with hot-dip galvanized bolts and wing nuts.
   3. Exterior applications:
      a. Construct from 16 GA stainless steel or aluminum.
      b. Construct to preclude entrance of rain, snow, or moisture.
      c. Roll to conform to shaft or coupling surface.
      d. Connect to equipment frame with stainless steel bolts and wing nuts.

B. Anchorage:
   1. Cast-in-place anchorage:
      a. Provide ASTM F593, Type 316 stainless steel anchorage for all equipment.
      b. Configuration and number of anchor bolts shall be per manufacturer's recommendations.
      c. Provide two (2) nuts for each bolt.
   2. Drilled anchorage:
      a. Adhesive anchors per Section 03 15 19.
      b. Epoxy grout per Section 03 31 30.
      c. Threaded rods same as cast-in-place.

C. Data Plate:
   1. Attach a stainless steel data plate to each piece of rotary or reciprocating equipment.
   2. Permanently stamp information on data plate including manufacturer's name, equipment operating parameters, serial number and speed.

D. Gages:
   1. Provide at the following locations:
      a. Inlet and outlet of all reciprocating, centrifugal and positive displacement mechanical and process equipment.
      b. At locations identified on Drawings.
   2. Utilize tapping sleeves for mounting.

E. Lifting Eye Bolts or Lugs:
   1. Provide on all equipment 50 LBS or greater.

2. Provide on other equipment or products as specified in the narrow-scope Specification Sections.

F. Platforms and Ladders:
   1. Design and fabricate in accordance with OSHA Standards.
   2. Fabricate components from painted carbon steel or fiberglass-reinforced plastic.
   3. Provide platform surface: Non-skid grating, unless specified in narrow-scope Specification Sections.

2.5 FABRICATION

A. Design, fabricate, and assemble equipment in accordance with modern engineering and shop practices.

B. Manufacture individual parts to standard sizes and gages so that repair parts, furnished at any time, can be installed in field.

C. Furnish like parts of duplicate units to be interchangeable.

D. Ensure that equipment has not been in service at any time prior to delivery, except as required by tests.

E. Furnish equipment which requires periodic internal inspection or adjustment with access panels which will not require disassembly of guards, dismantling of piping or equipment or similar major efforts.
   1. Quick opening but sound, securable access ports or windows shall be provided for inspection of chains, belts, or similar items.

F. Provide common, lipped base plate mounting for equipment and equipment motor where said mounting is a manufacturer's standard option.
   1. Provide drain connection for 3/4 IN PVC tubing.

G. Machine the mounting feet of rotating equipment.

H. Fabricate equipment which will be subject to Corrosive Environment in such a way as to avoid back to back placement of surfaces that can not be properly prepared and painted.
   1. When such back to back fabrication can not be avoided, provide continuous welds to seal such surfaces from contact with corrosive environment.
   2. Where continuous welds are not practical, after painting seal the back to back surfaces from the environment in accordance with Section 07 92 00.

I. Natural frequency/critical Speed:
   1. All rotating parts accurately machined and in as near perfect rotational balance as practicable.
   2. Excessive vibration is sufficient cause for equipment rejection.
   3. Ratio of all rotative speeds to natural frequency/critical speed of a unit or components: Greater than 1.2.

J. Control Panels Engineered and Provided with the Equipment by the Manufacturer:
   1. Manufacturer’s standard design for components and control logic unless specific requirements are specified in the specific equipment Specification Section.
   2. NEMA or IEC rated components are acceptable, whichever is used in the manufacturer’s standard engineered design, unless specific requirements are required in the specific equipment Specification Section.
   3. Affix entire assembly with a UL 508A or UL 698A label "Listed Enclosed Industrial Control Panel" prior to delivery.
      a. Control panels without an affixed UL 508A or UL 698A label shall be rejected.
   4. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
      a. Determine the SCCR rating by one of the following methods:
         1) Method 1: SCCR rating meets or exceeds the available fault current of the source equipment when indicated on the Drawings.

2) Method 2: SCCR rating meets or exceeds the source equipment's Amp Interrupting Current (AIC) rating as indicated on the Drawings.
3) Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.

b. The source equipment is the switchboard, panelboard, motor control center or similar equipment where the control panel circuit originates.
c. For Method 3, provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.

2.6 SHOP OR FACTORY PAINT FINISHES

A. Electrical Equipment:
1. Provide factory-applied paint coating system(s) for all electrical equipment components except those specified in Section 09 96 00 to receive field painting.
a. Field painted equipment: See Section 09 96 00 for factory applied primer/field paint compatibility requirements.

B. Field paint other equipment in accordance with Section 09 96 00.
1. See Section 09 96 00 for factory applied primer/field paint compatibility requirements.

2.7 SOURCE QUALITY CONTROL

A. Motor Tests:
1. Test motors in accordance with NEMA and IEEE standards.
2. Provide routine test for all motors.
3. The Owner reserves the right to select and have tested, either routine or complete, any motor included in the project.
a. The Owner will pay all costs, including shipping and handling, for all motors successfully passing the tests.
b. Pay all costs, including shipping and handling, for all motors failing the tests.
c. If two (2) successive motors of the same manufacturer fail testing, the Owner has the right to reject all motors from that manufacturer.

B. Balance:
1. Unless specified otherwise, for all equipment 10 HP or greater, all rotating elements in motors, pumps, blowers, and centrifugal compressors shall be fully assembled, including coupling hubs, before being statically and dynamically balanced. Balance all rotating elements to the following criteria, per ISO 21940-11:

$$Uper = \frac{G\ x\ 6.015\ x\ W/2}{N}$$

Where:
Uper = Permissible residual unbalance for each correction plane in ounce-inches (OZ-IN). See ISO 21940-11 for acceptable values.
G = ISO Balance Quality Grade Number, per ISO 21940-11
W = Rotor weight in pounds
N = Maximum continuous operating RPM

a. Where specified, balancing reports, demonstrating compliance with this requirement, shall be submitted as product data.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment as shown on Drawings and in accordance with manufacturer's directions.

B. Utilize templates for anchorage placement for slab-mounted equipment.

C. For equipment having drainage requirements such as seal water, provide 3/4 IN PVC or clear plastic tubing from equipment base to nearest floor or equipment drain.
   1. Route clear of major traffic areas and as approved by Engineer.

D. DO NOT construct foundations until major equipment supports are approved.

E. Extend all non-accessible grease fittings using stainless steel tubing to a location which allows easy access of fittings from closest operating floor level.

F. Equipment Base:
   1. Construct level in both directions.
   2. Take particular care at anchor bolt locations so these areas are flat and level.

G. Machine Base:
   1. Mount machine base of rotating equipment on equipment base.
      a. Level in both directions, using a machinist level, according to machined surfaces on base.
   2. Level machine base on equipment base and align couplings between driver and driven unit using stainless steel blocks and shims.
      a. Blocks and shims milled flat and coplanar of both faces.
      b. Maximum of 3 shims under each foot.
      c. Size blocks and shims to provide solid support at each mounting bolt location.
         1) Provide area size of blocks and shims approximately 1-1/2 times area support surface at each mounting bolt point.
      d. Provide blocks and shims at each mounting bolt.
         1) Furnish blocks and shims that are square shape with "U" cut out to allow blocks and shims to be centered on mounting bolts.
      e. After all leveling and alignment has been completed and before grouting, tighten mounting bolts to proper torque value.

H. Rotating equipment Couplings:
   1. Align in the annular and parallel positions.
      a. For equipment rotating at 1200 RPM or less, align both annular and parallel within 0.001 IN tolerance for couplings 4 IN size and smaller.
      b. Couplings larger than 4 IN size: Increase tolerance 0.0005 IN per inches of coupling diameter, i.e., allow 6 IN coupling 0.002 IN tolerance, and allow a 10 IN coupling 0.004 IN tolerance.
      c. For equipment rotating at speeds greater than 1200 RPM allow both annular and parallel positions within a tolerance rate of 0.00025 IN per inch coupling diameter.
   2. If equipment is delivered as a mounted unit from factory, verify factory alignment on site after installation and realigned if necessary.
   3. Check surfaces for runout before attempting to trim or align units.

I. Grouting:
   1. After machine base has been shimmed, leveled onto equipment base, couplings aligned and mounting bolts tightened to correct torque value, place a dam or formwork around base to contain grouting between equipment base and equipment support pad.
      a. Extend dam or formwork to cover leveling shims and blocks.
      b. Do not use nuts below the machine base to level the unit.
   2. Saturate top of roughened concrete subbase with water before grouting.
      a. Add grout until entire space under machine base is filled to the top of the base underside.
      b. Puddle grout by working a stiff wire through the grout and vent holes to work grout in place and release any entrained air in the grout or base cavity.
   3. When the grout has sufficiently hardened, remove dam or formwork and finish the exposed grout surface to fine, smooth surface.
      a. Cover exposed grout surfaces with wet burlap and keep covering sufficiently wet to prevent too rapid evaporation of water from the grout.

b. When the grout has fully hardened (after a minimum of seven (7) days) tighten all anchor bolts to engage equipment base to grout, shims, and equipment support pad.
c. Recheck driver-driven unit for proper alignment.

3.2 INSTALLATION CHECKS

A. For all equipment specifically required in detailed specifications, secure services of experienced, competent, and authorized representative(s) of equipment manufacturer to visit site of work and inspect, check, adjust and approve equipment installation.
   1. In each case, representative(s) shall be present during placement and start-up of equipment and as often as necessary to resolve any operational issues which may arise.

B. Secure from equipment manufacturer's representative(s) a written report certifying that equipment:
   1. Has been properly installed and lubricated.
   2. Is in accurate alignment.
   3. Is free from any undue stress imposed by connecting piping or anchor bolts.
   4. Has been operated under full load conditions and that it operated satisfactorily.
      a. Secure and deliver a field written report to Owner immediately prior to leaving jobsite.

C. No separate payment shall be made for installation checks.
   1. All or any time expended during installation check does not qualify as Operation and Maintenance training or instruction time when specified.

3.3 IDENTIFICATION OF EQUIPMENT AND HAZARD WARNING SIGNS

A. Identify equipment and install hazard warning signs in accordance with Section 10 14 00.

3.4 FIELD PAINTING AND PROTECTIVE COATINGS

A. For required field painting and protective coatings, comply with Section 09 96 00, High Performance Industrial Coatings.

3.5 WIRING CONNECTIONS AND TERMINATION

A. Clean wires before installing lugs and connectors.

B. Coat connection with oxidation eliminating compound for aluminum wire.

C. Terminate motor circuit conductors with copper lugs bolted to motor leads.

D. Tape stripped ends of conductors and associated connectors with electrical tape.
   1. Wrapping thickness shall be 150 PCT of the conductor insulation thickness.

E. Connections to carry full ampacity of conductors without temperature rise.

F. Terminate spare conductors with electrical tape.

3.6 FIELD QUALITY CONTROL

A. General:
   1. Furnish equipment manufacturer’s field quality control services and testing as specified in the individual equipment Specification Sections.
   2. Execute pre-demonstration requirements in accordance with Section 01 75 00.
   3. Perform and report on all tests required by the equipment manufacturer’s Operation and Maintenance Manual.
   4. Provide testing of electrical equipment and connections in accordance with the Electrical specifications.
   5. Equip testing and analysis personnel with all appropriate project related reference material required to perform tests, analyze results, and provide documentation including, but not limited to:
      a. Contract Drawings and Specifications.
      b. Related construction change documentation.
      c. Approved Shop Drawings.

d. Approved Operation and Maintenance Manuals.
e. Other pertinent information as required.

B. Equipment Monitoring and Testing Plans:
1. Approved in accordance with Shop Drawing submittal schedule.
2. Included as a minimum:
a. Qualifications of firm, field personnel, and analysis personnel doing the Work.
b. List and description of testing and analysis equipment to be utilized.
c. List of all equipment to be testing, including:
1) Name and tag numbers identified in the Contract Documents.
2) Manufacturer's serial numbers.
3) Other pertinent manufacturer identification,

C. Instruments Used in Equipment and Connections Quality Control Testing:
1. Minimum calibration frequency:
a. Field analog instruments: Not more than 6 months.
b. Field digital instruments: Not more than 12 months.
c. Laboratory instruments: Not more than 12 months.
d. If instrument manufacturer's calibration requirements are more stringent, those requirements shall govern.
2. Carry current calibration status and labels on all testing instruments.
3. See individual testing programs for additional instrumentation compliance requirements.

D. Testing and Monitoring Program Documentation:
1. Provide reports with tabbed sections for each piece of equipment tested.
2. Include all testing results associated with each piece of equipment under that equipment's tabbed section.
a. Include legible copies of all forms used to record field test information.
3. Prior to start of testing, submit one (1) copy of preliminary report format for Engineer review and comment
a. Include data gathering and sample test report forms that will be utilized.
4. In the final report, include as a minimum, the following information for all equipment tested:
a. Equipment identification, including:
1) Name and tag numbers identified in the Contract Documents.
2) Manufacturer's serial numbers.
3) Other pertinent manufacturer identification,
b. Date and time of each test.
c. Ambient conditions including temperature, humidity, and precipitation.
d. Visual inspection report.
e. Description of test and referenced standards, if any, followed while conducting tests.
f. Results of initial and all retesting.
g. Acceptance criteria.
h. "As found" and "as left" conditions.
i. Corrective action, if required, taken to meet acceptance.
j. Verification of corrective action signed by the Contractor, equipment supplier, and Owner's representative.
k. Instrument calibration dates of all instruments used in testing.
5. Provide three (3) bound final reports prior to Project final completion.

E. Electrical Equipment and Connections Testing Program:
1. Perform testing on Electrical equipment and connections in accordance with the Electrical specification requirements.
2. Testing of motors:
a. After installation and prior to energizing the motor, perform inspections and tests per NETA ATS 7.15 for all motors 15 HP or above.
b. Ensure motor has been lubricated.
c. Bump motor to check for correct rotation.

3. Repair or replace equipment shown to be out of range of the acceptable tolerance until the equipment meets or exceeds acceptability standards.

F. Other Testing:
   1. Perform tests and inspections not specifically listed but required to assure equipment is safe to energize and operate.
   2. Subbase that supports the equipment base and that is made in the form of a cast iron or steel structure that has supporting beams, legs, and cross members that are cast, welded, or bolted shall be tested for a natural frequency of vibration after equipment is mounted.
      a. The ratio of the natural frequency of the structure to the frequency of the disturbing force shall not be between 0.5 and 1.5.

G. Infrared Thermography Testing Program:
   1. Perform infrared thermography testing for equipment specified in other Divisions during the Equipment Demonstration Period.
      a. Perform on all rotating and reciprocating equipment having drivers 25 HP or greater.
      b. Perform on electrical equipment and connections:
   2. Additional requirements for infrared thermography monitoring and testing equipment:
      a. Temperature range: -10 to 350 DEGC.
      b. Accuracy: ±2 PCT or 2 DEGC, whichever is greater.
      c. Repeatability: ±1 PCT or 1 DEGC, whichever is greater.
      d. Temperature indication resolution: 0.1 DEGC.
      e. Minimum focus distance: 0.3 meters.
      f. Output in color palettes: JPEG, BMP, or other digital format compatible with Windows.
   3. Perform inspection per ASTM E1934.
      a. Operate VFD driven equipment at 100 PCT speed during thermographic inspection.
   4. Acceptability of electrical connections and components based on temperature comparison between components and ambient air temperatures not greater than 10 DEGC per ASTM E1934.
   5. Acceptability of motors and equipment bearings based on temperature rise not greater than 5 DegC above the equipment and/or bearing manufacturers published criteria.
   6. Repair or replace equipment shown to be out of range of the acceptable tolerance until the equipment meets or exceeds acceptability standards.

H. Equipment Vibration Monitoring and Testing Program:
   1. Perform vibration monitoring and testing for equipment specified in other Divisions during the Equipment Demonstration Period.
   2. Provide vibration testing on all rotating and reciprocating equipment having driver 25 HP and greater.
   3. Additional requirements for vibration monitoring and testing equipment at 25 DEGC:
      a. Requirements for analyzer.
         1) Frequency range: 10 Hz to 20 kHz
         2) Frequency Accuracy: 0.02 PCT.
         3) Non-integrated spectral amplitude accuracy: 5 PCT, 3 Hz to 65kHz.
         4) Single integrated spectral amplitude accuracy: 5 PCT 10 Hz to 20kHz.
         5) Supports measurements of acceleration, velocity, displacement, envelope demodulation for bearing defect detection.
         6) Capable of two-place computer balancing.
      b. Requirements for vibration sensor at 25 DEGC:
         1) Sensitivity: ±5 PCT = 100 mV/g.
         2) Acceleration range: ±50 g.
         3) Amplitude nonlinearity: ±1 PCT.
         4) Frequency response: ±10 Hz to 7 kHz (±3 dB).
         5) Permanently attach vibration test and monitoring mounting pads to mechanical equipment at location recommended by the equipment manufacturer or as recommended by the testing firm.

4. Acceptability of equipment conditions, except pumps, based on ISO 1940-1 Balance Quality Grade G2.5 criteria.
5. Acceptability of pumping equipment to be based on current ANSI/HI criteria:
   a. ANSI/HI 11.6-2012 for Submersible Pumps in a Wet-pit or Dry-pit configuration.
   b. ANSI/HI 9.6.4-2009 for all other centrifugal pumps.
6. Repair or replace equipment shown to be out of range of the acceptable tolerance until the equipment meets or exceeds acceptability standards.
7. Utilize an Engineer approved testing agency to perform vibration monitoring and testing on equipment defined in the schedule at the end of this Section.
8. Permanently attach vibration test and monitoring mounting pads to the equipment at locations recommended by the equipment manufacturer or as recommended by the vibration testing agency.
9. Utilize mounting pads suitable for permanent installation and for incorporation into a predictable maintenance program.
10. For variable speed equipment provide vibration testing at 1 Hz increments of VFD speed throughout entire operating range.
11. Diagnosis to include, but is not limited to the following:
    a. Unbalance.
    b. Misalignment.
    c. Bent shaft.
    d. Journal bearing related problems.
    e. Rolling contract bearing problems.
    f. Mechanical looseness.
    g. Resonance.
    h. Foundation flexibility.
    i. Electrically induced problems.
    j. Pump problems.
    k. Fan problems.
    l. Coupling problems.
    m. Drive belt problems.
    n. Gear problems.
    o. Centrifugal compressor problems.
    p. Electric motor induced vibration from VFD or VFD carrier frequency.
    q. Natural frequency of the installed equipment.
12. Provide machinery condition diagnosis based on an acceptable machinery vibration severity guide or machinery fault guide analysis provided by the testing agency, ISO 1940 Balance Quality Grade 6.3 as a minimum.
13. Tolerances for pumping equipment shall be per HI published standards.
14. Repair or replace equipment shown to be out of range of the specified tolerance until the equipment meets the specified normal operation range required in the machinery fault guide analysis.
15. Document testing with written report.
    a. Report to include initial testing results, acceptance criteria, corrective action taken to meet acceptance, verification of corrective action and acceptance report and baseline.
    b. Natural frequency of installed equipment utilizing an impact hammer.
    c. Report to include graphical plots of vibration signature for each test point at a scale which illustrates all vibration levels greater than 0.025 ips RMS.

3.7 DEMONSTRATION

A. Demonstrate equipment in accordance with Section 01 75 00.

END OF SECTION

SECTION 01 65 50
PRODUCT DELIVERY, STORAGE, AND HANDLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Scheduling of product delivery.
   2. Packaging of products for delivery.
   3. Protection of products against damage from:
      a. Handling.
      b. Exposure to elements or harsh environments.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.

C. Payment:
   1. No payment will be made to Contractor for equipment or materials not properly stored and insured or without approved Shop Drawings.
      a. Previous payments for items will be deducted from subsequent progress estimate(s) if proper storage procedures are not observed.

1.2 DELIVERY

A. Scheduling: Schedule delivery of products or equipment as required to allow timely installation and to avoid prolonged storage.

B. Packaging: Deliver products or equipment in manufacturer's original unbroken cartons or other containers designed and constructed to protect the contents from physical or environmental damage.

C. Identification: Clearly and fully mark and identify as to manufacturer, item, and installation location.

D. Protection and Handling: Provide manufacturer's instructions for storage and handling.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 PROTECTION, STORAGE AND HANDLING

A. Manufacturer's Instruction:
   1. Protect all products or equipment in accordance with manufacturer's written directions.
      a. Store products or equipment in location to avoid physical damage to items while in storage.
      b. Handle products or equipment in accordance with manufacturer's recommendations and instructions.
   2. Protect equipment from exposure to elements and keep thoroughly dry.
   3. When space heaters are provided in equipment, connect and operate heaters during storage until equipment is placed in service.

3.2 STORAGE FACILITIES

A. Temporary Storage Building:

1. Provide a weatherproof temporary storage building specifically for the purpose of providing for protection of products and equipment.
    a. Size building to accommodate anticipated storage items;
2. Equip building with lockable doors and lighting, and provide electrical service for equipment space heaters and heating or ventilation as necessary to provide storage environments acceptable to specified manufacturers.
3. Provide methods of storage of products and equipment off the ground.
4. Provide this structure within 60 days after Notice to Proceed.
    a. Locate building on-site where shown on the Drawings or in location approved by Engineer.
    b. Remove building from site prior to startup and demonstration period.

3.3 FIELD QUALITY CONTROL

A. Inspect Deliveries:
    1. Inspect all products or equipment delivered to the site prior to unloading.
        a. Reject all products or equipment that are damaged, used, or in any other way unsatisfactory for use on Project.

B. Monitor Storage Area: Monitor storage area to ensure suitable temperature and moisture conditions are maintained as required by manufacturer or as appropriate for particular items.

END OF SECTION

SECTION 01 71 14
MOBILIZATION AND DEMOBILIZATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Project mobilization and demobilization.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.

1.2 GENERAL

A. Mobilization work shall consist of preparatory work and operations necessary to be ready to perform the Work required under the Contract, and for other work and operations which must be performed, or costs incurred prior to the beginning of the Work.

B. Demobilization work shall consist of all activities and costs for transportation of personnel, equipment, and supplies necessary to demobilize the contractor from the site.

C. Mobilization and Demobilization shall not include mobilization or demobilization for specific items of work for which payment is provided elsewhere in the Contract.

D. When the Contract or proposed Schedule of Values includes a separate item for mobilization or demobilization, payment will include full compensation for the furnishings of all labor, materials, tools, equipment, administrative costs, and incidentals to mobilization or demobilization.

E. If additional mobilization and demobilization activities and costs are required during the performance of the Contract as a result of the changed, deleted, or added items of work for which the Contractor is entitled to an adjustment in Contract price, compensation for such costs shall be included in the price adjustment for the item of Work changed or added.

1.3 ITEMS INCLUDED

A. Mobilization costs shall be limited to the following items:
   1. Obtaining bonds and insurance.
   2. Obtaining required permits and licenses.
   3. Developing Project Work Schedule.
   4. Attending Preconstruction Conference.
   5. Processing Permits.
   6. Furnishing and installing signs.
   7. Any work that is necessary to provide access to the site, including, but not limited to, grading and clearing.
   8. Installing temporary construction power wiring.
   9. Necessary assembly and testing required prior to start of the Work.
   10. Establishment of all and other facilities necessary for the Work, including utilities and specified field offices.
   11. Providing for and establishing Contractor's work and storage yard.
   12. Movement of personnel, major equipment, supplies, and incidentals to the site.
   13. Cost incurred prior to the start of the Work which must be performed, such as a down payment on a long lead item.

B. Demobilization costs shall be limited to the following items:
   1. Disassembly, removal and site cleanup/repair of offices, buildings, and other facilities assembled on the site for the Contract.

2. Costs for final site cleanup, packaging of miscellaneous items for return to the yard and other project closeout related expenses.
3. Cost for final payment documents, and provision of Acknowledgement Certification Request, Bond, and Certificate of Completion.

C. The Owner will pay all costs for the Mobilization and Demobilization of all of the Contractor's personnel, equipment, supplies, and incidentals at the contract lump sum price as follows:
1. The Owner will pay no greater than 6 PCT of the original Contract Amount as a separate pay item for mobilization.
2. The Owner will pay no greater than 2 PCT of the original Contract Amount as a separate pay item for demobilization.
3. Owner will pay 50 PCT of the Mobilization lump sum price when 5 PCT of the original Contract Amount is earned.
4. Owner will pay the remaining 50 PCT of the Mobilization lump sum price when 10 PCT of the original Contract Amount is earned.
5. Owner will pay 25 PCT of the Demobilization lump sum price when all of the earthwork activities are completed.
6. Owner will pay 75 PCT of the Demobilization lump sum price when all closeout activities and documents are completed.
7. Furnish cost data and documentation to justify this portion of the bid if Owner believes that the percentages in this paragraph do not bear a reasonable relation to the cost of the work in this contract.
8. Failure to justify such price to the satisfaction of the Owner will result in payment as determined by the Owner, of:
   a. Actual mobilization costs at completion of mobilization.
   b. Actual demobilization costs at completion of demobilization; and.
   c. The remainder of this item in the final payment under this contract.
9. The Owner's determination of the actual costs in this paragraph is not subject to appeal.
10. This schedule of mobilization progress payments will not limit or preclude progress payments otherwise provided by the Contract.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 73 20
OPENINGS AND PENETRATIONS IN CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Methods of installing and sealing openings and penetrations in construction.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 05 50 00 - Miscellaneous Metals.
   4. Section 07 62 00 - Flashing and Sheet Metal.
   5. Section 07 84 00 - Firestopping.
   6. Section 07 92 00 - Joint Sealants.
   7. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. A36, Standard Specification for Carbon Structural Steel.
      b. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
      c. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
      d. A312, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
      e. A351, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
      f. A554, Standard Specification for Welded Stainless Steel Mechanical Tubing.
      g. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
      h. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
      i. A995, Castings, Austenitic-Ferritic (Duplex) Stainless Steel, for Pressure-Containing Parts.
   2. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC):
         1) Article 501, Class 1 Locations.
      b. 90A, Standard for Installation of Air Conditioning and Ventilating Systems.
      c. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

1.3 DEFINITIONS

A. Corrosive Areas: For the purpose of this specification section, the following areas are defined as corrosive:
   1. None.

B. Hazardous Areas: Areas shown in the Contract Documents as having Class I or Class II area classifications.

C. Washdown Areas: Areas having floor drains or hose bibbs.

1.4 SUBMITTALS

A. Shop Drawings:

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. For each structure provide dimensioned or scaled (minimum 1/8 IN = 1 FT) plan view drawings containing the following information:
    a. Vertical and horizontal location of all required openings and penetrations.
    b. Size of all openings and penetrations.
    c. Opening type.
    d. Seal type.
3. Manufacturer's installation instructions for standard manufactured products.

1.5 PROJECT SITE CONDITIONS

A. For purposes of this Project, water table level is elevation 50 ft BGS.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pipe Sleeves:
    1. Areas listed as Corrosive Areas in PART 1:
        a. Stainless steel, 304L or 316L.
        b. Penetrations 24 IN DIA or less: ASTM A269, ASTM A312 or ASTM A554, Schedule 40.
        c. Penetrations larger than 24 IN DIA: Stainless steel, ASTM A666, Minimum 1/4 IN thickness.
    2. All other Areas:
        a. Steel, Hot-dipped galvanized after fabrication.
        b. Penetrations 24 IN DIA or less: ASTM A53, Schedule 40.
        c. Penetrations larger than 24 IN DIA: ASTM A36, Minimum 1/4 IN thickness.

B. Backing Rod and Sealant: See Specification Section 07 92 00.

C. Modular Mechanical Seals:
    1. Acceptable manufacturers:
        a. Link-Seal.
    2. 304 or 316 stainless steel bolts, nuts and washers.

D. Firestopping Material: See Specification Section 07 84 00.

E. Sheet Metal Sleeves:
    1. Areas listed as Corrosive Areas in PART 1: Stainless steel: ASTM A240, Type 304L or 316L.
    2. All other areas: Galvanized steel: ASTM A653, G90.
    3. Minimum 12 GA.

F. Commercial Wall Castings:
    1. Ductile iron, ASTM A536.
    2. Grade equal to connecting piping system.

PART 3 - EXECUTION

3.1 FABRICATION

A. Fabricate pipe sleeves in accordance with Specification Section 05 50 00.

B. Fabricate sheet metal sleeves in accordance with Specification Section 07 62 00.

C. Provide waterstop plate/anchor flange for piping, ducts, castings and sleeves cast-in-place in concrete.
    1. For fabricated units, weld plate to sleeve, pipe, or ductwork.
    2. For commercial castings, cast water stop/anchor with wall pipe.

3. Plate is to be same thickness as sleeve, pipe, casting or ductwork.
4. For fabricated units, diameter of plate or flange to be 4 IN larger than outside diameter of sleeve, pipe or ductwork.
5. For commercial castings, waterstop/anchor size to be manufacturer standard.
6. Provide continuous around entire circumference of sleeve, pipe, or ductwork.

D. Factory or shop-coat painted components in accordance with Specification Section 09 96 00.

3.2 INSTALLATION AND APPLICATION

A. Firestopping materials used in fire-resistance rated construction shall be in full compliance with Specification Section 07 84 00.

B. Seal openings and penetrations in non-fire-resistance-rated construction in accordance with Specification Section 07 92 00.

C. Obtain prior approval from Engineer when any opening larger than 100 SQIN must be made in existing or newly completed construction.

D. Perform HVAC penetrations in accordance with NFPA 90A.

E. Perform electrical penetrations in accordance with NFPA 70, Article 501.

F. When mechanical or electrical work cannot be installed as structure is being erected, provide and arrange for building-in of boxes, sleeves, insets, fixtures or devices necessary to permit installation later.
   1. Lay out chases, holes or other openings which must be provided in masonry, concrete or other work.

G. Where pipes, conduits or ducts pass through floors in washdown areas, install sleeves with top 3 IN above finish floors.
   1. In non-washdown areas, install sleeves with ends flush with finished surfaces.

H. Size sleeves, blockouts and cutouts which will receive sealant seal such that free area to receive sealant is minimized and seal integrity may be obtained.

I. For insulated piping and ducts, size sleeves, blockouts and cutouts large enough to accommodate full thickness of insulation.

J. Where pipes, conduits or ducts pass through grating, provide banding at the entire perimeter of the opening.
   1. Metal grating: See Specification Section 05 50 00.

K. Where pipes, conduits or ducts are removed where passing through grating:
   1. Metal grating:
      a. Provide banding at perimeter and cover opening with 1/4 IN plate of the same material of the grating.
      b. See Specification Section 05 50 00.
   2. FRP grating:
      a. Provide full depth cover meeting same loading requirement as existing material or replace grating section.

L. Do not cut into or core drill any beams, joists, or columns.

M. Do not install sleeves in beams, joists, or columns.

N. Do not install recesses in beams, joists, columns, or slabs.

O. Field Cutting and Coring:
   1. Saw or core drill with non-impact type equipment.
   2. Mark opening and drill small 3/4 IN or less holes through structure following opening outline.
   3. Sawcut opening outline on both surfaces.
      a. Knock out within sawcuts using impact type equipment.

b. Do not chip or spall face of surface to remain intact.
c. Do not allow any overcut with saw kerf.

P. Precast-Prestressed Concrete Construction:
1. Do not cut openings or core drill vertically or horizontally through stems of members.
2. Do not locate or install sleeves or recess sleeves vertically or horizontally through or in stems of members.
3. Cast openings and sleeves into flanges of units.
4. Cast openings larger than 6 IN in diameter or 6 IN maximum dimension in units at time of manufacture.
5. Cast openings smaller than 6 IN in diameter or 6 IN maximum dimensions in flanges of units at time of manufacture or field cut.

Q. Where alterations are necessary or where new and old work join, restore adjacent surfaces to their condition existing prior to start of work.

R. Where area is blocked out to receive sheet metal sleeve at later date:
1. If blockout size is sufficient to allow placement, utilize dowels for interface of initially placed concrete and sleeve encasement concrete which is placed later.
a. Size blockout based on sleeve size required plus 4 to 6 IN each side of sleeve for concrete encasement.
b. Provide #4 dowels at 12 IN spacing along each side of blockout with minimum of two dowels required per side.
2. If blockout size is not sufficient to allow placement of dowels, provide keyway along all sides of blockout.
a. Size blockout based on sleeve size required plus 2 to 4 IN each side of sleeve for concrete encasement.

S. For interior wall applications where backer rod and sealant are specified, provide backer rod and sealant at each side of wall.

T. Refer to Drawings for location of fire-rated walls, floors, and ceilings.
1. Utilize firestopping materials and procedures specified in Specification Section 07 84 00 IN conjunction with scheduled opening type to produce the required fire rating.

U. Use full depth expanding foam sealant for seal applications where single or multiple pipes, conduits, etc., pass through a single sleeve.

V. Do not make duct or conduit penetrations below high water levels when entering or leaving tankage, wet wells, or other water holding structures.

W. Modular Mechanical Seals:
1. Utilize one seal for concrete thickness less than 8 IN and two seals for concrete, 8 IN thick or greater.
2. Utilize two seals for piping 16 IN diameter and larger if concrete thickness permits.
3. Install seals such that bolt heads are located on the most accessible side of the penetration.

X. Backer Rod and Sealant:
1. Install in accordance with Specification Section 07 92 00.
2. Provide backer rod and sealant for modular mechanical seal applications.
a. Apply on top side of slab penetrations and on interior, dry side wall penetrations.

3.3 SCHEDULES

A. General Schedule of Penetrations through Floors, Roofs, Foundation Base Slabs, Foundation Walls, Foundation Footings, Partitions and Walls for Ductwork, Piping, and Conduit:
1. Provide the following opening and penetration types:
a. Type A - Block out 2 IN larger than outside dimensions of duct, pipe, or conduits.
b. Type B - Saw cut or line-drill opening. Place new concrete with integrally cast sheet metal or pipe sleeve.

c. Type C - Fabricated sheet metal sleeve or pipe sleeve cast-in-place. Provide pipe sleeve with water ring for wet and/or washdown areas.
d. Type D - Commercial type casting or fabrication.
e. Type E - Saw cut or line-drill opening. Place new concrete with integrally cast pipe, duct or conduit spools.
f. Type F - Integrally cast pipe, duct or conduit.
g. Type G - Saw cut or line-drill and remove area 1 IN larger than outside dimensions of duct, pipe or conduit.
h. Type H - Core drill.
i. Type I - Block out area. At later date, place new concrete with integrally cast sheet metal or pipe sleeve.
j. Type J - Grating Banding for any field cut openings.

2. Provide seals of material and method described as follows.
   a. Category 1 - Modular Mechanical Seal.
   b. Category 2 - Roof curb and flashing according to SMACNA specifications unless otherwise noted on Drawings. Refer to Specification Section 07 62 00 and roofing Specification Sections for additional requirements.
   c. Category 3 - 12 GA sheet metal drip sleeve set in bed of silicon sealant with backing rod and sealant used in sleeve annulus.
   d. Category 4 - Backer rod and sealant.
   e. Category 5 - Full depth compressible sealant with escutcheons on both sides of opening.
   f. Category 6 - Full depth compressible sealant and flanges on both sides of opening. Flanges constructed of same material as duct, fastened to duct and minimum 1/2 IN larger than opening.
   g. Category 7 - Full depth compressible sealant and finish sealant or full depth expanding foam sealant depending on application.
   h. Category 8 - Banding for all grating openings and banding and cover plate of similar materials for abandoned openings.
3. Furnish openings and sealing materials through new floors, roofs, grating, partitions and walls in accordance with Schedule A, Openings and Penetrations for New Construction.
4. Furnish openings and sealing materials through existing floors, grating, roofs, partitions and walls in accordance with Schedule B, Openings and Penetrations for Existing Construction.

SCHEDULE A. OPENINGS AND PENETRATIONS SCHEDULE FOR NEW CONSTRUCTION

APPLICATIONS	DUCTS		PIPING		CONDUIT	
	OPENING TYPE	SEAL CATEGORY	OPENING TYPE	SEAL CATEGORY	OPENING TYPE	SEAL CATEGORY
Through floors with bottom side a hazardous location	C F I	7 Not Req 7	D F I (1)	Not Req Not Req 7	C F	7 Not Req
Through floors on grade above water table	C F I	4 Not Req 4	C F I (1)	7 Not Req 7	C F I (1)	4 Not Req 7
Through slab on grade below water table	F	Not Req	F	Not Req	F	Not Req
Through floors in washdown areas	C I	4 4	C H (2) I (1)	4 3 4	F H (2) I (1)	Not Req 3 7
Through walls where one side is a hazardous area	C F I	7 Not Req 7	D F I (1)	Not Req Not Req 7	C F	7 Not Req
Through exterior wall below grade above water table	C F I	7 Not Req 7	C D F I (1)	1 Not Req Not Req 1	F I (1)	Not Req 7
Through wall from tankage or wet well (above high water level) to dry well or dry area	C F I	7 Not Req 7	C D F H (2)	1 Not Req Not Req 1	C F H (2) I (1)	7 Not Req 7 7
Through wall from tankage or wet well (below high water level) to dry well or dry area	F	Not Req	F	Not Req	F	Not Req
Through exterior wall above grade	A B C	6 6 6	A B D H (2)	5 5 Not Req 5	C H (2)	5 4
Roof penetrations	A	2	A	2	A	2
Through interior walls and slabs not covered by the above applications	A C	4 4	A C	4 4	A C F	4 4 Not Req
Grating openings and penetrations	J	8	J	8	J	8

SCHEDULE B. OPENINGS AND PENETRATIONS SCHEDULE FOR EXISTING CONSTRUCTION

APPLICATIONS	DUCTS		PIPING		CONDUIT	
	OPENING TYPE	SEAL CATEGORY	OPENING TYPE	SEAL CATEGORY	OPENING TYPE	SEAL CATEGORY
Through floors with bottom side a hazardous location	B E	7 Not Req	B (1) E (3) H (2)	7 Not Req 7	B (1) E (3) H (2)	7 Not Req 7
Through floors on grade above water table	B	7	B	7	B	7
Through slab on grade below water table	E	Not Req	E	Not Req	E	Not Req
Through floors in washdown areas	G	3	G H (2)	3 3	G H (2)	3 3
Through walls where one side is a hazardous area	B E	7 Not Req	B (1) B (3) E H (2)	7 1 Not Req 7	B (1) (3) E H (2)	7 Not Req 7
Through exterior wall below grade above water table	B	7	B (1) B (3) H (2)	7 1 7	B (1) (3) H (2)	7 7
Through wall from tankage or wet well (above high water level) to dry well or dry area	B E	7 Not Req	B E H (2)	1 Not Req 1	B (1) (3) E H (2)	7 Not Req 7
Through wall from tankage or wet well (below high water level) to dry well or dry area	E	Not Req	E	Not Req	E	Not Req
Through exterior wall above grade	G	6	G (1) (3) H (2)	5 5	G (1) (3) H (2)	5 7
Roof penetrations	G	2	G (1) (3) H (2)	2	G	2
Through interior walls and slabs not covered by the above applications	G	4	G (1) (3) H (2)	4 4	G (1) (3) H (2)	4 4
Grating openings and penetrations	J	8	J	8	J	8

(1) Multiple piping 3 IN and smaller or multiple conduits.
(2) Single pipe 3 IN and smaller or single conduit.
(3) Single pipe or conduit larger than 3 IN.

END OF SECTION

SECTION 01 73 29
CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. General requirements for cutting and patching Work.

B. Scope:
   1. Contractor shall perform cutting and coring, and rough and finish patching of holes and openings in existing construction.
   2. Provide cutting, coring, fitting, and patching, including attendant excavation and fill, required to complete the Work, and to:
      a. remove and replace defective Work;
      b. remove samples of installed Work as specified or required for testing;
      c. remove construction required to perform required alterations or additions to existing construction;
      d. uncover the Work for Engineer's observation of covered Work, testing, or inspection by testing entities, or observation by authorities having jurisdiction;
      e. connect to completed Work not performed in proper sequence;
      f. remove or relocate existing utilities and piping that obstruct the Work in locations where connections are to be made;
      g. make connections or alterations to existing or new facilities.

C. Related Requirements:
   1. Section 03 31 30 - Concrete, Materials and Proportioning.
   2. Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.
   3. Section 09 96 00 - High Performance Industrial Coatings.

1.2 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Cutting and Patching Request:
      a. Submit written request to Engineer, well in advance of executing cutting or alteration that affects one or more of the following:
         1) Design function or intent of Project.
         2) Work of Owner or other contractors retained by Owner.
         3) Structural capacity or integrity of an element of the Project, building, or structure.
         4) Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
         5) Efficiency, operational life, maintenance, or safety of operational elements.
         6) Visual qualities of elements that will be exposed to view after completion of the Work.
      b. Request shall include:
         1) Identification of Project and Contract designation.
         2) Description of affected Work of Contractor and work of others (if any) retained by Owner.
         3) Necessity for cutting.
         4) Effect on work or operations of Owner and other contractors (if any) retained by Owner, and on structural and weatherproof integrity of Project, building, or structure.
         5) Description of proposed Work, indicating: scope of cutting and patching; trades that will execute the cutting and patching Work; materials and equipment to be

used; extent of refinishing; schedule of operations; alternatives (if any) to cutting and patching, and net effect on aesthetics following completion of finishing Work.
6) Indication of entity responsible for cost of cutting and patching, when applicable.
7) Written permission of other prime contractors (if any) whose work will or may be affected.

2. Recommendation Regarding Cutting and Patching:
   a. Should conditions of work or schedule indicate a change of materials or specified methods, furnish Submit written recommendation to Engineer including:
      1) Conditions indicating change.
      2) Recommendations for alternative materials or alternatives to specified methods.
      3) Material manufacturer's printed recommendations for the proposed product and recommendations of manufacturer's technical representative for the specific application(s). The latter shall be on technical representative's letterhead and shall explicitly indicate the Project and specific cutting and patching application(s) to which the recommendation(s) apply.
      4) Items required with request for approval of substitute, in accordance with the substitution request requirements of the Contract Documents.
3. Product Data:
   a. Submit manufacturer's published data for the protective compound to be applied to core-drilled surfaces and cut concrete surfaces.
   b. When not required under other Specifications sections, submit manufacturer's published data on materials to be used for finishing around the cut or patched area(s), together with indication of the location(s) where each is proposed for use.
   c. Furnish Submittals for patching materials under the associated Specifications section. Submittal to include letter of recommendation from product manufacturer's technical representative indicating on technical representative's letterhead, explicitly indicating:
      1) Project name and facility name;
      2) specific cutting and patching application(s) to which the recommendations apply;
      3) that product manufacturer's technical representative has personally observed and is familiar with conditions in the work area(s) of the subject cutting and patching;
      4) materials that are the subject of the Submittal are appropriate for the condition(s) of the proposed patch and will remain durable in the patch's final exposure upon Substantial Completion; and.
      5) patching material manufacturer's technical representative's recommendations for surface preparation, installation of patching material(s), and curing.

B. Informational Submittals: Submit the following:
1. Written Notification of Cutting and Patching:
   a. Furnish as a Submittal written indication designating the day and time that the construction associated with cutting and patching will be uncovered to allow for observation. Do not begin cutting or patching operations until submittal is accepted by Engineer.
2. X-ray Investigations:
   a. Proposed method of investigation. Submit and obtain Engineer's acceptance prior to performing x-ray inspections.
   b. Report of x-ray evaluation of slabs, floors, and walls to be cut or core-drilled.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials – General:
1. Provide materials that comply with the Contract Documents.
2. If not shown or indicated in the Contract Documents, use materials identical to existing materials affected by cutting and patching Work.

3. For exposed surfaces, use materials that visually match existing adjacent surfaces to fullest extent possible. If identical materials are unavailable or cannot be used, provide materials whose installed performance will equal or surpass that of existing materials.
4. Replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, using materials that do not void required or existing warranties.

B. Compound Applied to Core-Drilled Surfaces and Cut Concrete Surfaces:
1. After core-drilling or sawcutting (as applicable) and before installing the utility or equipment through the penetration, coat exposed concrete and exposed steel with solvent-free, two-component, protective, epoxy resin coating.
2. Color shall approximate the finish color of the existing surface to be coated.
3. Product and Manufacturer: Subject to compliance with the Contract Documents, the following products and manufacturers are acceptable:
a. Sikagard 62, by Sika Corporation.
b. Or equal.

C. Grout Materials:
1. Comply with Section 03 31 30 - Concrete, Materials and Proportioning.

D. Epoxy Bonding Adhesive:
1. Provide two-component, moister-insensitive adhesive manufactured for the purpose of bonding fresh concrete to hardened concrete.
2. Comply with Section 03 31 30 - Concrete, Materials and Proportioning.
3. Product and Manufacturer: Subject to compliance with the Contract Documents, the following products and manufacturers are acceptable:
a. Euco No.452 MV by Euclid Chemical Co.
b. Sikadur 32, Hi-Mod by Sika Corporation.
c. Or equal.

E. Epoxy Patch Material:
1. Product and Manufacturer: TBD.
2. Engage the manufacturer's representative to observe and recommend a suitable patching material of the actual construction conditions.
3. Subject to compliance with the Contract Documents, the following products and manufacturers are acceptable:
a. Depth of patch greater than 3/4 IN:
1) Five Star MP Epoxy Patch.
2) Or equal.
b. Depth of patch between 1/8 IN and 3/4 IN:
1) Five Star Fluid Epoxy.
2) Or equal

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examination and Assessment – General:
1. Examine surfaces to be cut or patched, and conditions under which cutting or patching will be performed before starting cutting or patching Work.
2. Report unsatisfactory or questionable conditions to Engineer in writing.
3. Do not proceed with cutting or patching Work until unsatisfactory conditions are corrected.

B. Non-Destructive Investigation:
1. In advance of cutting or coring through existing slabs or walls, use x-ray or other non-destructive methods accepted by Engineer to determine location of reinforcing steel, electrical conduits, and other items embedded in slabs and walls.
2. Submit to Engineer written report of findings of evaluation.

3. Perform x-ray investigation and submit results to Engineer sufficiently in advance of cutting Work to allow time to identify and implement alternatives, if changes to the Work are necessary because of conduit or other features in floor or wall.

3.2 PREPARATION

A. Provide temporary support required to maintain structural integrity of facilities, to protect adjacent work from damage during cutting, and to support the element(s) to be cut.

B. Protection of Existing Construction during Cutting and Patching:
   1. Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project and facility that will be exposed during cutting and patching operations.
   2. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
   3. Do not cut existing pipe, conduit, ductwork, or other utilities serving facilities scheduled to be removed or relocated until provisions have been made to bypass them.

3.3 CUTTING AND PATCHING – GENERAL

A. Perform cutting and coring in such manner that limits extent of patching required.

B. Structural Elements:
   1. Do not cut or patch structural elements in manner that would change the element's structural load-carrying capacity as load deflection ratio.

C. Operating Elements:
   1. Do not cut or patch operating elements in manner that would reduce their capacity to perform as intended.
   2. Do not cut or patch operating elements or related components in manner that would increase maintenance requirements or decrease operational life or safety.

D. Replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, using methods that do not void required or existing warranties.

E. Provide adequate temporary covering over openings (whether cut or core-drilled) where not in use. Avoid creating tripping hazards for openings provided in floors and slabs.

3.4 CORING

A. Use core-drilling to make penetrations through concrete and masonry walls, slabs, or arches, unless otherwise accepted by Engineer in writing.

B. Coring:
   1. Perform coring with non-impact rotary tool using diamond core-drills. Size holes for pipe, conduit, sleeves, equipment or mechanical seals, as required, to be installed through the penetration.
   2. Do not core-drill through electrical conduit or other utilities embedded in walls or slabs without approval of Engineer. To extent possible, avoid cutting reinforcing steel in slabs and walls.

C. Protection:
   1. Protect existing equipment, utilities, and adjacent areas from water and other damage caused by or resulting from core-drilling operations.
   2. After core-drilling and before installing the utility or equipment through the penetration, coat exposed concrete and steel with protective coating material indicated in Paragraph 2.1.B of this Specification Section. Apply protective coating in accordance with manufacturer's instructions.

D. Cleaning:
   1. After core-drilling, vacuum or otherwise remove slurry and tailings from the work area.

3.5 CUTTING

A. Cutting – General:
   1. Cut existing construction using methods least-likely to damage elements retained and adjoining construction and that provide proper surfaces to receive subsequent installation or repair.
   2. In general, use hand tools or small power tools suitable for sawing or grinding. When possible, avoid using hammering and avoid chopping. Carefully chip out concrete where necessary and as indicated in the Contract Documents.
   3. Cut holes and slots as small as possible, neatly to the size required, and with minimum disturbance of adjacent surfaces.
   4. Prior to starting cutting, provide adequate bracing of area to be cut.
   5. To avoid marring existing finished surfaces, cut or drill from exposed or finished side into concealed side.
   6. Use equipment of adequate size to remove the cut panel or "coupon".

B. Cutting – Concrete and Masonry:
   1. Cut through concrete and masonry using concrete wall saw with diamond saw blades.
   2. On both sides of the element being cut, provide for control of slurry generated during sawing.
   3. Concrete Cutting:
      a. Make openings by sawing through existing concrete. Core drill with 6 IN DIA core at the corners of openings to avoid overcutting at corners.
      b. When the cut-out concrete or "coupon" cannot be removed in one piece, or where concrete is too thick for saw to penetrate fully, break out concrete after initial saw cuts.
      c. Where saw cutting is not possible:
         1) Make openings by drilling holes around perimeter of required opening and subsequently carefully chip out concrete.
         2) Holes shall be sufficient in quantity to prevent damage to remaining concrete.
   4. Sizing and Repair of Cut Concrete Surfaces:
      a. Where reinforcing steel is cut, remove existing reinforcing steel back to 1.5 IN below concrete surface. When using heat or torching to remove ends of reinforcing steel, remove adjacent, heat-damaged concrete prior to patching. Sides of resulting hole to be patched shall be approximately perpendicular to finished concrete surface. Provide bonding adhesive on surfaces of resulting holes and fill resulting holes with non-shrink grout in accordance with the Contract Documents.
      b. Oversize required openings in existing concrete by one inch on all sides and build back to required opening size by providing epoxy grout bonded to existing concrete.
      c. Where oversizing the cut opening by one inch is not possible, cut the opening to the required dimensions. After cutting concrete and before installing subsequent construction on or through the opening, coat exposed concrete and steel with protective coating material indicated in Paragraph 2.1.B of this Specifications Section. Apply protective coating in accordance with manufacturer's instructions.
      d. Where indicated, finish remaining surfaces as indicated in Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.

3.6 PATCHING

A. Patching – General:
   1. Patch large openings to be filled with concrete in accordance with the Contract Documents. Before installing new concrete, apply bonding adhesive in accordance with manufacture's recommendations.
   2. Where large openings to be filled with concrete are indicated on the Drawings as requiring reinforcing steel, provide reinforcing steel as shown and indicated in the Contract Documents. Where openings in existing reinforced concrete are larger than 2 FT in diameter or 2 FT by 2 FT and the Drawings or elsewhere in the Contract Documents do not expressly require reinforcing steel for the opening, submit a request for interpretation to Engineer and obtain Engineer's response before proceeding.

3. Where concrete infill or grout repair materials are not used, patch using epoxy patch material indicated in Paragraph 2.1.D of this section unless otherwise indicated on Drawings.
4. Patch construction by filling, repairing, refinishing, closing-up, and similar operations following performance of other Work.
5. Patch with durable seams that are as inconspicuous as possible. Provide materials and comply with installation requirements indicated in the Contract Documents and the published installation instructions of the material's manufacturer.
6. Patch to provide airtight and watertight connections to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
7. Where feasible, test patched areas to demonstrate integrity of installation.

B. Restoration:
1. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in manner that eliminates evidence of patching and refinishing.
2. For continuous surfaces, refinish to nearest intersection.
3. For an assembly, refinish the entire unit that was patched.
4. Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.7 CLEANING

A. Cleaning and Restoration:
1. Perform cleaning promptly after associated cutting, coring, and patching.
2. Clean areas and spaces where cutting, coring, or patching were performed.
3. Clean piping, conduit, and similar constructions before applying paint or other finishing materials.
4. Restore damaged coverings of pipe and other utilities to original condition.

END OF SECTION

SECTION 01 74 00
CLEANING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for keeping the Site free of accumulations of waste materials during construction ("progress cleaning").
   2. Cleaning for Substantial Completion and prior to final inspection (collectively, "closeout cleaning").

B. Scope:
   1. Contractor shall perform cleaning during the Project, including progress cleaning, as condition precedent to Substantial Completion, upon completion of the Work, and as required by the General Conditions, as may be modified by the Supplementary Conditions, this Specifications section, and elsewhere in the Contract Documents.
   2. Maintain in a clean manner the Site, the Work, and areas adjacent to or affected by the Work.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. National Fire Protection Association (NFPA):
      a. 241, Safeguarding Construction, Alteration, and Demolition Operations.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 PROGRESS CLEANING

A. Progress Cleaning – General:
   1. Clean the Site, work areas, and other areas occupied by Contractor not less than weekly. Dispose of waste materials in accordance with the General Conditions, as may be modified by the Supplementary Conditions, and the following:
      a. Comply with NFPA 241 for removing combustible waste materials and debris.
      b. Do not hold non-combustible materials at the Site more than three days if the ambient air temperature is expected to rise above 80 DEGF. When ambient air temperature is less than 80 DEGF, dispose of non-combustible materials within seven days of their generation.
      c. Provide suitable containers for storage of waste materials and debris. Avoid generation of odors and creation of nuisances.
      d. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately.

B. Progress Cleaning – Site:
   1. Keep outdoor, dust-generating areas wetted down or otherwise control dust emissions.
   2. Not less than weekly, brush-sweep roadways and paved areas at the Site and adjacent areas used by construction vehicles or otherwise affected by construction activities.
   3. Comply with dust control requirements of Section 01 35 05 - Environmental Protection and Special Controls.

C. Progress Cleaning – Work Areas:
   1. Clean areas where the Work is in progress to maintain an extent of cleanliness necessary for proper execution of the Work and safety of personnel.

2. Remove liquid spills promptly. Where spills may have harmful effects on health, safety, protection of facilities, or the environment, immediately report spills to Owner, Engineer, and authorities having jurisdiction, in accordance with the Contract Documents and Laws and Regulations.
3. Where dust would impair proper execution of or quality of the Work, broom-clean or vacuum entire work area, as necessary.
4. Concealed Spaces: Remove waste material and debris from concealed spaces before enclosing the space.

D. Progress Cleaning – Installed Work:
1. Keep installed Work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of installed materials and equipment, using only cleaning agents and methods specifically recommended by material or equipment Supplier.
2. If Supplier does not recommend specific cleaning agents or methods, use cleaning agents and methods that are not hazardous to health and property and that will not damage or mar exposed surfaces.

E. Progress Cleaning – Exposed Surfaces:
1. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration until Substantial Completion.

F. Progress Cleaning – Cutting and Patching:
1. Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, trailings and cuttings, and similar materials.
2. Comply with Section 01 73 29 - Cutting and Patching, regarding cleaning during and after cutting and patching Work.
3. Thoroughly clean piping, ductwork, conduits, and similar features before applying patching material, paint, or other finishing materials.
4. Restore damaged insulation and coverings on piping, cutwork, and similar items to its pre-construction condition.

G. Cleaning of Hydraulic Structures:
1. Clean hydraulic structures that will contain fluid, such as tanks and channels, in accordance with this Specifications section.
2. Do not perform field quality control activities such as testing tanks, channels, and other hydraulic structures for leakage or disinfecting (where applicable), and do not apply for inspection for Substantial Completion for hydraulic structures, until the associated hydraulic structures are clean and free of all waste materials, and ready for intended use.

H. Waste Disposal:
1. Properly dispose of waste materials (including surplus materials, debris, rubbish, and other waste) off the Site or to the PRA building.
2. Do not burn or bury waste materials at the Site.
3. Remove waste material and rubbish from excavations before backfilling.
4. Do not discharge volatile or hazardous substances, such as mineral spirits, oil, or paint thinner, into storm sewers, gutters, sanitary sewers, or other location in the environment. Dispose of such materials in accordance with Laws and Regulations.
5. Do not discharge wastes to surface waters, drainage routes, or groundwater.
6. Contractor is solely responsible for complying with Laws and Regulations regarding storing, transporting, and disposing of waste generated by Contractor's operations or brought to the Site by Contractor.

I. During handling and installation of materials and equipment, clean and protect construction in progress and adjoining materials and equipment already in place. Apply protective covering where necessary or required for protection from damage or deterioration, until Substantial Completion.

J. Clean completed construction as frequently as necessary throughout the construction period.

3.2 CLOSEOUT CLEANING

A. Complete the following prior to requesting inspection for Substantial Completion:
   1. Clean and remove from the Site waste material (including rubbish and debris) and other foreign and undesirable items and substances.
   2. Sweep broom-clean paved areas suitable for access by vehicles.
   3. Remove spills and stains or petroleum, oils, solvents, other chemicals, and other foreign and undesirable deposits.
   4. Hose-clean sidewalks and loading areas.
   5. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
   6. Surface waterways and drainage routes (including storm sewers, gutters, and ditches) shall be open and clean.
   7. Repair pavement, roads, sod, and other areas affected by construction operations and restore to specified condition; if condition is not specified, restore to preconstruction condition.
   8. Clean exposed exterior and interior hard-surfaced finishes to dirt-free condition, free of spatter, grease, stains, fingerprints, films, and similar foreign and undesirable substances.
   9. Clean, wax, and polish wood, vinyl, and painted floors.
   10. Remove waste material and surface dust from limited-access spaces, including roofs, plenums, shafts, trenchway, equipment vaults, manholes, and similar spaces.
   11. In unoccupied spaces, sweep concrete floors broom-clean.
   12. Clean transparent materials, including mirrors and glazing in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
   13. Remove non-permanent tags and labels.
   14. Surface Finishes:
      a. Touch-up and otherwise repair and restore chipped, scratched, dented or otherwise marred surfaces to specified finish and match adjacent surfaces.
      b. Do not paint over “UL” or similar labels, including mechanical and electrical nameplates.
   15. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint, and mortar droppings, and other foreign or undesirable substances.
   16. Clean plumbing fixtures to sanitary condition, free of stains, including stains resulting from water exposure.
   17. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
   18. Clean lighting fixtures, lamps, globes, and reflectors to function with full efficiency. Replace temporary lamps provided in permanent fixtures. Replace existing lighting fixture components that are burned out or noticeably dimmed from use during construction. Replace defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
   19. Leave the Site clean, and in neat, orderly condition, satisfactory to Owner and Engineer.

B. Complete the following prior to requesting final inspection:
   1. After Substantial Completion of all the Work, following completion of items of incomplete or damaged Work (“punch list Work”), clean “punch list Work areas in accordance with Paragraph 3.2.A of this Specifications Section.
   2. Remove field offices, Contractor’s storage sheds, and remaining stockpiles and clean all such areas in accordance with Paragraph 3.2.B of this Specifications Section, and in accordance with Contract Documents for landscaping and restoration.

END OF SECTION

SECTION 01 75 00
CHECKOUT AND START-UP PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Administrative and procedural requirements for checkout and startup of equipment, systems, and facilities.

B. Scope:
   1. Contractor shall initially check out, start up, and place equipment and systems installed under the Contract into successful operation, in accordance with the material and equipment manufacturers' written instructions, Suppliers' recommendations at the Site, and the Contract Documents.
   2. Provide the following:
      a. All labor, tools, materials, and equipment required to complete equipment and system checkout and startup.
      b. Chemicals, lubricants, and other required operating fluids necessary for checkout, startup, and initial operation of the Work.
      c. Filters and other temporary or consumable items necessary for checkout, startup, and initial operation of the Work.
      d. Fuel, electricity, water, and other temporary utilities and temporary facilities necessary for checkout and startup of equipment and systems, unless otherwise specified.
   3. The General Conditions, as may be modified by the Supplementary Conditions, address requirements for documenting Substantial Completion.

C. Related Sections include but are not necessarily limited to:
   1. Section 01 33 04 - Operation and Maintenance Manuals
   2. Section 01 61 03 - Equipment - Basic Requirements.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate checkout and startup with other contractors, as necessary.
   2. Do not start up equipment or system(s) for continuous operation until all components of that equipment item or system, including instrumentation and controls, have been tested to the extent practicable and proven to be operable as intended by the Contract Documents.
   3. Subject to the constraints of this Specifications section, Owner will furnish sufficient personnel to assist Contractor in starting up equipment and system(s), but responsibility for proper operation of the Work is Contractor's.
   4. Supplier shall be present during checkout, startup, and initial operation, unless otherwise acceptable to Engineer or otherwise required by the Contract Documents.
   5. For startup of heating equipment, air conditioning equipment, and other equipment and systems that provide temperature control, that are dependent upon the time of year, return to the Site at beginning of next heating or cooling season (as applicable) to recheck and start the appropriate equipment and system(s).
   6. Do not start up equipment and system(s), without submitting acceptable preliminary operations and maintenance manuals by Contractor in accordance with the Contract Documents.

B. Checkout and Startup Planning Meeting:

1. Contractor, with appropriate Subcontractors and Suppliers, shall attend and participate in a meeting with Owner, facility manager, and Engineer to discuss planning, scheduling, and coordination of checkout and startup activities.
2. Upon mutual concurrence of Owner, facility manager, Engineer, and Contractor, meeting may be concurrent with the training scheduling planning meeting
3. Meeting shall be held by the earlier of: (1) not less than 60 days prior to first scheduled training session for the equipment and system(s) to be checked out and started-up, and (2) not less than 60]days prior to the checkout and startup of the associated equipment and system(s).
4. Attend meeting prepared to knowledgably and effectively discuss:
    a. Status of the Work and schedule-to-complete for requirements prerequisite to checkout and startup.
    b. Schedule for and status of training required for each equipment item and system.
    c. Schedule for checkout, startup, and field quality control activities for the subject Work.
    d. Status and quantities of required consumables, lubricants, and utility services necessary for checkout and startup.
5. Meeting will be chaired by Engineer. Engineer will prepare and distribute a record of topics discussed and decisions made during the meeting. If meeting is concurrent with the training planning meeting, Contractor shall chair and prepare minutes of the training scheduling planning portion of the meeting and furnish its draft minutes to Engineer to incorporate into the overall minutes.
6. Comply with decisions made at the meeting and the Contract Documents.

C. Sequencing:
1. Comply with Section 01 14 16 - Coordination with Owner's Operations, regarding staging (phasing) of the Work and allowable shutdowns.

D. Scheduling:
1. Progress Schedule:
    a. Clearly indicate in the Progress Schedule planned and actual dates for checkout, startup, and field quality control activities, including all demonstration testing activities addressed in this Specifications section and elsewhere in the Contract Documents. Separately indicate checkout, startup, and field quality control activities for each equipment item and system.
    b. Perform startup and field quality control activities on the associated, scheduled dates, unless otherwise acceptable to Owner, facility manager, and Engineer.
2. Restrictions for Scheduling:
    a. Checkout of materials, equipment, and systems by Contractor that do not involve or require Owner's or facility manager's personnel may be performed at any time during normal working hours. Where required by the Contract Documents or requested by Engineer, perform checkout in the presence of Engineer or Resident Project Representative (RPR).
    b. Startup, including initial operation of materials, equipment, and systems, shall not be initiated on: Monday, Friday, Saturday, Sunday, Owen's holidays, the day immediately prior to a holiday, or the day immediately following a holiday, unless otherwise acceptable to Owner, facility manager, and Engineer.
    c. Unless otherwise indicated in the Contract Documents or acceptable to Owner, facility manager, and Engineer, perform all startup during normal working hours of the day shift.
    d. To the extent practicable, where extended-duration startup or field quality control activities are required by the Contract, avoid having such activities extend into evening, night, weekend, or holiday hours.
    e. Owner reserves the right to require a minimum seven days' notice of rescheduled startup when Contractor cannot perform the associated activities as scheduled.
3. Operation and Maintenance Data:
    a. Comply with Section 01 33 04 - Operation and Maintenance Manuals.

b. A preliminary copy of all operation and maintenance manuals shall be received by Engineer prior to the start of the demonstration period "OAT".

4. Training:
5. Spare Parts, Tools, and Extra Materials.
   a. Provide spare parts and extra materials, for furnishing spare parts, tools, and extra materials as recommended by fabricators.
   b. Deliver to Owner or facility manager (as applicable) all required spare parts, tools, and extra materials prior to commencing the demonstration period "OAT", unless earlier delivery is required elsewhere in the Contract Documents.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Do not start up equipment or systems or place into initial operation until required operating permits are obtained from authorities having jurisdiction.
   2. Where Owner (with or without assistance of Engineer) has applied for and obtained initial approvals or permits necessary for operation, Contractor shall furnish information and assistance to Owner or Engineer for Owner to secure final approvals from authorities having jurisdiction for required operating permits.

1.4 DEFINITIONS

A. The following defined terms are used in this Specifications Section:
   1. Instrumentation Supplier: Entity retained by Contractor, Subcontractor, or Supplier to furnish instrumentation or controls that will be part of the completed Work, including manufacturers, manufacturer representatives, wholesalers, retailers, and others, including entities retained to perform systems integration Work.
   2. Project Classified System (PCS): An established, distinct part of the Project, consisting of an arrangement of items, such as equipment, structures, components, piping, cabling, materials, and incidentals, so related or connected to form an identifiable, unified, functional, operational, safe, and independent system. PCSs may be specifically indicated in this Specifications section or elsewhere in the Contract Documents.
   3. Pre-Demonstration Period: The period of time, of unspecified duration after initial construction and installation activities during which Contractor, with assistance from manufacturer's representatives, performs in the following sequence:
      a. Finishing type construction work to ensure the Project or each PCS has reached a state of Substantial Completion.
      b. Equipment start-up.
      c. Personnel training.
   4. Demonstration Period: A period of time, of specified duration, following the Pre-Demonstration Period, during which the Contractor initiates system functionality through the facility and starts up and operates the facility, without exceeding specified downtime limitations, to prove the functional integrity of the mechanical and electrical equipment and components and the control interfaces of the respective equipment and components comprising the facility as evidence of Substantial Completion.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Data collection and reporting log for each required Demonstration Period.

B. Informational Submittals: Submit the following:
   1. Progress Schedules indicating dates for checkout, startup, and field quality control activates.
   2. Completed checkout and startup log required in Paragraph 3.2.C of this Specifications section.
   3. Manufacturer's installation check letters (also known as Manufacturer's Field Services Report) required in Paragraph 3.2.C of this Specifications section.
   4. Instrumentation Supplier's Instrumentation Installation Certificate, required in Paragraph 3.2.C of this Specifications section.

5. Letter verifying completion of all pre-demonstration startup activities, required in Paragraph 3.2.C of this Specifications section.
6. Report of data collected during each required Demonstration Period.
7. Qualifications Statements:
    a. Qualifications, including resume' and copy of license, of Contractor-retained licensed operator.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 CHECKOUT AND STARTUP – GENERAL

A. Facility Startup Divided into Two Periods:
    1. Pre-Demonstration Period including:
        a. Obtain Engineer's approval or acceptance (as applicable) of Submittals required prior to checkout and startup, including all Shop Drawings, Samples, source quality control (shop testing) Submittals, preliminary operation and maintenance manuals, and other Submittals required by the Contract Documents, other than Submittals that cannot be furnished until after startup.
        b. Complete the Work to a point ready for checkout and startup, including operation available in all manual, automatic, and other modes.
        c. Checkout and initial field quality control activities that can be performed prior to startup of the equipment or system.
        d. Startup of the associated Work.
        e. Field quality control activities for the subject Work as indicated elsewhere in the Specifications and other Contract Documents, other than this section.
        f. Training of operations and maintenance personnel.
    2. Demonstration Period, including:
        a. Demonstration of functional integrity of equipment, system, or PCS.

3.2 PRE-DEMONSTRATION PERIOD

A. Prior to the Pre-Demonstration Period, complete the Work to the point where it is ready for checkout and startup.

B. Checkout.
    1. Comply with Section 01 61 03 - Equipment - Basic Requirements, including provisions concerning installation checks

C. Startup:
    1. Comply with requirements for startup of materials, equipment, and systems indicated in the associated Specification sections and elsewhere in the Contract Documents.
    2. Prepare the Work so it will operate properly and safely and be ready to demonstrate functional integrity during the Demonstration Period.
    3. Perform startup to extent possible without introducing process flow.
    4. Introduce process flow to complete startup for the following:
        a. Fire suppression system, sanitary pumping systems, stormwater pumping systems, groundwater supply system, water supply system, electrical supply system.
    5. Procedures include but are not necessarily limited to the following:
        a. Test or check and correct deficiencies of:
            1) Power, control, and monitoring circuits for continuity prior to connection to power source.
            2) Voltage of all circuits.
            3) Phase sequence.
            4) Cleanliness of connecting piping systems.
            5) Alignment of connected machinery.

6) Vacuum and pressure of all closed systems.
7) Lubrication.
8) Valve orientation and position status for manual operating mode.
9) Tankage for integrity using clean water.
10) Pumping equipment using clean water.
11) Instrumentation and control signal generation, transmission, reception, and response.
12) Tagging and identification systems.
13) Proper connections, alignment, calibration and adjustment.

b. Calibrate safety equipment.
c. Manually rotate or move moving parts to assure freedom of movement.
d. "Bump-start" electric motors to verify proper rotation.
e. Perform other tests, checks, and activities required to make the Work ready for Demonstration Period.
f. Checkout and Startup Log:
1) Prepare a log showing each equipment item and system requiring checkout and startup. Indicate in the log activities to be accomplished during checkout and startup.
2) Provide a place for Contractor to record date and person performing required checkout and startup. Indicate associated date(s), personnel, and employer of each.
3) Submit completed checkout and startup log to Engineer and obtain Engineer's acceptance.

6. Obtain Suppliers' certifications of the installed and operational Work, without restrictions or conditions, and submit to Engineer:
a. Manufacturer's installation check letters (sometimes referred to as Manufacturer's Field Services Report).
b. Instrumentation Supplier's Instrumentation Installation Certificate.
7. Letter verifying completion of all pre-demonstration startup activities including receipt of all specified items from Suppliers as final item prior to initiation of Demonstration Period.
8. Personnel Training:

3.3 DEMONSTRATION PERIOD

A. Demonstration Period – General:
1. Demonstrate the operation and performance of mechanical, electrical, instrumentation, and control interfaces of the Work undergoing the Demonstration Period, in accordance with the Contract Documents.
2. Duration of Demonstration Period: 120 consecutive hours.
3. If, during the Demonstration Period, the aggregate time used for repair, alteration, or unscheduled adjustments to any part of the Work that renders the affected Work inoperative or operation outside of recommended ranges exceeds 10 PCT of the Demonstration Period, the demonstration of operation and performance will be deemed unacceptable and Contractor shall provide appropriate adjustments and remedies and re-perform the Demonstration Test, at no additional cost to Owner or facility manager, until acceptable results are obtained. Re-performance of the Demonstration Period shall comply with the same requirements as the original Demonstration Period.
4. Perform the demonstration of operation and performance of the Work under full operational conditions.
5. Owner's or Facility Manager's Personnel:
a. Owner or facility manager (as applicable) will make available operations personnel to make process decisions affecting facility performance and compliance with applicable operating permits.
b. Owner's or facility manager's assistance will be available only for process decisions.
c. Contractor will perform all other functions associated with the Demonstration Period including but not limited to equipment operation and maintenance until successful completion of the Demonstration Period in accordance with the Contract Documents.

6. Owner or facility manager reserves the right to simulate operational variables, equipment failures, routine maintenance scenarios, and similar actions and events during the Demonstration Period to verify the operation and performance of the Work in automatic, manual, and other types of operating modes, backup systems, and alternate operating modes.
7. Prior to Starting Demonstration Period:
    a. Prepare data collection and reporting log for sampling, analytical data, and data to be obtained by manually recording data from field or panel indicators. Not less than 30 days prior to the start of the Demonstration Period, submit the data collection and reporting log to Engineer for acceptance.
8. Timing of Start and End of Demonstration Period:
    a. Schedule the end of the Demonstration Period at a convenient time such as midnight, so the Owner or facility manager can assume operational responsibility on a new day beginning immediately after completion of the Demonstration Period.
    b. Time of beginning and ending Demonstration Period shall be agreed upon by Contractor, Owner (and facility manager, if other than Owner), and Engineer in advance of initiating Demonstration Period.

B. Demonstration Period, Evaluation, and Acceptance:
1. Throughout the Demonstration Period, provide knowledgeable personnel to answer Owner's or facility manager's questions, provide final field instruction on select systems (where appropriate) and to respond to problems or failures of the Work.
2. Responsibilities for Sampling and Data Collection:
    a. Use the data collection and reporting log format accepted by Engineer. Indicate data clearly and legibly.
3. Responsibilities for Data Reporting:
    a. Submit data collected to Engineer for evaluation of acceptability of results.
4. Data Evaluation:
    a. Engineer, in consultation with Owner and facility manager (as applicable) as necessary, will evaluate the data collected during the Demonstration Period and other information obtained during the Demonstration Period for compliance with the Contract Documents.
    b. Engineer will advise Contractor in writing of whether the data and information obtained indicate that the Demonstration Period was successfully completed.

END OF SECTION

SECTION 01 81 10
WIND AND SEISMIC DESIGN CRITERIA

PART 1 - GENERAL

1.1 SUMMARY

A. This Section is intended to be used for all aspects of this project. When there are conflicts between this Section and other wind and seismic design criteria given in the Contract Documents, the more stringent loading shall control unless clarified in writing during the Bid phase. Obtain clarification of all conflicts in writing prior to construction.

B. Section Includes:
   1. The wind and seismic design criteria for this project including all items directly specified in the Contract Documents as well as all items that are specified to be designed by the Contractor and submitted for approval. Items include but are not necessarily limited to the following:
      a. Anchorage of mechanical and electrical equipment.
      b. Anchorage of pipe support structures.
      c. Design and anchorage of tanks and vessels fabricated off site and shipped to Project site.
      d. Self-contained enclosures
      e. Self-Framing Building Systems.
      f. Pre-engineered and/or prefabricated Metal Building systems.
      g. Packaged equipment systems.
      h. Other structures or items as specified or indicated in the Contract Documents.

C. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Civil Engineers (ASCE):
      a. 7-16, Minimum Design Loads for Buildings and Other Structures.
   2. California Building Code (CBC):
      1) California Building Code and associated standards, 2019 Edition including all amendments, referred to herein as Building Code.
   3. When referenced standards conflict the most stringent shall apply unless specifically indicated otherwise in the Contract Documents or unless approved otherwise in writing by the Engineer.

B. Qualifications:
   1. Engineer for Contractor designed items: Professional Engineer licensed in the State of California.

1.3 GENERAL DESIGN CRITERIA

A. This paragraph is applicable to both wind and seismic design criteria.

B. Design in accordance with the requirements of the Building Code and all applicable referenced standards.

C. Risk Category: II.

D. Design in accordance with the Building Code load combinations for service level or factored level at Contractor's option.
   1. Mechanical and electrical equipment loads will be considered dead loads.

1.4 SEISMIC DESIGN CRITERIA

A. Seismic Design Load Criteria:
   1. Design spectral acceleration at short period: $S_{DS} = 0.45$.
   2. Design spectral acceleration at 1-second period: $S_{D1} = 0.23$.
   3. Importance Factor: Ie = 1.0.
   4. Seismic Design Category: D.
   5. Component or system amplification factor, (a_P) and Component response modification factor, (R_P): In accordance with ASCE 7-10, Tables 13.5-1 and 13.6-1.
   6. Component importance factor:
      a. In accordance with ASCE 7-16 Section 13.1.3: $I_P = 1.50$.
      b. All other components: $I_P = 1.00$.

B. Seismic forces must be resisted by direct load transfer through fasteners to all seismic resisting elements. Do not use connections that use friction to transfer seismic forces.

1.5 WIND DESIGN CRITERIA

A. Wind design load criteria:
   1. Basic wind speed: 94 MPH.
   2. Exposure category: C.
   3. Topographic factor: $K_{zt} = 1.0$.
   4. Building Description for wind design is Enclosed/Partially enclosed open, the most stringent one.

B. Wind forces must be resisted by direct load transfer through fasteners to wind resisting elements. Do not use connections that use friction to transfer wind forces.

1.6 SUBMITTALS

A. Informational Submittals:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Structural Calculations:
      a. Submit calculations for each Contractor designed item under the Specification Section number for that item.
      b. Indicate compliance with specific referenced documents of the Building Code.
      c. Provide basis of design and lateral analysis as required to derive all loads and to show system stability including compatibility of deflections and compatibility with allowable soil parameters as applicable.
      d. Indicate design load to each connection.
      e. Provide a complete lateral load resisting system that transfers all wind and seismic loads through a load path to ground.
      f. Sealed by a professional engineer licensed in the State the project is located in.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

END OF SECTION

DIVISION 02

EXISTING CONDITIONS

SECTION 02 21 13
SITE SURVEY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Underground utility locate.
   2. Measurement and mapping of all local site features, easements, utility locates and legal monuments.
   3. Photography of local site features and legal monuments.
   4. Mapping of all site easements.
   5. Placement of local control for transfer station site development.
   6. Placement of soil boring locations for geotechnical investigation.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. National Society of Professional Surveyors:
      a. Minimum Standard Detail Requirements for ALTA/NSPS Land Title Surveys, 2/16.
   2. Building code:
      a. International Code Council (ICC):
         1) International Building Code and associated standards, 2015 Edition including all amendments, referred to herein as Building Code.
   3. General:
      a. Furnish all necessary equipment, materials, and labor to effectively measure the site in accordance with these specifications. Additional local surveying requirements for local platting, mapping, etc., shall be researched and followed by the surveyor.
      b. The Contractor shall be responsible for all damage to public and private property resulting from the operations of its employees.
      c. The Contractor shall be responsible for gaining permission to access any site(s) required for surveying. Any site-specific training to access the property shall be the responsibility of the Contractor.

1.3 DEFINITIONS

A. "Contractor" shall mean person, firm, or corporation with whom Owner may enter into contract for execution of work specified relating to the Survey of the site.

1.4 SUBMITTALS

A. Topographical Survey:
   1. See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Submit to the Owner complete CAD files within 1 week after field visit.
   3. CAD file shall be AutoCAD Civil 3D files with 3D points and TIN (Triangulated Irregular Network) surfaces of topography included. All site features shall be drawn and included within CAD file. Contractor shall receive Owner approval to use different CAD software.
   4. TIN surface(s) shall be exported as individual .XML format files. XML files shall be delivered with CAD files.
   5. Point files of all field survey data, including control shall be delivered in .csv format. Any point code description data sets shall be included with point files.
   6. Submit PDF of the completed topography survey to the Owner.

B. Site Photos:
   1. Field survey photos shall be included with the topographical survey.

C. Site Staking:
   1. Provide site control staking as required for site development. Work with the Owner to determine amount of staking to be completed.
   2. Provide soil boring staking as required for geotechnical investigation drilling. Soil boring shall be clearly marked and labeled. Work with the Engineer to determine the location and quantity of boring staking.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION

3.1 SURVEY

A. The following shall be included in the final topography survey:

B. Survey datum and units: the vertical and horizontals datum shall meet state and local guidelines. The datum and units shall be provided with the survey, including coordinate system, foot units (international, U.S. survey), ground conversion factors (as applicable), etc.
   1. All surveys shall be spatially tied in and geo-referenced. A datum specific only to the development area shall not be used.
   2. The contractor shall provide all digital source data (i.e., for Trimble equipment, the .job file) and the RTK survey report.

C. Site topography including but not limited to:
   1. Existing ground topography shall be recorded with a maximum grid spacing of 30 FT. Topography shall be presented in 1 FT intervals unless otherwise noted.
   2. Grade breaks, including but not limited to: berms (tops and toes), depressions, ditches, swales, drainages, hills, rock piles, steep hill faces, topsoil piles, road shoulders, road centerlines, waterlines, wetlands, trees, shrubs, storm water ponds, sidewalks, curbs, and flow lines.
   3. All roads surrounding public and private roads shall be surveyed, including centerline, edge of asphalt, intersections, shoulder, culverts, and borrow ditches. Private access roads shall be provided, including two tracks (both tracks to allow for rebuilding if needed).
   4. Adjacent property topography information shall be provided up to 50 FT past the proposed development area, unless otherwise noted by the Owner. Additional topography past the initial development area shall include any utilities (road, storm water, electric) that may need updating due to proposed development.

D. Easements: All utility, property, landscape, road, road right-of-way, floodplain, and public and private easement information shall be included and displayed with the survey file for plat and/or site development. Road centerlines shall be provided for structure setback requirements.
   1. Research of site easements shall be the Contractor's responsibility prior to site surveying.
   2. Title reports shall be requested as needed by the Contractor.

E. Monuments: All monuments shall be clearly surveyed and labeled within survey file. All section corners and existing property pins shall be located. Section corners (minimum of three) shall be located or established for development of new property parcels. Research of monuments shall be the responsibility of the Contractor prior to site visit.

F. Control shall be clearly established on the site. Contractor will be responsible for establishing a minimum of three control points that can be located within the site development area. Control shall be clearly established in an area that will preserve the horizontal and vertical information. Marked rebar (12 IN minimum depth) shall be used for control points.

G. Underground utilities shall be located and surveyed in via "Call before you dig 811" locate services. All private and public underground utilities shall be located. Utilities survey information shall include the name of the corresponding utility company with the field marking.

H. Power and electrical utilities shall be located and surveyed. All power poles, anchors, electrical structures, etc., shall be surveyed. Overhead electric lines crossing the survey site shall have the next adjacent pole(s) in all directions surveyed in. Utility owner information shall be provided with survey.

I. Any additional surface utilities, including but not limited to: manholes, light structures, storm drains, fiber optics, railroads, inlets, utility boxes, hydrants, and valves shall be provided. Research of site utilities shall be completed prior to field survey visit.

J. All visible site structures, including but not limited to: buildings, fences, gates, junk piles, signs, mailboxes, concrete structures (top and bottom of concrete), walk paths, and cattle guards shall be surveyed.

K. Culverts shall be located and surveyed; inlets and outlet elevation shall be provided along with culvert size and type.

L. A 3D TIN surface shall be developed with the approved CAD software. Contractor shall review and prepare a 3D TIN surface to be used for grading and volume calculations.

M. Survey notes and legend information shall be included in survey deliverables.

N. Site photos shall include site features, including but not limited major structure, utilities or any additional items that may require removal to allow for site development. Adjacent roads, structures, property boundaries, etc., shall be photographed. All storm drains, culverts, and storm structures shall be clearly photographed.

3.2 WORKMANSHIP AND METHODS

A. Provide equipment capable of recording horizontal and vertical measurements within 1/100 FT degree of accuracy.

B. Contractor is responsible for meeting local surveying best practices and plat recording requirements.

C. Contractor is responsible for providing additional survey equipment if needed when GPS equipment may not be suitable.

D. Aerial surveys are not to be used unless requested and approved by the Owner.

END OF SECTION

DIVISION 03

CONCRETE

SECTION 03 05 05
CONCRETE TESTING AND INSPECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Contractor requirements for testing of concrete and grout.
   2. Definition of Owner provided testing.
   3. Acceptance criteria for concrete.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 03 21 00 - Reinforcement.
   4. Section 03 31 30 - Concrete, Materials and Proportioning.
   5. Section 03 31 31 - Concrete Mixing, Placing, Jointing and Curing.

1.2 RESPONSIBILITY AND PAYMENT

A. Owner will hire an independent Testing Agency/Service Provider to perform the following testing and inspection and provide test results to the Engineer and Contractor.
   1. Testing and inspection of concrete and grout produced for incorporation into the work during the construction of the Project for compliance with the Contract Documents.
   2. Additional testing or retesting of materials occasioned by their failure, by test or inspection, to meet requirements of the Contract Documents.
   3. Strength testing on concrete required by the Engineer or Inspector when the water-cement ratio exceeds the water-cement ratio of the typical test cylinders.
   4. In-place testing of concrete as may be required by Engineer when strength of structure is considered potentially deficient.
   5. Other testing services needed or required by Contractor such as field curing of test specimens and testing of additional specimens for determining when forms, form shoring or reshoring may be removed.
   6. Owner will pay for services defined in Paragraph 1.2A.1.
   7. See Specification Section 01 30 00.

B. Hire a qualified testing agency to perform the following testing and provide test results to the Engineer.
   1. Testing of materials and mixes proposed by the Contractor for compliance with the Contract Documents and retesting in the event of changes.
   2. Additional testing and inspection required because of changes in materials or proportions requested by Contractor.
   3. Pay for services defined in Paragraphs 1.2B.1. and 1.2B.2.
   4. Reimburse Owner for testing services defined in Paragraphs 1.2A.2., 1.2A.3., 1.2A.4. and 1.2A.5.
   5. See Specification Section 01 30 00.

C. Duties and Authorities of Testing Agency/Service Provider:
   1. Any Testing Agency/Service Provider or agencies and their representatives retained by Contractor or Owner for any reason are not authorized to revoke, alter, relax, enlarge, or release any requirement of Contract Documents, nor to reject, approve or accept any portion of the Work.
   2. Testing Agency/Service Provider shall inform the Contractor and Engineer regarding acceptability of or deficiencies in the work including materials furnished and work performed by Contractor that fails to fulfill requirements of the Contract Documents.

3. Testing Agency to submit test reports and inspection reports to Engineer and Contractor immediately after they are performed.
    a. All test reports to include exact location in the work at which batch represented by a test was deposited.
    b. Reports of strength tests to include detailed information on storage and curing of specimens prior to testing.
4. Owner retains the responsibility for ultimate rejection or approval of any portion of the Work.

1.3 QUALITY ASSURANCE

A. Referenced Standards:
    1. American Concrete Institute (ACI):
        a. 318, Building Code Requirements for Structural Concrete.
    2. ASTM International (ASTM):
        a. ASTM Cement and Concrete Reference Laboratory (CCRL).
        b. C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
        c. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
        d. C42, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
        e. C94, Standard Specification for Ready-Mixed Concrete.
        f. C138, Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
        g. C143, Standard Test Method for Slump of Hydraulic-Cement Concrete.
        h. C172, Standard Practice for Sampling Freshly Mixed Concrete.
        i. C173, Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
        j. C231, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
        k. C1019, Standard Test Method for Sampling and Testing Grout.
        l. C1218, Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
        m. E329, Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

B. Qualifications:
    1. Contractor's Testing Agency:
        a. Meeting requirements of ASTM E329 and ASTM C94.
        b. Provide evidence of recent inspection by CCRL of NBS, and correction of deficiencies noted.

C. Use of Testing Agency and approval by Engineer of proposed concrete mix design shall in no way relieve Contractor of responsibility to furnish materials and construction in full compliance with Contract Documents.

1.4 DEFINITIONS

A. Testing Agency/Service Provider: An independent professional testing/inspection firm or service hired by Owner to perform testing, inspection or analysis services as directed, and as provided in the Contract Documents.

1.5 SUBMITTALS

A. Shop Drawings:
    1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
    2. Product technical data including:
        a. Concrete materials and concrete mix designs proposed for use.
            1) Include results of all testing performed to qualify materials and to establish mix designs.

2) Place no concrete until approval of mix designs has been received in writing.
3) Submittal for each concrete mix design to include:
a) Sieve analysis and source of fine and coarse aggregates.
b) Test for aggregate organic impurities.
c) Proportioning of all materials.
d) Type of cement with mill certificate for the cement.
e) Brand, quantity and class of fly ash proposed for use along with other submittal data as required for fly ash by Specification Section 03 31 30.
f) Slump.
g) Brand, type and quantity of air entrainment and any other proposed admixtures.
h) Shrinkage test results.
i) Total water soluble chloride ion concentration in hardened concrete from all ingredients determined per ASTM C1218.
j) 28-day compression test results and any other data required by Specification Section 03 31 30 to establish concrete mix design.

3. Certifications:
a. Testing Agency qualifications.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION

3.1 TESTING SERVICES TO BE PERFORMED SERVICE PROVIDER/TESTING AGENCY

A. The following concrete testing will be performed by the Service Provider/Testing Agency:
1. Concrete strength testing:
a. Secure concrete samples in accordance with ASTM C172.
1) Obtain each sample from a different batch of concrete on a random basis, avoiding selection of test batch other than by a number selected at random before commencement of concrete placement.
b. For each strength test, mold and cure cylinders from each sample in accordance with ASTM C31.
1) Record any deviations from requirements on test report.
2) Cylinder size: Per ASTM C31.
a) 4 IN cylinders shall not be used for concrete mixes with maximum aggregate size larger than 1 IN.
b) Use the same size cylinder for all tests for each concrete mix.
3) Quantity:
a) 6 IN DIA by 12 IN high: Five (5) cylinders.
b) 4 IN DIA by 8 IN high: Six (6) cylinders.
c. Field cure one (1) cylinder for the seven (7) day test.
1) Laboratory cure the remaining.
d. Test cylinders in accordance with ASTM C39.
1) 6 IN DIA cylinders:
a) Test two (2) cylinders at 28 days for strength test result and the one (1) field cured sample at seven (7) days for information.
b) Hold remaining cylinder in reserve.
2) 4 IN DIA cylinders:
a) Test three (3) cylinders at 28 days for strength test result and the one (1) field cured cylinder at seven (7) days for information.
b) Hold remaining cylinders in reserve.
e. Strength test result:
1) Average of strengths of two (2) 6 IN DIA cylinders or three (3) 4 IN DIA cylinders from the same sample tested at 28 days.

2) If one (1) cylinder in a test manifests evidence of improper sampling, molding, handling, curing, or testing, discard and test reserve cylinder(s); average strength of remaining cylinders shall be considered strength test result.
3) Should all cylinders in any test show any of above defects, discard entire test.

f. Frequency of tests:
1) Concrete sand cement grout: One (1) strength test for each 4 HR period of grout placement or fraction thereof.
a) Test grout in accordance with ASTM C1019.
2) Concrete topping, concrete fill and lean concrete: One (1) strength test for each 10 CY of each type of concrete or fraction thereof placed.
3) All other concrete:
a) One (1) strength test to be taken not less than once a day, nor less than once for each 60 CY or fraction thereof placed in any one (1) day.
b) Once for each 5000 SQ FT of slab or wall surface area placed each day
c) If total volume of concrete on Project is such that frequency of testing required in above paragraph will provide less than five (5) strength tests for each concrete mix, tests shall then be made from at least five (5) randomly selected batches or from each batch if fewer than five (5) batches are provided.

2. Slump testing:
a. Determine slump of concrete sample for each strength test.
1) Determine slump in accordance with ASTM C143.
b. If consistency of concrete appears to vary, the Engineer or Owner's Representative shall be authorized to require a slump test for each concrete truck.
1) This practice shall continue until three consecutive batches are determined to be consistent and meet the slump requirements specified.
3. Air content testing: Determine air content of concrete sample for each strength test in accordance with either ASTM C231, ASTM C173, or ASTM C138.
4. Temperature testing: Determine temperature of concrete sample for each strength test.
5. In-place concrete testing (if required).

3.2 INSPECTIONS

A. As specified.
1. Inspections listed are for the Contractor reference only and is not part of the Contract Documents.
2. It is included to assist the Contractor in understanding the Owner-provided Services so that those services may be factored into the Contractor's pricing and schedule.

B. Formwork Inspections:
1. Shape, location, and dimensions.
a. Inspect in accordance with dimensions and details on Drawings.
b. Frequency: Inspect prior to each concrete pour.

C. Reinforcing Inspections:
1. Reinforcing size, spacing, lap length and concrete cover.
a. Inspect in accordance with Drawings and Specification.
b. Frequency: Inspect prior to each concrete pour.
2. Reinforcing adhesive anchoring system:
a. Inspect in accordance with ICC-ES report.
b. Frequency:
1) Inspect all adhesive anchors for the first 4 HRS of installation.
2) Inspect approximately 25 percent of adhesive anchors thereafter.
3) Additional inspection will be required for different installer or if the quality of installation appears to vary.
3. Mechanical splices:
a. Inspect in accordance with ICC-ES report.
b. Frequency:
1) Inspect all mechanical splices prior to placing concrete.

2) Additional inspection will be required for different installer or if the quality of installation appears to vary.

D. Mixing, Placing, Jointing, and Curing Inspections:
   1. Perform concrete tests per the requirements of this Specification Section.
   2. Verification of proper mix design.
      a. Frequency: Periodically, prior to each concrete pour.
   3. Proper concrete placement techniques.
      a. Inspect per requirements of Section 03 31 31.
      b. Frequency: During each concrete pour.
   4. Proper curing temperature and techniques.
      a. Inspect per requirements of Section 03 31 31.
      b. Frequency: Periodically, but not less than every third day.
   5. Joints:
      a. Inspect joints for proper joint type, dimensions, reinforcing, dowel alignment, surface preparation and location.
      b. Frequency: Prior to each concrete pour.
   6. Waterstops:
      a. Visually inspect waterstops for proper location, continuity, installation to prevent displacement, cleanliness and damage to waterstops.
      b. Frequency:
         1) Prior to each concrete pour.

E. Anchorage to Concrete Inspection:
   1. Post installed anchors as required by the Building Code, ICC-ES Evaluation Reports, and as specified by the Engineer.
      a. Frequency: Per ICC-ES Report.
   2. Cast-in-place concrete anchors, including anchor size, embedment, material and location.
      a. Frequency: Prior to each concrete pour.

3.3 SAMPLING ASSISTANCE AND NOTIFICATION FOR OWNER

A. To facilitate testing and inspection, perform the following:
   1. Furnish any necessary labor to assist Testing Agency in obtaining and handling samples at site.
   2. Provide and maintain for sole use of Testing Agency adequate facilities for safe storage and proper curing of test specimens on site for first 24 HRS as required by ASTM C31.
   3. Take samples at point of placement into concrete member.

B. Notify Owner's Testing Agency sufficiently in advance of operations (minimum of 24 HRS) to allow for assignment of personnel and for scheduled completion of quality tests.

3.4 ACCEPTANCE

A. Completed concrete work which meets applicable requirements will be accepted without qualification.

B. Completed concrete work which fails to meet one or more requirements but which has been repaired to bring it into compliance will be accepted without qualification.

C. Completed concrete work which fails to meet one or more requirements and which cannot be brought into compliance may be accepted or rejected as provided in these Contract Documents.
   1. In this event, modifications may be required to assure that concrete work complies with requirements.
   2. Modifications, as directed by Engineer, to be made at no additional cost to Owner.

D. Dimensional Tolerances:
   1. Formed surfaces resulting in concrete outlines smaller than permitted by tolerances shall be considered potentially deficient in strength and subject to modifications required by Engineer.

2. Formed surfaces resulting in concrete outlines larger than permitted by tolerances may be rejected and excess material subject to removal.
    a. If removal of excess material is permitted, accomplish in such a manner as to maintain strength of section and to meet all other applicable requirements of function and appearance.
3. Concrete members cast in wrong location may be rejected if strength, appearance or function of structure is adversely affected or misplaced items interfere with other construction.
4. Inaccurately formed concrete surfaces exceeding limits of tolerances and which are exposed to view, may be rejected.
    a. Repair or remove and replace if required.
5. Finished slabs exceeding tolerances may be required to be repaired provided that strength or appearance is not adversely affected.
    a. High spots may be removed with a grinder, low spots filled with a patching compound, or other remedial measures performed as permitted or required.

E. Appearance:
1. Concrete surfaces exposed to view with defects which, in opinion of Engineer, adversely affect appearance as required by specified finish shall be repaired by approved methods.
2. Concrete not exposed to view is not subject to rejection for defective appearance unless, in the opinion of the Engineer, the defects impair the long-term strength or function of the member.

F. High Water-Cement Ratio:
1. Concrete with water in excess of the specified maximum water-cement ratio will be rejected.
2. Remove and replace concrete with high water-cement ratio or make other corrections as directed by Engineer.

G. Strength of Structure:
1. Strength of structure in place will be considered potentially deficient if it fails to comply with any requirements which control strength of structure, including but not necessarily limited to following:
    a. Low concrete strength:
        1) Test results for standard molded and cured test cylinders to be evaluated separately for each mix design.
            a) Such evaluation shall be valid only if tests have been conducted in accordance with specified quality standards.
            b) For evaluation of potential strength and uniformity, each mix design shall be represented by at least three (3) strength tests.
            c) A strength test shall be the average of two (2) 6 IN diameter cylinders or three (3) 4 IN diameter cylinders from the same sample tested at 28 days.
        2) Acceptance:
            a) Strength level of each specified compressive strength shall be considered satisfactory if both of the following requirements are met:
                (1) Average of all sets of three (3) consecutive strength tests equal or exceed the required specified 28 day compressive strength.
                (2) No individual strength test falls below the required specified 28 day compressive strength by more than 500 PSI.
    b. Reinforcing steel size, configuration, quantity, strength, position, or arrangement at variance with requirements in Specification Section 03 21 00 or requirements of the Contract Drawings or approved Shop Drawings.
    c. Concrete which differs from required dimensions or location in such a manner as to reduce strength.
    d. Curing time and procedure not meeting requirements of this Specification Section.
    e. Inadequate protection of concrete from extremes of temperature during early stages of hardening and strength development.

f. Mechanical injury, construction fires, accidents or premature removal of formwork likely to result in deficient strength.
g. Concrete defects such as voids, honeycomb, cold joints, spalling, cracking, etc., likely to result in deficient strength or durability.

2. Structural analysis and/or additional testing may be required when strength of structure is considered potentially deficient.
3. In-place testing of concrete may be required when strength of concrete in place is considered potentially deficient.
   a. Testing by impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer to determine relative strengths at various locations in the structure or for selecting areas to be cored.
      1) Such tests shall not be used as a basis for acceptance or rejection.
   b. Core tests:
      1) Where required, test cores will be obtained in accordance with ASTM C42.
         a) If concrete in structure will be dry under service conditions, air dry cores (temperature 60 to 80 DEGF, relative humidity less than 60 PCT) for seven (7) days before test then test dry.
         b) If concrete in structure will be wet or subjected to high moisture atmosphere under service conditions, test cores after immersion in water for at least 40 HRS and test wet.
         c) Testing wet or dry to be determined by Engineer.
      2) Three (3) representative cores may be taken from each member or area of concrete in place that is considered potentially deficient.
         a) Location of cores shall be determined by Engineer so as least to impair strength of structure.
         b) If, before testing, one (1) or more of cores shows evidence of having been damaged subsequent to or during removal from structure, damaged core shall be replaced.
      3) Concrete in area represented by a core test will be considered adequate if average strength of three (3) cores is equal to at least 85 PCT of specified strength and no single core is less than 75 PCT of specified strength.
      4) Fill core holes with non-shrink grout and finish to match surrounding surface when exposed in a finished area.
4. If core tests are inconclusive or impractical to obtain or if structural analysis does not confirm safety of structure, load tests may be required and their results evaluated in accordance with ACI 318, Chapter 20.
5. Correct or replace concrete work judged inadequate by structural analysis or by results of core tests or load tests with additional construction, as directed by Engineer, at Contractor's expense.
6. Contractor to pay all costs incurred in providing additional testing and/or structural analysis required.

END OF SECTION

SECTION 03 11 13
FORMWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Formwork requirements for concrete construction.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 03 05 05 - Concrete Testing and Inspection.
   4. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.
   5. Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):
      a. CT-13, Concrete Terminology.
      b. 117, Specification for Tolerances for Concrete Construction and Materials.
      c. 347R, Guide to Formwork for Concrete.
   2. Building code:
      a. California Building Code (CBC):
         1) California Building Code and associated standards 2019 Edition including all amendments, referred to herein as Building Code.

B. Qualifications:
   1. Formwork, shoring and reshoring to be designed by a licensed professional engineer currently registered or having a minimum of three (3) years experience in this type of design work.
      a. Above qualifications apply to slabs and beams not cast on the ground.

C. Miscellaneous:
   1. Design and engineering of formwork, shoring and reshoring as well as its construction is the responsibility of the Contractor.
   2. Design requirements:
      a. Design formwork for loads, lateral pressures and allowable stresses outlined in ACI 347R and for design considerations, wind loads, allowable stresses and other applicable requirements of the controlling local Building Code.
         1) Where conflicts occur between the above two (2) standards, the more stringent requirements shall govern.
      b. Design formwork to limit maximum deflection of form facing materials reflected in concrete surfaces exposed to view to 1/240 of span between structural members.
   3. For slabs and beams not cast on the ground, develop a procedure and schedule for removal of shores and installation of reshores and for calculating the loads transferred to the structure during this process in accordance with ACI 347R.
      a. Perform structural calculations as required to prove that all portions of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its own weight plus the loads placed thereon. Calculations shall be performed by a licensed professional engineer.
      b. When developing procedure, schedule and structural calculations, consider the following at each stage of construction:
         1) The structural system that exists.
         2) Effects of all loads during construction.

3) Strength of concrete.
4) The influence of deformations of the structure and shoring system on the distribution of dead loads and construction loads.
5) The strength and spacing of shores or shoring systems used, as well as the method of shoring, bracing, shore removal, and reshoring including the minimum time intervals between the various operations.
6) Any other loading or condition that affects the safety or serviceability of the structure during construction.

1.3 DEFINITIONS

A. Words and terms used in these Specifications are defined in ACI CT-13.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for the requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Manufacturer and type of proposed form ties.

B. Samples:
   1. A 12 IN SQ sample of each of the following form finishes.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Forms for Surfaces Exposed to View:
   1. Wood forms:
      a. 5/8 or 3/4 IN 5-ply structural plywood of concrete form grade.
      b. Built-in-place or prefabricated type panel.
   2. Metal forms:
      a. Metal forms may be used except for aluminum in contact with concrete.
      b. Forms to be tight to prevent leakage, free of rust and straight without dents to provide members of uniform thickness.

B. Forms for Surfaces Not Exposed to View:
   1. Wood or metal sufficiently tight to prevent leakage.
   2. Do not use aluminum forms.

2.2 ACCESSORIES

A. Form Ties:
   1. Commercially fabricated for use in form construction.
      a. Field fabricated ties are unacceptable.
   2. Constructed so that ends or end fasteners can be removed without causing spalling at surfaces of the concrete.
   3. Embedded portion of ties to be not less than 1-1/2 IN from face of concrete after ends have been removed.
   4. Cone size:
      a. 3/4 IN minimum diameter cones on both ends.
      b. Depth of cone not to exceed the concrete reinforcing cover.
   5. Provide ties with built-in waterstops in all walls that will be in contact with below grade soil.
   6. Through-wall ties that are designed to be entirely removed are not allowed in all walls that will be in contact with process liquid during plant operation.

B. Void Forms:

1. Constructed from double faced corrugated cardboard or fiberboard which is wax impregnated and laminated with moisture-resistant adhesive.
2. Capable of resisting moisture with no loss of load carrying strength or change in depth or configuration.

PART 3 - EXECUTION

3.1 PREPARATION

A. Form Surface Treatment:
   1. Before placing of reinforcing steel or concrete, cover surfaces of forms with an approved release material that will effectively prevent absorption of moisture and prevent bond with concrete, will not stain concrete or prevent bonding of future finishes.
      a. A field applied form release agent or sealer of approved type or a factory applied nonabsorptive liner may be used.
   2. Do not allow excess form release material to stand in puddles in forms nor in contact with hardened concrete against which fresh concrete is to be placed.

B. Provide temporary openings at base of column and wall forms and at other points where necessary to facilitate cleaning and observation immediately before concrete is placed, and to limit height of free fall of concrete to prevent aggregate segregation.
   1. Temporary openings to limit height of free fall of concrete shall be spaced no more than 8 FT apart.

C. Clean surfaces of forms, reinforcing steel and other embedded materials of any accumulated mortar or grout from previous concreting and of all other foreign material before concrete is placed.

3.2 ERECTION

A. Install products in accordance with manufacturer's instructions.

B. Tolerances:
   1. Conform to ACI 117.
   2. Variation from plumb:
      a. In lines and surfaces of columns, piers, walls, and in risers.
         1) Maximum in any 10 FT of height: 1/4 IN.
         2) Maximum for entire height: 1/2 IN.
      b. For exposed corner columns, control-joint grooves, and other exposed to view lines:
         1) Maximum in any 20 FT length: 1/4 IN.
         2) Maximum for entire length: 1/2 IN.
   3. Variation from level or from grades specified:
      a. In slab soffits, ceilings, beam soffits and in arises, measured before removal of supporting shores.
         1) Maximum in any 10 FT of length: 1/4 IN.
         2) Maximum in any bay or in any 20 FT length: 3/8 IN.
         3) Maximum for entire length: 3/4 IN.
      b. In exposed lintels, sills, parapets, horizontal grooves, and other exposed to view lines:
         1) Maximum in any bay or in 20 FT length: 1/4 IN.
         2) Maximum for entire length: 1/2 IN.
   4. Variation of linear structure lines from established position in plan and related position of columns, walls, and partitions:
      a. Maximum in any bay: 1/2 IN.
      b. Maximum in any 20 FT of length: 1/2 IN.
      c. Maximum for entire length: 1 IN.
   5. Variation in sizes and location of sleeves, floor openings, and wall openings: Maximum of +1/2 IN.

6. Variation in horizontal plan location of beam, column and wall centerlines from required location: Maximum of +1/2 IN.
7. Variation in cross sectional dimensions of columns and beams and in thickness of slabs and walls: Maximum of -1/4 IN, +1/2 IN.
8. Footings and foundations:
    a. Variations in concrete dimensions in plan: -1/2 IN, +2 IN.
    b. Misplacement or eccentricity:
        1) 2 PCT of footing width in direction of misplacement but not more than 2 IN.
    c. Thickness:
        1) Decrease in specified thickness: 5 PCT.
        2) Increase in specified thickness: No limit except that which may interfere with other construction.
9. Variation in steps:
    a. In a flight of stairs:
        1) Rise: +1/8 IN.
        2) Tread: +1/4 IN.
    b. In consecutive steps:
        1) Rise: +1/16 IN.
        2) Tread: +1/8 IN.
10. Establish and maintain in an undisturbed condition and until final completion and acceptance of Project, sufficient control points and bench marks to be used for reference purposes to check tolerances.
11. Regardless of tolerances listed allow no portion of structure to extend beyond legal boundary of Project.
12. To maintain specified tolerances, camber formwork to compensate for anticipated deflections in formwork prior to hardening of concrete.

C. Make forms sufficiently tight to prevent loss of mortar from concrete.

D. Place 3/4 IN chamfer strips in exposed to view corners of forms to produce 3/4 IN wide beveled edges.

E. At construction joints, overlap contact surface of form sheathing for flush surfaces exposed to view over hardened concrete in previous placement by at least 1 IN.
    1. Hold forms against hardened concrete to prevent offsets or loss of mortar at construction joint and to maintain a true surface.
    2. Where possible, locate juncture of built-in-place wood or metal forms at architectural lines, control joints or at construction joints.

F. Where circular walls are to be formed and forms made up of straight sections are proposed for use, provide straight lengths not exceeding 2 FT wide.
    1. Brace and tie formwork to maintain correct position and shape of members.

G. Construct wood forms for wall openings to facilitate loosening, if necessary, to counteract swelling.

H. Anchor formwork to shores or other supporting surfaces or members so that movement of any part of formwork system is prevented during concrete placement.

I. Provide runways for moving equipment with struts or legs, supported directly on formwork or structural member without resting on reinforcing steel.

J. Provide positive means of adjustment (wedges or jacks) of shores and struts and take up all settlement during concrete placing operation.
    1. Securely brace forms against lateral deflection.
    2. Fasten wedges used for final adjustment of forms prior to concrete placement in position after final check.

3.3 REMOVAL OF FORMS

A. No construction loads shall be supported on, nor any shoring removed from, any part of the structure under construction except when that portion of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its weight and loads places thereon.

B. When required for concrete curing in hot weather, required for repair of surface defects or when finishing is required at an early age, remove forms as soon as concrete has hardened sufficiently to resist damage from removal operations or lack of support.

C. Remove top forms on sloping surfaces of concrete as soon as concrete has attained sufficient stiffness to prevent sagging.
   1. Perform any needed repairs or treatment required on such sloping surfaces at once, followed by curing specified in Specification Section 03 31 31.

D. Loosen wood forms for wall openings as soon as this can be accomplished without damage to concrete.

E. Formwork for columns, walls, sides of beams, and other parts not supporting weight of concrete may be removed as soon as concrete has hardened sufficiently to resist damage from removal.

F. Where no reshoring is planned, leave forms and shoring used to support weight of concrete in place until concrete has attained its specified 28 day compressive strength.
   1. Where a reshoring procedure is planned, supporting formwork may be removed when concrete has reached the concrete strength required by the formwork designer's structural calculations.

G. When shores and other vertical supports are so arranged that non-load-carrying form facing material may be removed without loosening or disturbing shores and supports, facing material may be removed when concrete has sufficiently hardened to resist damage from removal.

3.4 RESHORING

A. No construction loads shall be supported on, nor any shoring removed from, any part of the structure under construction except when that portion of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its weight and loads placed thereon.

B. While reshoring is underway, no superimposed dead or live loads shall be permitted on the new construction.

C. During reshoring do not subject concrete in structural members to combined dead and construction loads in excess of loads that structural members can adequately support.

D. Place reshores as soon as practicable after stripping operations are complete but in no case later than end of working day on which stripping occurs.

E. Tighten reshores to carry their required loads without overstressing.

F. Shoring, reshoring and supporting formwork may be removed when concrete has reached the concrete strength required by the formwork designer's structural calculations.

G. For floors supporting shores under newly placed concrete leave original supporting shores in place or reshore.
   1. Reshoring system shall have a capacity sufficient to resist anticipated loads.
   2. Locate reshores directly under a shore position above.

H. In multi-story buildings, extend reshoring over a sufficient number of stories to distribute weight of newly placed concrete, forms, and construction live loads in such a manner that design superimposed loads of floors supporting shores are not exceeded.

3.5 FIELD QUALITY CONTROL

A. Inspection:
   1. See Section 03 05 05.

END OF SECTION

SECTION 03 15 19
ANCHORAGE TO CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for all cast-in-place anchor bolts, anchor rods, reinforcing adhesive anchorage, and post-installed concrete anchors required for the Project but not specified elsewhere in the Contract Documents.
   2. Design of all concrete anchors not indicated on the Drawings including, but not limited to, installation of anchors into concrete for the following structural and nonstructural components:
      a. Structural members and accessories.
      b. Metal, wood, and plastic fabrications.
      c. Architectural components.
      d. Mechanical and electrical equipment and components.
      e. Plumbing, piping, and HVAC work.
      f. All other components requiring attachment to concrete.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 03 05 05 - Concrete Testing and Inspection.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):
      a. 318, Building Code Requirements for Structural Concrete and Commentary.
      b. 350, Code Requirements for Environmental Engineering Concrete Structures.
   2. American Concrete Institute/Concrete Reinforcing Steel Institute (ACI-CRSI):
      a. Adhesive Anchor Installation Certification Program: Adhesive Anchor Installer.
   3. American Institute of Steel Construction (AISC):
      a. 303, Code of Standard Practice for Steel Buildings and Bridges.
   4. ASTM International (ASTM):
      a. A36, Standard Specification for Carbon Structural Steel.
      b. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
      c. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
      d. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
      e. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
      f. A496, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
      g. A563, Standard Specification for Carbon and Alloy Steel Nuts.
      h. A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
      i. F436, Standard Specification for Hardened Steel Washers.
      j. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
      k. F594, Standard Specification for Stainless Steel Nuts.
      l. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

m. F2329, Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

5. ICC Evaluation Service (ICC-ES):
   a. AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.
   b. AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.
6. Building code:
   a. California Building Code (CBC):
      1) California Building Code and associated standards 2019 Edition including all amendments, referred to herein as Building Code.

B. Qualifications:
   1. Anchor designer for Contractor-designed post-installed anchors and cast in place anchorage shall be a professional civil or structural engineer licensed in the State that the Project is located in.
   2. Installer for post-installed anchors shall be trained by the manufacturer or certified by a training program approved by the Engineer.

C. Post-installed anchors and related materials shall be listed by the following agencies:
   1. ICC-ES.
   2. Engineer approved equivalent.

1.3 DEFINITIONS

A. Adhesive Anchors:
   1. Post-installed anchors developing their strength primarily from chemical bond between the concrete and the anchor.
   2. Includes anchors using acrylics, epoxy and other similar adhesives.

B. Anchor Bolt: Any cast-in-place anchorage that is made of a headed (i.e. bolt) material.

C. Anchor Rod: Any cast-in-place or post-installed anchorage made from unheaded, threaded, rod or deformed bar material.

D. Concrete Anchor: Generic term for either an anchor bolt or an anchor rod.

E. Galvanizing: Hot-dip galvanizing per ASTM A123, ASTM A153 or ASTM F2329 with minimum coating of 2.0 OZ of zinc per square foot of metal (average of specimens) unless noted otherwise or dictated by standard.

F. Hardware: As defined in ASTM A153.

G. Installer or Applicator:
   1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
   2. Installer and applicator are synonymous.

H. MPII: Manufacturer's printed installation instructions.

I. Mechanical Anchors:
   1. Post-installed anchors developing their strength from attachment other than thru adhesives or chemical bond to concrete.
   2. Includes expansion anchors, expansion sleeve, screw anchors, undercut anchors, specialty inserts and other similar types of anchorages.
   3. Drop-in anchors and other similar anchors are not allowed.

J. Post-Installed Anchor: Any adhesive or mechanical anchor installed into previously placed and adequately cured concrete.

1.4 SUBMITTALS

A. Shop Drawings:

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Product technical data including:
    a. Acknowledgement that submitted products meet requirements of referenced standards.
    b. Manufacturer material data sheet for each anchor.
        1) Clearly indicate which products on the data sheet are proposed for use on the Project.
    c. Manufacturer's printed installation instructions.
    d. Current ICC-ES report for each post-installed anchor system indicating the following:
        1) Certification that anchors meet all requirements indicated in this Specification.
        2) Performance data showing that anchor is approved for use in cracked concrete.
        3) Seismic design categories for which anchor system has been approved.
        4) Required installation procedures.
        5) Inspection requirements for installation.
    e. Anchorage layout drawings and details:
        1) Indicate anchor diameter, embedment, length, anchor type, material and finish.
        2) Drawings showing location, configuration, spacing and edge distance.
    f. Contractor Designed Post-Installed Anchors:
        1) Show diameter and embedment depth of each anchor.
        2) Indicate compliance with ACI 318, Chapter 17.
        3) Design tension and shear loads used for anchor design.
        4) Engineering design calculations:
            a) Indicate design load to each anchor.
            b) When the design load is not indicated on Drawings, include calculations to develop anchor forces based on Design Criteria listed herein.
            c) Sealed and signed by contractor's Professional Engineer licensed in the State that the Project is located in.
            d) Calculations will be submitted for information purposes only.
        5) Type of post-installed anchor system used.
            a) Provide manufacturer's ICC-ES report for the following:
                (1) Mechanical anchorage per ICC-ES AC193.
                (2) Adhesive anchorage per ICC-ES AC308.

B. Samples:
1. Representative samples of concrete anchors may be requested by Engineer. Review will be for type and finish only. Compliance with all other requirements is exclusively the responsibility of the Contractor.

C. Informational Submittals:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Certification of qualifications for each installer of post-installed anchors.
    a. Indicate successful completion or certification for each type of approved post-installed anchor as required by the Contract Documents.
    b. Provide one of the following for each type of anchor, as required by this specification section:
        1) Letter from manufacturer documenting successful training.
        2) Certification of completion for Engineer approved program.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to job site in manufacturer's or distributor's packaging undamaged and complete with installation instructions.

B. Store above ground on skids or other supports to keep items free of dirt and other foreign debris and to protect against corrosion.

C. Protect and handle materials in accordance with manufacturer's recommendations to prevent damage or deterioration.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cast-in-place Concrete Anchors:
   1. Building, nonbuilding structures, and equipment:
      a. ASTM F1554, Grade 36 or Grade 55 with weldability supplement S1 for galvanized threaded rods.
      b. ASTM A307, Grade A for galvanized headed bolts.
   2. All other cast-in-place concrete anchors:
      a. Stainless steel with matching nut and washer.
      b. Submerged application: ASTM F593, Type 316.
      c. Non-submerged application: ASTM F593, Type 304 or Type 316.

B. Post-Installed Mechanical and Adhesive Concrete Anchors:
   1. Stainless steel with matching nut and washer.
   2. Submerged application: ASTM F593, Type 316.
   3. Non-submerged application: ASTM F593, Type 304 or Type 316.

C. Reinforcement: See Section 03 21 00.

D. Headed Studs: ASTM A108 with a minimum yield strength of 50,000 PSI and a minimum tensile strength of 60,000 PSI.

E. Deformed Bar Anchors: ASTM A496 with minimum yield strength of 70,000 PSI and a minimum tensile strength of 80,000 PSI.

F. Washers:
   1. ASTM F436 unless noted otherwise.
   2. If stainless steel anchorage is being used for cast-in-place anchorage, furnish washers of the same material and alloy as in the accompanying anchorage.
   3. Plate washers: Minimum 1/2 IN thick fabricated ASTM A36 square plates as required.
   4. Follow manufacturer's requirements for all post-installed anchorage.

G. Nuts:
   1. ASTM A563 for all cast-in-place anchorage.
   2. If stainless steel anchorage is being used for cast-in-place anchorage, nuts shall meet ASTM F594 and be the matching material and alloy as in the accompanying anchorage.
   3. Follow manufacturer's requirements if using post-installed anchorage.

H. Galvanizing Repair Paint:
   1. High zinc dust content paint for regalvanizing welds and abrasions.
   2. ASTM A780.
   3. Zinc content: Minimum 92 PCT in dry film.
   4. ZRC "ZRC Cold Galvanizing" or Clearco "High Performance Zinc Spray."

I. Dissimilar Materials Protection: See Specification Section 09 96 00.

2.2 CONTRACTOR DESIGNED ANCHORAGE

A. Acceptable Manufacturers:
   1. Post-installed anchor systems for the listed manufacturers will be considered only if a current ICC-ES evaluation report is submitted in accordance with the SUBMITTALS Article in PART 1 of this Specification Section and if the anchor system is approved by the Engineer.
      a. Hilti.
      b. Dewalt.
      c. Simpson Strong-Tie.
   2. Submit request for substitution in accordance with Specification Section 01 25 13.

B. Design the anchorage when any of the following occur:
   1. Design load for concrete anchorage is shown on the Drawings.

2. When specifically required by the Contract Documents.
3. When an anchorage is required but not specified in the Drawings.
4. When anchorage is shown on Drawings other than Structural Drawings.

C. Anchorage Design Loads:
1. Determine all of the design loads, including wind and seismic loads, per the Building Code.
a. Anchorage of equipment and non-structural components: Use the actual dead and operating loads provided by the manufacturer.

D. When Contract Drawings, other than the Structural Drawings, indicate an anchor diameter or length, the Contractor design shall incorporate these as "minimums."

E. Cast-in-Place Concrete Anchors:
1. Provide the material, nominal diameter, embedment length, spacing, edge distance and design capacity to resist the calculated load based on the requirements given in the Building Code including ACI 318, Chapter 17.
2. Design assuming cracked concrete.

F. Post-installed Concrete Anchors:
1. Provide the manufacturer's system name/type, nominal diameter, embedment depth, spacing, minimum edge distance, cover, and design capacity to resist the specified or calculated load based on requirements given in the Building Code, ACI 318, Chapter 17, and current ICC-ES report, for the anchor to be used.
2. Design assuming cracked concrete.

2.3 ENGINEER DESIGNED ANCHORAGE

A. When the size, length and details of anchorages are shown on Contract Structural Drawings, Contractor design of anchorage is not required unless otherwise indicated.

B. Acceptable Manufacturers:
1. Additional newer post-installed anchor systems for the listed manufacturers will be considered only if a current evaluation agency report is submitted in accordance with the SUBMITTALS Article in PART 1 of this Specification Section, the anchor system is certified by ICC-ES for cracked concrete conditions, and if approved by the Engineer.
2. Mechanical Anchors:
a. Hilti:
1) Kwik Bolt TZ (ICC-ES ESR-1917).
3. Adhesive Concrete Anchors:
a. Hilti:
1) HIT RE 500 V3 (ICC ESR-3814).
4. Concrete Screw Anchors:
a. Hilti:
1) Kwik HUS-EZ Screw (ICC-ES ESR-3027).
5. Submit request for substitution in accordance with Specification Section 01 25 13.
a. Substitution request to indicate the proposed anchor has the at least the same tension and shear strength as the specified anchor installed as indicated in the Contract Drawings.
b. Calculations to be stamped by a professional civil or structural engineer registered in the state that the Project is located in.

PART 3 - EXECUTION

3.1 GENERAL

A. Cast-in-Place Anchorage:
1. Use where anchor rods or bolts are indicated on the Drawings, unless another anchor type is approved by the Engineer.

2. Provide concrete anchorage as shown on the Drawings or as required to secure components to concrete.

B. Adhesive Anchorage:
   1. Use only where specifically indicated on the Drawings or when approved for use by the Engineer.
   2. May be used where subjected to vibration or where buried or submerged.
   3. Do not use in overhead applications or sustained tension loading conditions such as utility hangers.
   4. Contact Engineer for clarification when anchors will not be installed in compliance with manufacturer's printed installation requirements.

C. Mechanical Anchorage:
   1. Use only where specifically indicated on the Drawings or when approved for use by the Engineer.
   2. Do not use where subjected to vibration.
   3. May be used in overhead applications.
   4. Contact Engineer for clarification when anchors will not be installed in compliance with manufacturer's printed installation requirements.

D. Do not use powder actuated fasteners and other types of bolts and fasteners not specified herein for structural applications unless approved by the Engineer or specified in Contract Documents.

3.2 PREPARATION

A. Provide adequate time to allow for proper installation and inspection prior to placing concrete for cast-in-place concrete anchorage.

B. Prior to installation, inspect and verify areas and conditions under which concrete anchorage is to be installed.
   1. Notify Engineer of conditions detrimental to proper and timely completion of work.
   2. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

C. Inspection is required in accordance with the Building Code for all concrete anchorage.
   1. Notify the Inspector that an inspection is required prior to concrete placement (or during post-installed anchorage installation).
   2. See the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section for additional requirements.

D. Post-installed anchor manufacturer’s representative shall demonstrate and observe the proper installation procedures for the post-installed anchors at no additional expense to the Owner.
   1. Follow such procedures to assure acceptable installation.
   2. Adhesive anchors must be installed in concrete aged a minimum of 21 days

3.3 INSTALLATION

A. Tie cast-in-place anchorage in position to embedded reinforcing steel using wire.
   1. Tack welding of anchorage is prohibited.
   2. Coat the projected portion of carbon steel anchors and nut threads with a heavy coat of clean grease after concrete has cured.
   3. Anchorage location tolerance shall be in accordance with AISC 303.
   4. Provide steel or durable wood templates for all column and equipment anchorage.
      a. Templates to be placed above top of concrete and not impede proper concrete placement and consolidation.

B. Unless noted or specified otherwise:
   1. Connect aluminum and steel members to concrete and masonry using stainless steel cast-in-place anchorage unless shown otherwise.
      a. Provide dissimilar materials protection per Specification Section 09 96 00.
   2. Provide washers for all anchorage.

3. Where exposed, extend threaded anchorage a maximum of 3/4 IN and a minimum of 1/2 IN above the top of the fully engaged nut.
    a. If anchorage is cut off to the required maximum height, threads must be dressed to allow nuts to be removed without damage to the nuts.

C. Do the following after nuts are snug-tightened down:
1. If using post-installed anchorage, follow MPII.
2. Upset threads of anchorage to prevent nuts from backing off.
    a. Provide double nut or lock nut in lieu of upset threads for items that may require removal in the future.
3. For all other cast-in-place anchorage material, tighten nuts down an additional 1/8 turn to prevent nuts from backing off.
4. If two (2) nuts are used per concrete anchor above the base plate, tighten the top nut an additional 1/8 turn to "lock" the two (2) nuts together.
5. If using post-installed anchorage, follow manufacturer's installation procedures.

D. Assure that embedded items are protected from damage and are not filled in with concrete.

E. Secure architectural components such that it will not be aesthetically distorted nor fasteners overstressed from expansion, contraction or installation.

F. Coat aluminum surfaces in contact with dissimilar materials in accordance with Specification Section 09 96 00.

G. Repair damaged galvanized surfaces in accordance with ASTM A780.
1. Prepare damaged surfaces by abrasive blasting or power sanding.
2. Apply galvanizing repair paint to minimum 6 mils DFT in accordance with manufacturer's instructions and ASTM A780.

H. For post-installed anchors, comply with the MPII on the hole diameter and depth required to fully develop the tensile strength of the anchor or reinforcing bar.
1. Use hammer drills to create holes.
2. Properly clean out the hole per the ICC-ES reports utilizing a non-metallic fiber bristle brush and compressed air or as otherwise required to remove all loose material from the hole prior to installing the anchor in the presence of the Inspector.

3.4 FIELD QUALITY CONTROL

A. Inspection:

1. See Section 03 05 05.

3.5 CLEANING

A. After concrete has been placed, remove protection and clean all anchorage of all concrete, dirt, and other foreign matter.

B. Provide surface acceptable to receive field applied paint coatings when specified in Specification Section 09 96 00.

END OF SECTION

SECTION 03 21 00
REINFORCEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Reinforcing bar requirements for concrete construction.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 03 05 05 - Concrete Testing and Inspection.
   4. Section 03 15 19 - Anchorage to Concrete.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):
      a. SP 66, ACI Detailing Manual.
      b. 117, Specification for Tolerances for Concrete Construction and Materials.
      c. 315, Manual of Standard Practice for Detailing Reinforced Concrete Structures.
      d. 318, Building Code Requirements for Structural Concrete.
   2. ASTM International (ASTM):
      a. A36, Standard Specification for Carbon Structural Steel.
      b. A276, Standard Specification for Stainless Steel Bars and Shapes.
      c. A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
      d. A706, Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
      e. A970, Standard Specification for Headed Steel Bars for Concrete Reinforcement.
      f. A1022, Standard Specification for Deformed and Plain Stainless Steel Wire and Welded Wire for Concrete Reinforcement.
      g. A1064, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
   3. Concrete Reinforcing Steel Institute (CRSI):
      a. Manual of Standard Practice.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Mill certificates for all reinforcing.
      d. Manufacturer and type of proprietary reinforcing mechanical splices.
   3. Qualifications of welding operators, welding processes and procedures.
   4. Reinforcing number, sizes, spacing, dimensions, configurations, locations, mark numbers, lap splice lengths and locations, concrete cover and reinforcing supports.
   5. Sufficient reinforcing details to permit installation of reinforcing.
   6. Reinforcing details in accordance with ACI SP 66 and ACI 315.
   7. Locations where proprietary reinforcing mechanical splices are required or proposed for use.

8. Shop Drawings shall be in sufficient detail to permit installation of reinforcing without reference to Contract Drawings.
    a. Shop Drawings shall not be prepared by reproducing the plans and details indicated on the Contract Drawings but shall consist of completely redrawn plans and details as necessary to indicate complete fabrication and installation of all reinforcing steel.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Support and store all reinforcing above ground.

B. Ship to jobsite with attached plastic or metal tags with permanent mark numbers which match the Shop Drawing mark numbers.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURES

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
    1. Reinforcing adhesive anchors:
        a. See Specification Section 03 15 19.
    2. Reinforcing mechanical splices:
        a. Lenton Rebar Splicing by Erico, Inc.
        b. Richmond dowel bar splicer system by Richmond Screw and Anchor Co., Inc.
        c. Bar-Grip Systems by Barsplice Products, Inc.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. Reinforcing Bars: ASTM A615, grade 60, deformed.

B. Reinforcing Bars to be Welded: ASTM A706.

C. Welded Wire Reinforcement: ASTM A1064.

D. Smooth Dowel Bars:
    .
    1. ASTM A36, with metal end cap to allow longitudinal movement equal to joint width plus 1 IN, unless noted otherwise.

E. Proprietary Reinforcing Mechanical Splices: To develop in tension and compression a minimum of 125 PCT of the yield strength of the reinforcing bars being spliced.

F. Headed Deformed Bars:
    1. ASTM A970, Class A.

G. Reinforcing Adhesive Anchors:
    1. See Specification 03 15 19.

2.3 ACCESSORIES

A. Chairs, Runners, Bolsters, Spacers, Hangers, and Other Reinforcing Supports:
    1. Metal fabrications with plastic-coated tips in contact with forms.
        a. Plastic coating meeting requirements of CRSI Manual of Standard Practice.
    2. All plastic construction meeting the requirements of CRSI Manual of Standard Practice.
        a. 100 PCT non-metallic, non-corrosive.
        b. Required for all walls and elevated construction exposed to liquid containing structures.

B. Protective plastic caps at mechanical splices.

2.4 FABRICATION

A. Tolerances:

1. Conforms to ACI 117, expect as modified herein.
2. Sheared lengths: +1 IN.
3. Overall dimensions of stirrups, ties and spirals: +1/2 IN.
4. All other bends: +0 IN, -1/2 IN.

B. Minimum diameter of bends measured on the inside of the reinforcing bar to be as indicated in ACI 318 Paragraph 7.2.

C. Ship reinforcing to jobsite with attached plastic or metal tags.
   1. Place on each tag the mark number of the reinforcing corresponding to the mark number indicated on the Shop Drawing.
   2. Mark numbers on tags to be so placed that the numbers cannot be removed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Tolerances:
   1. Conform to ACI 117, except as modified herein.
   2. Reinforcing placement:
      a. Clear distance to formed surfaces: +1/4 IN.
      b. Minimum spacing between bars: -1/4 IN.
      c. Top bars in slabs and beams:
         1) Members 8 IN deep or less: +1/4 IN.
         2) Members between 8 IN and 2 FT deep: -1/4 IN, +1/2 IN.
         3) Members more than 2 FT deep: -1/4 IN, +1 IN.
      d. Crosswise of members: Spaced evenly within +1 IN.
      e. Lengthwise of members: +2 IN.
   3. Minimum clear distances between reinforcing bars:
      a. Beams, walls and slabs: Distance equal to bar diameter or 1 IN, whichever is greater.
      b. Columns: Distance equal to 1-1/2 times the bar diameter or 1-1/2 IN, whichever is greater.
      c. Beam and slab reinforcing shall be threaded through the column vertical rebars without displacing the column vertical bars and still maintaining the clear distances required for the beam and slab reinforcing bars.

B. Minimum concrete protective covering for reinforcement: As shown on Drawings.

C. Unless indicated otherwise on Drawings, provide splice lengths for reinforcing as follows:
   1. For reinforcing: Class B splice meeting the requirements of ACI 318.
   2. For welded wire reinforcement:
      a. Splice lap length measured between outermost cross wires of each fabric sheet shall not be less than one (1) spacing of cross wires plus 2 IN, nor less than 1.5 x development length nor less than 6 IN.
      b. Development length shall be as required for the yield strength of the welded wire reinforcement in accordance with ACI 318.
   3. Provide splices of reinforcing not specifically indicated or specified subject to approval of Engineer.
      a. Mechanical proprietary splice connectors may only be used when approved or indicated on the Contract Drawings.

D. Welding:
   1. Welding reinforcing is not permitted.

E. Placing Reinforcing:
   1. Assure that reinforcement at time concrete is placed is free of mud, oil or other materials that may affect or reduce bond.
   2. Reinforcement with rust, mill scale or a combination of both will be accepted as being satisfactory without cleaning or brushing provided dimensions and weights including

heights of deformations on a cleaned sample is not less than required by applicable ASTM specification that governs for the reinforcing supplied.

3. Reinforcing support:
    a. Uncoated reinforcing:
        1) Support reinforcing and fasten together to prevent displacement by construction operations.
            a) Locate and support reinforcement with bar supports to maintain minimum concrete cover.
            b) Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
            c) Reinforcement shown on the Contract Documents may not be repositioned for use a support for reinforcement. Additional drop bars may be provided for support of reinforcing,
        2) Reinforcing supported on ground:
            a) Slab on grade and other members with only one mat of reinforcing:
                (1) Provide metal bar supports with bottom plate.
                (2) Do not use concrete blocks to support slab-on-grade reinforcing.
            b) All other members: Provide supporting concrete blocks or metal bar supports with bottom plate.
        3) Reinforcing supported on formwork:
            a) Concrete surfaces in contact with or over process liquid: All-Plastic chairs, runners and bar supports.
            b) All other formed surfaces:
                (1) Provide plastic-coated metal chairs, runners, bolsters, spacers, hangers and other reinforcing support.
                (2) Only tips in contact with the forms need to be plastic coated.
4. Support reinforcing over cardboard void forms by means of concrete supports which will not puncture or damage the void forms during construction nor impair the strength of the concrete members in any way.
5. Where parallel horizontal reinforcement in beams is indicated to be placed in two or more layers, bars in the upper layers shall be placed directly above bars in the bottom layer with clear distance between layers to be 1 IN.
    a. Place spacer bars at 3 FT maximum centers to maintain the required 1 IN clear distance between layers.
6. Extend reinforcement to within 2 IN of concrete perimeter edges.
    a. If perimeter edge is formed by earth extend reinforcement to within 3 IN of the edge.
7. To assure proper placement, furnish templates for all column vertical bars and dowels.
8. Do not bend reinforcement after embedding in hardened concrete unless approved by Engineer.
    a. Do not bend reinforcing by means of heat.
9. Do not tack weld reinforcing.
10. Embed reinforcing into hardened concrete utilizing adhesive anchor system specifically manufactured for such installation:
    a. See Specification Section 03 15 19.

3.2 FIELD QUALITY CONTROL

A. Reinforcement Congestion and Interferences:
    1. Notify Engineer whenever the specified clearances between bars cannot be met.
    2. Do not place any concrete until the Engineer submits a solution to reinforcing congestion problem.
    3. Reinforcing may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items.
    4. If bars are moved more than one bar diameter, obtain Engineer's approval of resulting arrangement of reinforcing.
    5. No cutting of reinforcing shall be done without written approval of Engineer.

B. Inspection:

1. See Section 03 05 05.

END OF SECTION

SECTION 03 31 30
CONCRETE, MATERIALS AND PROPORTIONING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Concrete materials, strengths and proportioning for concrete work.
   2. Grouting:
      a. Base plates for columns and equipment.
      b. As specified and indicated in the Contract Document.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 03 05 05 - Concrete Testing and Inspection.
   4. Section 03 15 19 - Anchorage to Concrete.
   5. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.
   6.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):
      a. CT-13, Concrete Terminology.
      b. 211.1, Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
      c. 212.3R, Chemical Admixtures for Concrete.
      d. 232.2R, Use of Fly Ash in Concrete.
      e. 318, Building Code Requirements for Structural Concrete.
   2. ASTM International (ASTM):
      a. C33, Standard Specification for Concrete Aggregates.
      b. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
      c. C94/C94M, Standard Specification for Ready-Mixed Concrete.
      d. C150, Standard Specification for Portland Cement.
      e. C157, Standard Test Method for Length Change of Hardened Hydraulic-Cement, Mortar, and Concrete.
      f. C192, Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.
      g. C260, Standard Specification for Air-Entraining Admixtures for Concrete.
      h. C227, Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method).
      i. C494, Standard Specification for Chemical Admixtures for Concrete.
      j. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
      k. C989, Standard Specification for Slag Cement for Use in Concrete and Mortars.
      l. C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).
      m. C1116, Standard Specification for Fiber-Reinforced Concrete.
      n. C1240, Standard Specification for Silica Fume Used in Cementitious Mixtures.
      o. C1260, Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).
      p. C1293, Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction.

q. C1399, Standard Test Method for Obtaining Average Residual-Strength of Fiber-Reinforced Concrete.
r. C1567, Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).
s. C1609, Standard Test Method for Flexural Performance of Fiber-Reinforced Concrete (Using Beam With Third-Point Loading).

3. Steel Deck Institute (SDI):
   a. 31, Design Manual for Composite Decks, Form Decks and Roof Decks.

1.3 DEFINITIONS

A. Words and terms used in these Specifications are defined in ACI CT-13.

B. Environmental Concrete: Any concrete surface to be in contact with trash or trash juice during normal operation of the facility, including, but not limited to, tipping floor.

C. Supplementary Cementitious Materials (SCM): Fly ash, silica fume and ground granulated blast furnace slag.

D. Ground Granulated Blast Furnace Slag (GGBFS).

1.4 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Product technical data including:
   a. Acknowledgement that products submitted meet requirements of standards referenced.
   b. Manufacturer's instructions.
   c. Concrete mix designs as required by Specification Section 03 05 05.
   d. Manufacturer and type of proposed admixtures.
   e. Manufacturer and type of proposed non-shrink grout and grout cure/seal compound.
3. Certifications:
   a. Certification of standard deviation value in psi for ready mix plant supplying the concrete.
   b. Certification that the SCM meet the quality requirements stated in this Specification Section, and SCM supplier's certified test reports for each shipment of SCM delivered to concrete supplier.
   c. Certification that the class of coarse aggregate meets the requirements of ASTM C33 for type and location of concrete construction.
   d. Certification of aggregate gradation.
   e. Certification of coarse aggregate impurities as relates to alkali-silica reactivity per ASTM C33, Appendix X.
   f. Certification of shrinkage test results.
4. Test reports:
   a. Cement and SCM mill reports for all cement to be supplied.
   b. Provide test results for alkali-silica reactive impurities on coarse aggregates per referenced ASTM standards.

1.5 DELIVERY, STORAGE AND HANDLING

A. Storage of Materials:
1. Store cement and SCM in weathertight buildings, bins, or silos which will exclude moisture and contaminants.
2. Arrange aggregate stockpiles and use in a manner to avoid excessive segregation and to prevent contamination with other materials or with other sizes of like aggregates.
3. Allow natural sand to drain until it has reached a relatively uniform moisture content before use.
4. Do not use frozen or partially frozen aggregates.

5. Do not use bottom 6 IN layer of stockpiled material in contact with ground.
6. Store admixtures in such a manner as to avoid contamination, evaporation, or damage.
    a. For those used in form of suspensions or non-stable solutions, provide agitating equipment to assure thorough distribution of ingredients.
    b. Protect liquid admixtures from freezing and temperature changes which would adversely affect their characteristics and performance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers are acceptable:
    1. Non-shrink grout:
        a. BASF Corporation.
        b. Euclid Chemical Company.
        c. Five Star Products, Inc.
    2. Epoxy grout:
        a. BASF Corporation.
        b. Five Star Products, Inc.
        c. Euclid Chemical Company.
        d. Sika Corporation.
    3. Synthetic fibers:
        a. GCP Applied Technologies, Inc.
        b. BASF Corporation.
        c. Euclid Chemical Company.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. Cement:
    1. ASTM C150, Type V (plus pozzolan or slag cement for the Tipping Floor) per ACI318 Table 19.3.2.1 for Exposure Class F3.
    2. Cement type used shall correspond to that upon which selection of concrete proportions was based in the mix design.

B. SCM:
    1. Fly Ash:
        a. ASTM C618, Class F or Class C.
        b. Non-staining.
        c. Suited to provide hardened concrete of uniform light gray color.
        d. Compatible with other concrete ingredients and having no deleterious effects on the hardened concrete.
        e. Produced by source approved by the State Highway Department in the state where the Project is located for use in concrete for bridges.
        f. Evaluate and use in accordance with ACI 232.2R.
    2. Silica fume:
        a. ASTM C1240.
        b. Acceptable manufacturers:
            1) BASF Corporation, MasterLife SF 100.
            2) Euclid Chemical Company, Eucon MSA.
            3) GCP Applied Technologies, Inc., Force 10,000.
    3. Ground Granulated Blast Furnace Slag:
        a. ASTM C989, Grade 100 or 120.
    4. Cement and SCM type used shall correspond to that upon which selection of concrete proportions was based in the mix design.

C. Admixtures:

1. Air entraining: ASTM C260.
2. Water reducing, retarding, and accelerating: Conform to ASTM C494, Types A through E, and provisions of ACI 212.3R.
3. High range water reducers (superplasticizers): Conform to ASTM C494, Types F or G.
4. All concrete mixes require the use of water reducers to maintain the specified water-to-cement ratios without additional cement.
5. SCM: Per above.
6. Admixtures to be chloride free.
    a. Do not use calcium chloride.
7. Provide admixtures of same type, manufacturer and quantity as used in establishing required concrete proportions in the mix design.
8. Provide admixtures certified by manufacturer to be compatible with other admixtures.
9. Shrinkage reducing admixtures:
    a. Admixture used to reduce the shrinkage of Portland C ement concrete.
    b. Utilize at dosage necessary to help achieve required shrinkage value stated herein.
    c. Similar to:
        1) Eclipse 4500 by GCP Applied Technologies, Inc.
        2) Conex by Euclid Chemical Co.
        3) MasterLife SRA 20 or MasterLife CRA 007 by BASF Corporation.

D. Macrosynthetic Fibers:
1. Conform to ASTM C1116.
2. Dosage to obtain a minimum average residual strength at a net deflection of L/150: PSI in accordance with ASTM C1609 and ASTM C1399.
3. Acceptable manufacturers:
    a. MasterFiber MAC Series by BASF Corporation.
    b. Strux 90/40 by GCP Applied Technologies, Inc.
    c. Tuf-Strand SF by Euclid Chemical Company.

E. Microsynthetic Fibers:
1. Conform to ASTM C1116.
2. Minimum average residual strength at a net deflection of L/150: PSI in accordance with ASTM C1609.
3. Acceptable manufacturers:
    a. BASF Corporation; MasterFiber F or M Series.
    b. Fiberstrand by Euclid Chemical Company.
    c. Gilco Fibers by GCP Applied Technologies, Inc.

F. Water:
1. Potable.
2. Clean and free from deleterious substances.
3. Free of oils, acids and organic matter.

G. Aggregates for Normal Weight Concrete:
1. ASTM C33.
2. Fine and coarse aggregates to be regarded as separate ingredients.
3. Concrete mix for **all tipping floor flat areas** as detailed on the Contract Documents shall include coarse aggregate of the appropriate size per below and complying with the following:
    a. Specific gravity: 2.91 (minimum) for bulk SSD condition.
    b. Maximum 13.5% abrasion loss according to ASTM C131, Grading B.
4. Coarse aggregate:
    a. Use only washed aggregates.
    b. Coarse aggregate sieve analysis:
        1) Per Table 1 IN the PART 2 MIXES Article.
5. Fine aggregates to be natural, not manufactured.
6. Do not use aggregates that may be deleteriously reactive when combined with alkalis in cement.

a. Evaluate proposed aggregates for potential deleterious expansion due to alkali silica reactivity per ASTM C33 (Appendix X), ASTM C227, ASTM C1260, ASTM 1293, or ASTM C1567.

7. Pozzolan or other additives shall not be used to compensate for alkali reactivity of aggregates.

H. Maximum total chloride ion content for concrete mix including all ingredients measured as a weight percent of cement in accordance with ASTM C1218:
   1. Prestressed concrete: 0.06.
   2. All other concrete: 0.10.

I. Sand Cement Grout (referred to as "Grout" on the Drawings):
   1. Approximately three (3) parts sand, one (1) part Portland cement, 6 $\pm$1 PCT entrained air and water to produce a slump which allows grout to completely fill required areas and surround adjacent reinforcing.
      a. Provide sand in accordance with requirements for fine aggregate for concrete.
   2. Minimum 28 day compressive strength:
      a. 3000 PSI.
      b. Shall be at least strength of parent concrete when used at construction joints or as patching grout.

J. Non-shrink Grout:
   1. Non-shrink, nonmetallic, noncorrosive, and nonstaining.
      a. Conform to ASTM C1107.
   2. Premixed with only water to be added in accordance with manufacturer's instructions at jobsite.
   3. Grout to produce a positive but controlled expansion.
      a. Mass expansion shall not be created by gas liberation or by other means.
   4. Minimum 28 day compressive strength: 7,000 PSI.
   5. Acceptable manufacturers:
      a. BASF Admixtures, Inc. "Masterflow, 713 IN.
      b. Euclid Chemical "NS Grout".
      c. Sika Corporation "Sika Grout 212 IN.
      d. Sauereisen, Inc. "F-100 Level Fill Grout".

K. Epoxy Grout:
   1. Three-component epoxy resin system:
      a. Two (2) liquid epoxy components.
      b. One (1) inert aggregate filler component.
   2. Adhesive acceptable manufacturers:
      a. BASF “Masterflow 648 IN.
      b. Five Start Products, Inc. "DP Five Start Epoxy Grout."
      c. Euclid Chemical "E3-G."
      d. Sika "Sikadur Hi-Mod."
   3. Aggregate acceptable manufacturers:
      a. BASF “Masterflow 648 IN.
      b. Five Start Products, Inc. "DP Five Start Epoxy Grout."
      c. Euclid Chemical "Euclid aggregate."
      d. Sika aggregate.
   4. Aggregate manufacturer shall be the same as the adhesive manufacturer.
   5. The aggregate shall be compatible with the adhesive.
   6. Each component furnished in separate package for mixing at jobsite.

L. See Specification Section 03 31 31 for Grout Schedule of use.

2.3 MIXES

A. General:

1. Provide concrete capable of being placed without aggregate segregation and, when cured, of developing all properties specified.
2. Ready-mixed concrete shall conform to ASTM C94/C94M.
3. All concrete to be normal weight concreteweighing approximately 145 to 150 LBS per cubic foot at 28 days after placement.

B. Concrete Mixes:
   1. See Table 1.

C. Air Entrainment:
   1. Provide air entrainment in concrete resulting in a total air content percent by volume per Table 1 below.
      a. Adjust dosage rate as necessary to compensate for shrinkage reducing admixtures.

D. Slump:
   1. Measure slump at point of discharge into concrete members.
   2. Walls and columns:
      a. 8 IN maximum, 4 IN minimum measured at the point of discharge into the concrete member.
      b. Slump shall be obtained by use of mid-range or high-range water reducer conforming to ASTM C494.
   3. All other members:
      a. Concrete using a water reducer per ASTM C494: 8 IN maximum, 4 IN minimum measured at the point of discharge into the concrete member.
      b. Concrete without a water reducer per ASTM C494: 5 IN maximum, 1 IN minimum measured at point of discharge into the concrete member.
   4. Concrete of lower than minimum slump may be used provided it can be properly placed and consolidated.
   5. Provide additional water or water reducing admixture at ready mix plant for concrete that is to be pumped to allow for slump loss due to pumping.
      a. Provide only enough additional water so that slump of concrete at discharge end of pump hose does not exceed maximum slump specified and the maximum specified water-cement ration is not exceeded.
   6. Slump may be adjusted in the field through the use of water reducers.
      a. Coordinate dosage and mixing requirements with concrete supplier.
   7. Slump tolerances shall comply with the requirements of ACI 117.

E. Proportioning:
   1. General:
      a. Proportion ingredients to produce a mixture which will work readily into corners and angles of forms and around reinforcement by methods of placement and consolidation employed without permitting materials to segregate or excessive free water to collect on surface.
      b. Proportion ingredients to produce proper placability, durability, strength and other required properties.
   2. Normal weight concrete target cementitious materials contents and maximum water cementitious ratios per Table 1 below.
      a. Target cementitious materials contents are intended to provide a crack free, durable finished product, not one with excessive strength
   3. SCM:
      a. Fly ash:
         1) For cast-in-place concrete only, a maximum of 25 PCT by weight of Portland cement content per cubic yard may be replaced with fly ash at a rate of 1 LB fly ash for 1 LB cement.
         2) If fly ash is used, the water to fly ash plus cement ratio not to exceed the maximum water cement ratio specified in this Specification Section.
         3) Concrete containing fly ash shall not be used in the construction of the precast concrete units.

b. Silica fume:
    1) Required for cast-in-place concrete for tipping floor walls and slabs.
    2) Apply at a rate of 4 percent by weight of all cementitious products.
    3) Maximum 10 PCT of total cementitious material by weight.

c. Ground Granulated Blast Furnace Slag:
    1) For cast-in-place concrete only, a maximum of 30 PCT by weight of Portland cement content per cubic yard may be replaced with GGBFS at a rate of 1 LB GGBFS for 1 LB cement.

d. Pozzolans;
    1) Total of fly ash or other pozzolans, slag, and silica fume shall be limited to 50 PCT of total cementitious material by weight.
    2) Total of fly ash or other pozzolans and silica fume shall be limited to 35 PCT of total cementitious material by weigh
    3) Fly ash or other pozzolans and silica fume shall constitute no more than 25 and 10 percent, respectively, of the total weight of the cementitious materials.

4. Water reducing, retarding, and accelerating admixtures:
    a. Use in accordance with manufacturer's instructions.
    b. Add to mix at batching plant.
    c. Use water-reducing or high-range water reducing admixture in concrete, as required, for placement and workability.
        1) Water reducers are required to maintain specified maximum water to cement ratios.
5. High range water reducers (superplasticizers):
    a. Use required for:
        1) All concrete to be pumped except slabs on grade.
        2) All concrete for water containing structures.
        3) Other concrete members at Contractor’s option.
    b. Use required for all non-pumped concrete except slabs on grade and foundations.
    c. Maximum concrete slump before addition of admixture to be 3 IN maximum slump after addition to be 8 IN.
    d. Reference Specification Section 03 31 31 for additional requirements.
6. Macrosynthetic Fiber or Micro Fiber:
    a. Dosage:
        1) Determined by Contractor and concrete supplier as required to meet the specified minimum average residual strength.
        2) Per ASTM C1399 and ASTM C1609.
        3) Under no circumstances shall dosage be less than:
            a) 4 LBS per cubic yard when used in concrete slabs on metal deck per SDI 31.
            b) 3 LBS per cubic yard for all specified locations.
    b.
7. Concrete mix proportioning methods for normal weight concrete:
    a. Method 1:
        1) Used when combination of materials proposed is to be evaluated and proportions selected to be on a basis of trial mixes.
        2) Produce mixes having suitable proportions and consistencies based on ACI 211.1, using at least three (3) different water cement ratios or cement contents which will produce a range of compressive strengths encompassing the required average strength.
        3) Design trial mixes to produce a slump within 0.75 IN of maximum specified, and for air entrained concrete, air content within 0.5 PCT specified.
        4) For each water cement ratio or cement content, make at least three (3) trial strength tests for specified test age, and cure in accordance with ASTM C192.
            a) Cylinder size: Per ASTM C31.
            b) Test for strength at 28 days in accordance with ASTM C39.
                (1) Quantity of cylinders per trial strength test:
                    (a) 6 IN DIA cylinders: Two (2).

(b) 4 IN DIA cylinders: Three (3).

5) From results of these tests, plot a curve showing relationship between water cement ratio or cement content and compressive strength.
6) From this curve select water cement ratio or cement content to be used to produce required average strength.
7) Use cement content and mixture proportions such that maximum water cement ratio is not exceeded when slump is maximum specified.
8) Base field control on maintenance of proper cement content, slump, air content and water cement ratio.
9) See paragraph hereafter for definition of required average strength.

b. Method 2:
1) In lieu of trial mixes, field test records for concrete made with similar ingredients may be used.
2) Use of proposed concrete mix proportions based on field test records subject to approval by Engineer based on information contained in field test records and demonstrated ability to provide the required average strength.
3) Field test records to represent materials, proportions and conditions similar to those specified.
a) Changes in the materials, proportions and conditions within the test records shall have not been more restricted than those for the proposed concrete mix.
b) Field test records shall meet the requirements of ACI 318 Paragraph 5.3.
4) Required concrete proportions may be established by interpolation between the strengths and proportions of two (2) or more test records each of which meets the requirements of this Specification Section.

8. Required average strength to exceed the specified 28 day compressive strength by the amount determined or calculated in accordance with ACI 318, Chapter 5 using the standard deviation of the proposed concrete production facility as described in ACI 318, Chapter 5.

F. Flowable Fill:
1. A mixture of cement, fly ash, fine sand, water and air having a consistency which will flow under a very low head.
2. Approximate quantities of each component per cubic yard of mixed material:
a. Cement (Type I or II): 50 LBS.
b. Fly ash: 200 LBS.
c. Fine sand: 2,700 LBS.
d. Water (approximate): 420 LBS.
e. Air content (approximate): 10 PCT.
3. Actual quantities shall be adjusted to provide a yield of 1 CY with the materials used.
4. Approximate compressive strength should be 85 to 175 PSI.
5. Fine sand shall be an evenly graded material having not less than 95 PCT passing the No. 4 sieve and not more than 5 PCT passing the No. 200 sieve.

G. Allowable Shrinkage:
1. Per Table 1 when tested in accordance with ASTM C157 at 28 Days.
2. Continue testing to 64 weeks for informational purposes.

TABLE 1

TYPE OF CONCRETE	28 DAY COMPRESSIVE STRENGTH	W/C RATIO (BY WEIGHT)	TARGET TOTAL CEMENT (LBS/CY)	SCM	ASTM C33 Size No.	AIR CONTENT	ALLOWABLE SHRINKAGE LIMIT

Normal weight lean concrete	3000 PSI	0.45	517	Note 1	7 (Max ½ IN)	0 to 2	
Normal weight concrete fill utility encasement concrete	4500 PSI	0.40	517	Note 1	57 (Max 1 IN)	6% +/- 1- 1/2%	0.048 PCT
Normal weight precast concrete	5000 PSI	0.40	611		57 (Max 1 IN)	6% +/- 1- 1/2%	0.048 PCT
Normal weight concrete Tipping Floor flat work	6000 PSI	0.38	658	Note 1	57 (Max 1 IN)	6% +/- 1%	0.040 PCT
Normal weight all other concrete	5000 PSI	0.40	564	Note 1	57 (Max 1 IN)	6% +/- 1%	0.048 PCT

Table 1 Notes:

1. If fly ash or GGBFS is proposed for use, the weight of SCM plus weight of Portland cement shall be used to meet total target cement requirement.

2.4 SOURCE QUALITY CONTROL

A. To assure stockpiles are not contaminated or materials are segregated, perform any test for determining conformance to requirements for cleanness and grading on samples secured from aggregates at point of batching.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Inspection:

1. See Specification Section 03 05 05.

B. Perform concrete tests per Specification Section 03 05 05.
   1. Perform a strength test on all concrete to which water or superplasticizer, above the amount stated in the approved concrete mix design, has been added.
      a. Perform sampling after water or superplasticizer has been added and additional mixing has been performed.

END OF SECTION

SECTION 03 31 31
CONCRETE MIXING, PLACING, JOINTING, AND CURING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Mixing, placing, jointing, and curing of concrete construction.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 03 05 05 - Concrete Testing and Inspection.
   4. Section 03 11 13 - Formwork.
   5. Section 03 21 00 - Reinforcement.
   6. Section 03 31 30 - Concrete, Materials and Proportioning.
   7. Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.
   8. Section 07 92 00 - Joint Sealants.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):
      a. CT-13, Concrete Terminology.
      b. 304R, Guide for Measuring, Mixing, Transporting and Placing Concrete.
      c. 304.2R, Placing Concrete by Pumping Methods.
      d. 305.1, Specification for Hot Weather Concreting.
      e. 306.1, Standard Specification for Cold Weather Concreting.
      f. 308.1, Specification for Curing Concrete.
      g. 309R, Guide for Consolidation of Concrete.
      h. 360R, Guide to Design of Slabs-on-Ground.
   2. ASTM International (ASTM):
      a. C94/C94M, Standard Specification for Ready-Mixed Concrete.
      b. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
      c. C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
      d. D994, Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
      e. D1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
      f. D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
   3. Corps of Engineers (COE):
      a. CRD-C572, Specifications for Polyvinylchloride Waterstop.
   4. National Ready Mixed Concrete Association (NRMCA):
      a. Checklist for Certification of Ready Mixed Concrete Production Facilities.
   5. NSF International (NSF).

B. Qualifications:
   1. Ready Mixed Concrete Batch Plant: Certified by NRMCA.
   2. Waterstop manufacturer's representative shall provide on-site training of waterstop installation, field splicing, welding and inspection procedures prior to construction, and at no additional cost.

1.3 DEFINITIONS

A. Words and terms used in this Specification Section are defined in ACI CT-13.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
         1) Procedure for adding high-range water reducer at the jobsite.
      c. Scaled (minimum 1/8 IN per foot) drawings showing proposed locations of construction joints, control joints, expansion joints (as applicable) and joint profile dimensions for each joint type.
      d. Manufacturers and types:
         1) Joint fillers.
         2) Curing agents.
         3) Construction joint bonding adhesive.
         4) Waterstops.
   3. Certifications:
      a. Ready mix concrete plant certification.

B. Informational Submittals:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Copies of concrete delivery tickets.
   3. Description of proposed curing methods.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Concrete Delivery:
   1. Prepare a delivery ticket for each load of ready mixed concrete.
   2. Truck operator shall hand ticket to Contractor at the time of delivery.
   3. Ticket to show:
      a. Mix identification.
      b. Quantity delivered.
      c. Amount of material in each batch.
      d. Outdoor temperature in the shade.
      e. Time at which cement was added.
      f. Time of delivery.
      g. Time of discharge.
      h. Amount of water that may be added at the site without exceeding the specified water-cement ratio.
      i. Amount of water added at the site.

1.6 PROJECT CONDITIONS

A. Adjust concrete mix design when material characteristics, job conditions, weather, strength test results or other circumstances warrant.
   1. Do not use revised concrete mixes until submitted to and approved by Engineer.

1.7 SEQUENCING AND SCHEDULING

A. Do not begin concrete production until proposed concrete mix design has been approved by Engineer.
   1. Approval of concrete mix design does not relieve Contractor of his responsibility to provide concrete that meets the requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Subject to compliance with the Contract Documents, the manufacturers listed in this article are acceptable.

B. Neoprene Expansion Joint Fillers:
   1. Acceptable manufacturers:
      a. Permaglaze.
      b. Rubatex.
      c. Williams Products.
   2. Materials:
      a. Closed cell neoprene.
      b. ASTM D1056, Type 2, Class A or C.
      c. Grade: Compression deflection as required to limit deflection to 25 PCT of joint thickness under pressure from concrete pour height.

C. Asphalt Expansion Joint Fillers:
   1. Acceptable manufacturers:
      a. W.R Meadows.
      b. J and P Petroleum Products.
   2. Materials: ASTM D994.

D. Fiber Expansion Joint Fillers:
   1. Materials: ASTM D1751.

E. Waterstops, PVC Type:
   1. Acceptable manufacturers:
      a. Greenstreak Plastic Products.
      b. W.R Meadows.
      c. Vinylex Corporation.
      d. Bometals, Inc.
   2. Materials:
      a. Virgin polyvinyl chloride compound not containing any scrap or reclaimed materials or pigment.
      b. Cast-in-place type: COE CRD-572.
   3. Approved profiles as listed.
      a. Construction joints:
         1) Ribbed: 6 IN wide by 3/8 IN.
         2) Greenstreak Plastic Products Style #679, or equal.
      b. Control joints:
         1) 6 IN wide by 3/8 IN thick with ribs and center bulb.
         2) Greenstreak Plastic Products Style #705, or equal.
   4. Provide factory-made waterstop fabrications at all changes in direction, intersections and transitions, leaving only straight butt splices for the field. Butt welds to be a minimum 6 IN from the intersection.
   5. Factory prepunched (12 IN centers, each edge) for wire supports.
      a. Provide hog rings or grommets at maximum 12 IN OC along the length of the waterstop at Contractor's option.
   6. See Drawings for application and other requirements.

F. Waterstops, Preformed Strip Type:
   1. Acceptable manufacturers:
      a. Greenstreak Plastics, Inc. (Hydrotite).
      b. Adeka Ultra Seal USA (MC-2010MN).
      c. DeNeef (Swellseal Plus).
   2. Hydrophilic, nonbentonite composition.

3. Manufactured solely for the purpose of preventing water from traveling through construction joints.
4. Volumetric expansion limited to 3 times maximum.
5. See Drawings for application and other requirements.

G. Water Swelling Sealant:
1. Compatible with strip-type waterstop.
2. Single component, gun applied.
3. Moisture cured.
4. Minimum 70 PCT volumetric expansion swelling capability.

H. Curing Products to conform to one or more of the following:
1. Absorbent Covers.
2. Moisture Retaining Covers.
a. Moisture Retaining Fabric.
3. Dissipating curing compound:
a. Fugitive dye, waterborne, membrane-forming.
b. ASTM C309, Type 1D, Class A or B, shall be composed of hydrocarbon resins, and dissipating agents that begin to break down upon exposure to UV light, and traffic, approximately four to six weeks after applications, providing a film that is removable with standard degreasing agents, and mechanized scrubbing actions so as to not impair the later addition and performance of applied finishes.
c. Acceptable Products:
1) DaytonSuperior Corporation; Day Chem Rez Cure (J-11-WD).
2) Euclid Chemical Company (The); Kurez DR VOX.
3) L&M Construction Chemicals, Inc.; L&M Cure R.
4. Clear, water-borne, membrane-forming curing and sealing compound:
a. ASTM C1315, Type 1, Class A.
b. Moisture loss shall be not more than 0.40 Kg/m^2 when applied at 300 SQFT/GAL.
c. Manufacturer's certification is required.
d. Subject to project requirements, provide one of the following products:
e. Products:
1) Euclid Chemical Company (The); Super Diamond Clear, Luster Seal 300 (exterior), Super Rez-Seal (interior).
2) L&M Construction Chemicals, Inc.; Lumiseal Plus.
3) Meadows, W.R., Inc.; CS-309/30.
4) Euclid Chemical Company (The); Super Diamond Clear VOX.
5) L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
6) Meadows, W.R., Inc.; Vocomp-30.

I. Vapor Retarder: See Specification Section 07 26 00.

J. Sand cement grout, non-shrink grout and epoxy grout: See Specification Section 03 31 30.

2.2 SOURCE QUALITY CONTROL

A. The concrete plant shall conform to the Checklist for Certification of Ready Mixed Concrete Production Facilities of the NRMCA.

PART 3 - EXECUTION

3.1 PREPARATION

A. General:
1. Complete formwork.
a. See Specification Section 03 11 13.
2. Remove earth, snow, ice, water, and other foreign materials from areas that will receive concrete.
3. Secure reinforcement in place.

a. See Specification Section 03 21 00.
4. Position expansion joint material, anchors and other embedded items.
5. Obtain approval of reinforcement erection and placement prior to placing concrete.
6. Do not place concrete during rain, sleet, or snow, unless adequate protection is provided and approval is obtained.
   a. Plan size of crews with due regard for effects of concrete temperature and atmospheric conditions on rate of hardening of concrete as required to obtain good surfaces and avoid unplanned cold joints.
   b. Do not allow rainwater to increase mixing water nor to damage surface finish.
7. Remove hardened concrete and foreign materials from inner surfaces of conveying equipment and formwork.
8. Provide slabs and beams of minimum indicated required depth when sloping structural foundation base slabs and elevated slabs to drains.
   a. For floor slabs on grade, slope top of subgrade to provide slab of required uniform thickness.

B. Preparation of Subgrade for Slabs On Ground:
1. Granular subgrade to be wetted without standing water immediately prior to placing concrete.
2. Obtain approval of granular subgrade compaction density prior to placing slabs on ground.

C. Edge Forms and Screeds:
1. Set accurately to produce designated elevations and contours of finished surface.
2. Sufficiently strong to support vibrating screeds or roller pipe screeds, if required.
3. Use strike off templates, or approved vibrating type screeds, to align concrete surfaces to contours of screed strips.

3.2 CONCRETE MIXING

A. General:
1. Provide all concrete from a central plant conforming to Checklist for Certification of Ready Mixed Concrete Production Facilities of the NRMCA.
2. Batch, mix, and transport in accordance with ASTM C94/C94M.

B. Control of Admixtures:
1. Control at the batch plant:
   a. All admixtures to be introduced at the batch plant in accordance with manufacturer's recommendations.
   b. Charge admixtures into mixer as solutions.
      1) Measure by means of an approved mechanical dispensing device.
      2) Liquid considered a part of mixing water.
      3) Admixtures that cannot be added in solution may be weighed or measured by volume if so recommended by manufacturer.
   c. Add separately, when two or more admixtures are used in concrete, to avoid possible interaction that might interfere with efficiency of either admixture, or adversely affect concrete.
   d. Complete addition of retarding admixtures within one minute after addition of water to cement has been completed, or prior to beginning of last three quarters of required mixing, whichever occurs first.
2. Control of Admixtures in the field:
   a. Additional quantities of admixtures (with the exception of retarders) may be added in the field provided:
      1) Addition of admixtures shall be under the supervision of the ready mix quality control representative.
      2) Addition of each admixture to be documented on the delivery ticket.
      3) Provide additional mixing per ASTM C94.

C. Tempering and Control of Mixing Water:
1. Mix concrete only in quantities for immediate use.

2. Discard concrete which has set.
3. Discharge concrete from ready mix trucks within time limit and drum revolutions stated in ASTM C94/C94M.
4. Addition of water at the jobsite:
    a. See Specification Section 03 31 30 for specified water cement ratio and slump.
    b. Do not exceed maximum specified water cement ratio or slump.
    c. Incorporate water by additional mixing equal to at least half of total mixing required.

3.3 PLACING OF CONCRETE

A. General:
1. Place concrete as such a rate that concrete, which is being integrated with fresh concrete, is still workable.
    a. Select placement equipment and manpower in order to assure timely delivery of concrete into forms to avoid cold joints and placement issues.
2. Comply with ACI 304R and ACI 304.2R.
3. Do not begin placing concrete during rain, sleet, or snow.
    a. Protect fresh concrete from ensuing inclement weather.
4. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials.
5. Begin work only when work of other trades affecting concrete is complete.
6. Deposit concrete:
    a. Continuously to avoid cold joints.
7. Locate construction joints at locations approved by Engineer.
    a. Plan size of crews with due regard for effects of concrete temperature and atmosphere conditions to avoid unplanned cold joints.
8. Spreaders:
    a. Temporary: Remove as soon as concrete placing renders their function unnecessary.
    b. Embedded:
        1) Obtain approval of Engineer.
        2) Materials: Concrete or metal.
        3) Ends of metal spreaders coated with plastic coating 2 IN from each end.
9. Deposit concrete as nearly as practicable in its final position to avoid segregation.
    a. Maximum free fall: 4 FT.
    b. Place concrete by means of hopper, elephant trunk or tremie pipe extending down to within 4 FT of surface placed upon.
10. Perform the following operations before bleeding water has an opportunity to collect on surface:
    a. Spread.
    b. Consolidate.
    c. Straightedge.
    d. Darby or bull float.
11. No water shall be added to the concrete surface to ease finishing operation.

B. Cold Weather Concrete Placement:
1. Comply with ACI 306.1.
2. Do not place concrete on subgrade that are below 32 DEGF or contain frozen material.
3. Maintain all materials, forms, reinforcement, subgrade and any other items which concrete will come in contact with free of frost, ice or snow at time of concrete placement.
4. Temperature of concrete when discharged at site: Per ACI 306.1.
5. Heat subgrade forms, embedments and reinforcement to between 45 and 70 DEGF, when temperature of surrounding air is 40 DEGF or below at time concrete is placed.
    a. Remove all frost from subgrade, forms and reinforcement before concrete is placed.
6. Combine water with aggregate in mixer before cement is added, if water or aggregate is heated above 90 DEGF.
7. Do not mix cement with water or with mixtures of water and aggregate having a temperature greater than 90 DEGF.

8. Follow ACI 360R-10 for specific requirements dealing with elevated steel troweled slabs that will be exposed to freeze-thaw cycles.

C. Hot Weather Concrete Placement:
   1. Comply with ACI 305.1.
   2. Cool ingredients before mixing, or add flake ice or well crushed ice of a size that will melt completely during mixing for all or part of mixing water if high temperature, low slump, flash set, cold joints, or shrinkage cracks are encountered.
   3. Temperature of concrete at point of delivery (i.e. truck discharge) when placed:
      a. Not to exceed 90 DEGF.
      b. Not so high as to cause:
         1) Shrinkage cracks.
         2) Difficulty in placement due to loss of slump.
         3) Flash set.
   4. Temperature of forms and reinforcing when placing concrete:
      a. Not to exceed 90 DEGF.
      b. May be reduced by spraying with water to cool below 90 DEGF.
         1) Leave no standing water to contact concrete being placed.
   5. Prevent plastic shrinkage cracking and/or slab curling due to evaporation.

D. Placing, Consolidating, and Curing for Tipping Floor Slab:
   1. General:
      a. Lightly tamp concrete to force coarse aggregate flush with finished surface. Screed with straightedge, eliminate high and low places, bring surface to required elevations.
   2. For Specific finishing requirements, reference Specification 03 35 00.
   3. Curing:
      a. Tipping Floor Slab shall be moisture cured.
      b. Provide curing for a minimum of seven days.

E. Consolidating:
   1. Consolidate in accordance with ACI 309R except as modified herein.
   2. Do not use vibrators, vibrating screeds, vibrating forms, or any other mechanical vibrating in the placement of the Tipping Floor concrete.
   3. Consolidate by vibration so that concrete is thoroughly worked around reinforcement, embedded items and into corners of forms.
      a. Eliminate:
         1) Air or stone pockets.
         2) Honeycombing or pitting.
         3) Planes of weakness.
   4. Use suitable form vibrators located just below top surface of concrete, where internal vibrators cannot be used in areas of congested reinforcing.
      a. Size and coordinate external vibrators to specifically match forming system used.
   5. Internal vibrators:
      a. Minimum frequency of 8000 vibrations per minute.
      b. Insert and withdraw at points approximately 18 IN apart.
         1) Allow sufficient duration at each insertion to consolidate concrete but not sufficient to cause segregation.
      c. Use in:
         1) Beams and girders of framed slabs.
         2) Columns and walls.
         3) Vibrating concrete around all waterstops.
      d. Size of vibrators shall be in accordance with ACI 309R, Table 5.1.5.
   6. Do not excessively vibrate or power screed concrete on all Tipping Floor flat areas with aggregate meeting ASTM C131, Grading B.
   7. Do not use vibrators to transport concrete within forms.
   8. Provide spare vibrators on jobsite during all concrete placing operations.

9. Bring a full surface of mortar against form by vibration supplemented if necessary by spading to work coarse aggregate back from formed surface, where concrete is to have an as-cast finish.
10. Prevent construction equipment, construction operations, and personnel from introducing vibrations into freshly placed concrete after the concrete has been placed and consolidated.

F. Handle concrete from mixer to place of final deposit by methods which will prevent segregation or loss of ingredients and in a manner which will assure that required quality of concrete is maintained.
   1. Use truck mixers, agitators, and non-agitating units in accordance with ASTM C94/C94M.
   2. Horizontal belt conveyors:
      a. Mount at a slope which will not cause segregation or loss of ingredients.
      b. Protect concrete against undue drying or rise in temperature.
      c. Use an arrangement at discharge end to prevent segregation.
      d. Do not allow mortar to adhere to return length of belt.
      e. Discharge conveyor runs into equipment specially designed for spreading concrete.
   3. Metal or metal lined chutes:
      a. Slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal.
      b. Chutes more than 20 FT long and chutes not meeting slope requirements may be used provided they discharge into a hopper before distribution.
      c. Provide end of each chute with a device to prevent segregation.
   4. Pumping or pneumatic conveying equipment:
      a. Designed for concrete application and having adequate pumping capacity.
      b. Control pneumatic placement so segregation is avoided in discharged concrete.
      c. Loss of slump in pumping or pneumatic conveying equipment shall not exceed 1-1/2 IN.
      d. Do not convey concrete through pipe made of aluminum or aluminum alloy.
      e. Provide pumping equipment without Y sections.

3.4 JOINTS AND EMBEDDED ITEMS

A. Construction Joints - General:
   1. Locate joints as indicated on Contract Drawings or as shown on approved Shop Drawings.
      a. Where construction joint spacing shown on Drawings exceeds the joint spacing indicated in Paragraph B. below, submit proposed construction joint location in conformance with this Specification Section.
   2. Unplanned construction joints will not be allowed.
      a. If concrete cannot be completely placed between planned construction joints, then it must be removed.
   3. In general, locate joints near middle of spans of slabs, beams and girders unless a beam intersects a girder at this point, in which case, offset joint in girder a distance equal to twice the width of the beam.
   4. Locate joints in walls and columns at underside of floors, slabs, beams, or girders, and at tops of foundations or floor slabs, unless shown otherwise.
      a. At Contractor's option, beam pockets may be formed into concrete walls.
      b. Size pockets to allow beam reinforcing to be placed as detailed on Drawings.
   5. Place beams, girders, column capitals and drop panels at same time as slabs.
   6. Place corbels monolithically with walls.
      a. Locate wall vertical construction joints midway between corbels.
      b. Where only a single corbel is located place it also monolithically with wall and locate wall vertical construction joint a minimum of 3 FT from face of corbel.
   7. Make joints perpendicular to main reinforcement with all reinforcement continuous across joints.
   8. Provide the following joints unless noted otherwise on Drawings:
      a. Roughen joints: horizontal construction joints.
      b. Keyed joints: vertical construction joints.

9. Roughen construction joints:
    a. Clean the previously hardened concrete interface and remove all laitance.
    b. Intentionally roughen the interface to a full amplitude of 1/4 IN.
10. Keyways:
    a. Construction joint keyways shall have the following dimensions, unless shown otherwise on Drawings.
    b. Wall keys:
        1) Keyway width, not less than 1/3 and not more than 1/2 the wall thickness measured perpendicular to wall faces.
        2) Keyway depth to be not less than 1-1/2 IN.
        3) Continuous along length of wall.
        4) Place keyway in wall center unless shown otherwise on Drawings.
    c. Keyways in footings, foundations, base slabs, and structural or elevated slabs:
        1) Keyway height not less than 1/3 and not more than 1/2 the footing or slab thickness.
        2) Keyway depth not less than 1-1/2 IN.
        3) Continuous along footing or slab.
        4) Keyway in footing or slab center unless shown otherwise on Drawings.
    d. Beam keyways:
        1) Full width of beam.
        2) Keyway height not less than 5-1/2 IN.
        3) Keyway depth not less than 1-1/2 IN.
        4) Keyway located in initial beam pour, directly above the bottom reinforcing, unless shown otherwise on Drawings.
11. Minimum time before placement of adjoining concrete construction:
    a. All concrete: 72 HRS.

B. Construction Joints - Spacing Unless Otherwise Specified:
1. Structures not intended to contain liquid:
    a. Wall vertical construction joints:
        1) 50 FT maximum centers.
        2) At wall intersections, 4 FT minimum from corner.
    b. Base slab, floor, and elevated slab construction joints:
        1) Placements to be approximately square and not to exceed 4000 SQFT.
        2) Maximum side dimension of a slab pour to be 90 FT.

C. Construction Joints - Bonding:
1. Obtain bond between concrete pours at construction joints by thoroughly cleaning and removing all laitance from construction joints.
2. Before new concrete is placed, all construction joints shall be coated with cement grout, or dampened, as outlined below:
3. Roughen construction joints:
    a. Roughen the surface of the concrete to expose the coarse aggregate uniformly with 1/4 IN minimum amplitude.
        1) Remove laitance, loosened particles of aggregate or damaged concrete at the surface, or at the Contractor's option, use an approved chemical retarder which delays but does not prevent setting of the surface of the mortar in accordance with the manufacturer's recommendations.
            a) Retarded mortar shall be removed within 24 HRS after placing to produce a clean exposed aggregate bonding surface.
    b. Dampen the hardened concrete immediately prior to placing of fresh concrete or grout.
4. Keyed construction joints:
    a. Thoroughly clean construction joints and remove all laitance.
    b. Dampen the hardened concrete immediately prior to placing of fresh concrete.

D. Slab On Grade Joints:
1. Locate construction and control joints in slabs on grade as indicated on Drawings.

2. Time cutting properly with set of concrete, if saw cut joints are required or permitted.
    a. Start cutting as soon as concrete has hardened sufficiently to prevent aggregates being dislodged by saw.
    b. Complete before shrinkage stresses become sufficient to produce cracking.

E. Expansion Joints:
1. Do not permit reinforcement or other embedded metal items bonded to concrete (except smooth dowels bonded on only one side of joint) to extend continuously through an expansion joint.
2. Use neoprene expansion joint fillers, unless noted otherwise on Drawings.
3. Seal expansion joints as shown on Drawings.
    a. See Specification Section 07 92 00 for requirements.

F. Waterstops - General:
1. Waterstop to be continuous with splices in accordance with manufacturer's instructions and create water tight joints.
2. Do not mix different types of waterstop materials in the same structure without specific approval from the Engineer unless shown on Drawings.
3. Preformed strip type:
    a. Locate waterstop at center of wall, unless noted otherwise on Drawings.
        1) Maintain at least 3 IN from edge of concrete.
    b. Install in a bed of swelling sealant on smooth surface of hardened concrete by use of nails, adhesive or other means as recommended by manufacturer to prevent movement of waterstop during placement of concrete.
    c. Roughened joints shall be especially prepared during concrete placement to provide smooth surface for proper water stop installation.
    d. Use in joints against existing concrete where indicated on Drawings.
4. PVC waterstops:
    a. Position waterstops accurately in joints, with adequate clearance from all reinforcing.
    b. Secure waterstops in correct position using hog rings or grommets spaced 24 IN maximum staggered along each edge full length and passed through the edge of the waterstop.
        1) Tie wire to adjacent reinforcing.
    c. Hold horizontal waterstops in place with continuous supports.
    d. Install according to manufacturer's instructions.
        1) Do not displace reinforcement from required location.
    e. Splice ends and intersections with perpendicular butt splice using electrical splicing iron in accordance with manufacturer's instructions.
        1) Use factory fabricated "T" and corner intersection fittings.
        2) Field splice straight runs of material.
    f. Unless otherwise noted, use for all construction joints in new construction for all structures indicated on Drawings.

G. Other Embedded Items:
1. Place sleeves, inserts, anchors, and embedded items required for adjoining work or for its support, prior to initiating concreting.
    a. Give Contractor whose work is related or integral to concrete, or supported by it, ample notice and opportunity to furnish and install items before placing concrete.
2. Do not route electrical conduit, drains, or pipes in concrete slabs, walls, columns, foundations, beams or other structural members unless approved by Engineer.

H. Placing Embedded Items:
1. Support against displacement.
2. Fill voids in sleeves, inserts and anchor slots temporarily with readily removable material to prevent entry of concrete into voids.
3. Provide adequate means for anchoring waterstop in concrete.
    a. Provide means to prevent waterstops in the forms from being folded over by the concrete as it is placed.

3.5 FINISHING

A. See Specification Section 03 35 00.

B. Coordinate mixing and placing with finishing.

3.6 INSTALLATION OF GROUT

A. Grout Schedule of Use:
   1. Non-shrinking non-metallic grout:
      a. Filling form tie holes.
      b. Under column and beam base plates.
      c. Other uses indicated on the Drawings.
   2. Epoxy grout:
      a. Patching cavities in concrete.
      b. Grouting of dowels and anchor bolts into existing concrete.
      c. Grouting of equipment base plates where driving motor is 500 HP and above.
      d. Other uses indicated on the Drawings.

B. Grout Installation:
   1. Non-shrink non-metallic grout:
      a. Clean concrete surface to receive grout.
      b. Saturate concrete with water for 24 HRS prior to grouting.
      c. Mix in a mechanical mixer.
      d. Use no more water than necessary to produce flowable grout.
      e. Place in accordance with manufacturer's instructions.
      f. Provide under beam, column, and equipment base plates, in joints between precast concrete filter slabs, and in other locations indicated on the Drawings.
      g. Completely fill all spaces and cavities below the top of base plates.
      h. Provide forms where base plates and bed plates do not confine grout.
      i. Where exposed to view, finish grout edges smooth.
      j. Except where a slope is indicated on the Drawings, finish edges flush at the base plate, bed plate, member or piece of equipment.
      k. Coat exposed edges of grout with cure or seal compound recommended by the grout manufacturer.
   2. Epoxy grout:
      a. Mix and place in accordance with manufacturer's instructions.
      b. Apply only to clean, dry, sound surface.
      c. Completely fill all cavities and spaces around dowels and anchors without voids.
      d. Grout base and bed plates as specified for non-shrinking, non-metallic grout.
      e. Obtain manufacturer's field technical assistance as required to assure proper placement.

3.7 CURING AND PROTECTION

A. Protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury immediately after placement, and maintain with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement, hardening, and compressive strength gain.
   1. Follow recommendations of ACI 308.1 except as modified herein.
   2. All traffic shall be kept from the surface as necessary to protect the concrete but not less than the first 48 HRS of curing.

B. Apply one of the following curing procedures immediately after completion of placement and finishing (surfaces not in contact with forms).
   1. Ponding or continuous sprinkling. Take care to avoid eroding the surface of freshly placed concrete.
   2. Application of wet Absorbent Covers:
      a. Minimum lap: 12 IN.
      b. Provide continuous uniform supply of moisture, such as sprinklers or soaker hoses as required to keep concrete surface continuously wet.

c. Monitor Absorbent Covers as required to prevent cover materials or concrete surface from drying out.

3. Application of sand kept continuously wet.
4. Continuous application of steam (not exceeding 150 DEGF) or mist spray.
5. Application of Moisture Retaining Cover sheet materials.
   a. Place as soon as possible after final finishing and without marring the surface.
   b. Minimum lap: 12 IN.
   c. Seal all edges to make water-tight.
   d. Place Moisture Retaining Cover in intimate contact with the concrete surface, without wrinkles and weighted to hold in place.
   e. Hold cover and edges in place as required to prevent wind from displacing the cover.
   f. Moisture Retaining Fabric:
      1) Install in accordance with manufacturer's written recommendations.
      2) Saturate concrete surface and fabric side of cover immediately prior to placing.
   g. Monitor continuously during the curing period:
      1) Repair any holes, tears or displaced cover.
      2) Rewet as required to keep concrete moist under cover.
6. Application of other moisture retaining covering as approved by Engineer.
7. Water used for curing shall be within 20 DEGF of the concrete temperature.
8. Application of a curing compound.
   a. Apply curing compound in accordance with manufacturer's recommendations immediately after any water sheen, which may develop after finishing, has disappeared from concrete surface.
   b. Do not use on any surface against which additional concrete or other material is to be bonded unless it is proven that curing compound will not prevent bond.
   c. Where a vertical surface is cured with a curing compound, the vertical surface shall be covered with a minimum of two coats of the curing compound.
      1) Apply the first coat of curing compound to a vertical surface immediately after form removal.
      2) The vertical concrete surface at the time of receiving the first coat shall be damp with no free water on the surface.
      3) Allow the preceding coat to completely dry prior to applying the next coat.
      4) A vertical surface: Any surface steeper than 1 vertical to 4 horizontal.
   d. Curing compounds used in water treatment plant construction shall be non-toxic and taste and odor free, and NSF approved.
      1) Alternately, all tank surfaces shall be cleaned to remove non-NSF approved curing compound without damaging the concrete finish.
9. Surfaces In Contact with Forms:
   a. Formed surfaces: Cure formed concrete surfaces utilizing final curing methods per ACI 308.1, including underside of beams, supported slabs, and other similar surfaces,
      1) See Section 03 11 13.
   b. Minimize moisture loss from and temperature gain of concrete placed in forms exposed to heating by sun by keeping forms wet and cool until they can be safely removed.
   c. Make provisions to keep concrete wall moist while stripping forms and until curing measures are in place.
   d. After form removal, cure concrete until end of time prescribed.
   e. Use one of the methods listed above.
   f. Forms left in place shall not be used as a method of curing in hot weather.
   g. The term "hot weather", where used in these specifications, is defined in ACI 305.1.
   h. In hot weather, remove forms from vertical surfaces as soon as concrete has gained sufficient strength so that the formwork is no longer required to support the concrete.

C. Curing Period:
   1. Continue curing for at least seven days for all non- water bearing concrete except Type III, high early strength concrete for which period shall be at least three days.

a. If one of curing procedures indicated above is used initially, it may be replaced by one of other procedures indicated any time after concrete is seven days old, provided concrete is not permitted to become surface dry during transition.

D. Cold Weather:
   1. Follow recommendations of ACI 306.1.
   2. Maintain temperature of concrete per ACI 306.1 for a minimum of 72 HRs after concrete is placed, when outdoor temperature is 40 DEGF, or less.
      a. Maximum temperature rate of decrease: Per ACI 306.1.
   3. Use heating, covering, insulating, or housing of the concrete work to maintain required temperature without injury due to concentration of heat.
   4. Do not use combustion heaters unless precautions are taken to prevent exposure of concrete to exhaust gases which contain carbon dioxide.
   5. Interior slabs in areas intended to be heated shall be adequately protected so that frost does not develop in the supporting subgrade.

E. Hot Weather:
   1. Follow recommendations of ACI 305.1 and ACI 308.1.
   2. Make provision for cooling forms, reinforcement and concrete, windbreaks, shading, fog spraying, sprinkling, ponding, or wet covering with a light colored material.
   3. Provide protective measures as quickly as concrete hardening and finishing operations will allow.
   4. Maximum temperature rate of decrease: Per ACI 305.1.

F. Rate of Temperature Change:
   1. Keep changes in temperature of air immediately adjacent to concrete as uniform as possible, during and immediately following curing period.

G. Protection from Mechanical Injury:
   1. Protect concrete from damaging mechanical disturbances, such as load stresses, heavy shock, and excessive vibration.
   2. Protect finished concrete surfaces from damage by construction equipment, materials, or methods, and by rain or running water.
   3. Do not load self supporting structures in such a way as to overstress concrete.

3.8 FIELD QUALITY CONTROL

A. Inspection:

   1. See Section 03 05 05.

END OF SECTION

SECTION 03 35 00
CONCRETE FINISHING AND REPAIR OF SURFACE DEFECTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Concrete finishing and repair of surface defects.
2. Chemical Sealers.
3. Polymer Modified Cementitious Coating.
4. Resurfacing Mortar.

B. Related Specification Sections include but are not necessarily limited to:
1. Division 00 - Procurement and Contracting Requirements.
2. Division 01 - General Requirements.
3. Section 03 11 13 - Formwork.
4. Section 03 31 30 - Concrete, Materials and Proportioning.
5. Section 03 31 31 - Concrete Mixing, Placing, Jointing and Curing.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
1. American Concrete Institute (ACI):
   a. CT-13, Concrete Terminology.
   b. 117, Specification for Tolerances for Concrete Construction and Materials.
   c. 303R, Guide to Cast-in-Place Architectural Concrete Practice.
   d. 308, Standard Practice for Curing Concrete.
2. ASTM International (ASTM):
   a. C109, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. Cube Specimens).
   b. C150, Standard Specification for Portland Cement.
   c. C157, Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
   d. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
   e. C666, Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.
   f. C779, Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces.
   g. C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
   h. D4258, Standard Practice for Surface Cleaning Concrete for Coating.
   i. D4259, Standard Practice for Abrading Concrete.
   j. E1155, Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers.
   k. E1486, Standard Test Method for Determining Floor Tolerances Using Waviness, Wheel Path and Levelness Criteria.
3. International Concrete Repair Institute (ICRI):
   a. 310.2R, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.
4. National Council Highway Research Program (NCHRP):
   a. 244, Concrete Sealers for the Protection of Bridge Structures.
5. The Society for Protective Coatings/NACE International (SSPC/NACE):
   a. SP 13/NACE No. 6, Surface Preparation of Concrete.

B. Qualifications:

1. Chemical Sealer CS-2:
    a. Applicator shall be factory trained and approved, in writing, by the manufacturer to apply the product.
    b. Applicator shall have a minimum of five (5) years experience successfully applying materials specified.

C. Mock-Ups.
1. General:
    a. Construct additional mock-ups as required until accepted.
    b. Mock-ups constitute minimum standard of quality for actual construction.
    c. Maintain mock-up during construction.
    d. Remove when directed by Engineer.

2. Construct mock-up floor slab of Tipping Floor Flat work for review and acceptance by Engineer.
    a. Minimum 10 x 10 FT.

1.3 DEFINITIONS

A. Vertical Surface Defects:
1. Any void in the face of the concrete deeper than 1/8 IN, such as:
    a. Tie holes.
    b. Air pockets (bug holes).
    c. Honeycombs.
    d. Rock holes.
2. Scabbing:
    a. Scabbing is defect in which parts of the form face, including release agent, adhere to concrete.
3. Foreign material embedded in face of concrete.
4. Fins 1/16 IN or more in height.

B. Installer or Applicator:
1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
2. Installer and applicator are synonymous.

C. Other words and terms used in this Specification Section are defined in ACI CT-13.

1.4 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Product technical data including:
    a. Acknowledgement that products submitted meet requirements of standards referenced.
    b. Manufacturer's installation instructions.
3. Certifications:
    a. Certification of aggregate gradation.
    b. Certification of manufacturer experience qualifications and performance history.
    c. Certification of applicator's qualifications.
        1) Refer to Qualifications paragraph.
        2) Provide manufacturer's written approval of applicators.
        3) Provide references substantiating specialty experience.

B. Informational Submittals:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's recommendations and requirements for materials used.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Bonding Agents:
      a. BASF Master Builders Solutions.
      b. Euclid Chemical Co.
      c. Laticrete - L&M Construction Chemicals.
   2. Chemical Sealers:
      a. BASF Master Builders Solutions.
      b. Euclid Chemical Co.
      c. Laticrete - L&M Construction Chemicals.
      d. Tnemec Chemprobe.
   3. Polymer Modified Cementitious Coating:
      a. Aquafin International.
      b. BASF Master Builders Solutions.
      c. Euclid Chemical Co.
   4. Patching Mortar:
      a. BASF Master Builders Solutions.
      b. Euclid Chemical Co.
      c. Laticrete - L&M Construction Chemicals.
      d. Sika Corporation.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. Chemical Sealer CS-1:
   1. High solids, water-based solution containing acrylic copolymers.
      a. ASTM C1315, Type I, Class A.
      b. Non-yellowing UV resistant.
      c. VOC Content: <200 g/L.
   2. USDA approved as a concrete floor sealer.
   3. Euclid Chemical Super Diamond Clear VOX.

B. Chemical Sealer CS-2:
   1. Water based chemical solution containing a blend of silicate and siliconate polymers designed to seal, harden and dustproof concrete floors.
   2. VOC Content: 0 g/L.
   3. Performance of treated concrete floor:
      a. Coefficient of Friction:
         1) Dry: 0.81.
         2) Wet: 0.72.
      b. Liquid repellency, RILEM Method 11.4:
         1) ≥ 1 mL.
   4. Euclid Chemical Euco Diamond Hard.

C. Chemical Sealer CS-3:
   1. Clear, penetrating, breathable, waterborne silane-siloxane solution.
   2. VOC content: ≤50 g/L.
   3. Odorless.
   4. Flash point: >200 DEGF.
   5. Water absorption: 85 PCT reduction per NCHRP 244.
   6. Chloride penetration: 82 PCT reduction per NCHRP 244.
   7. Euclid Chemical Baracade WB 244.

D. Patching Mortar: Trowelable cementitious repair mortar for vertical, overhead, and horizontal repairs.

1. Portland cement-based, rapid set repair mortar for interior or exterior use.
2. Compressive Strength, ASTM C109:
   a. Minimum 3000 PSI at 7 days.
   b. Minimum 5000 PSI at 28 days.
3. Freeze Thaw Durability, ASTM C666: 96.75 PCT at 300 Cycles.
4. Shrinkage, ASTM C157: 0.040 PCT.
5. Euclid Chemical Speed Crete Red Line.

E. Bonding Agents:
   1. For use only on concrete surfaces not receiving liquid water repellent coating:
      a. High solids acrylic latex base liquid for interior or exterior application as a bonding agent to improve adhesion and mechanical properties of concrete patching mortars.
         1) BASF Master Builders MasterEmaco A 660.
         2) Euclid Chemical Co. Flex-Con.
         3) Laticrete L&M Everbond.
   2. For use only on concrete surface receiving liquid water repellent:
      a. Non-acrylic base liquid for interior or exterior application as a bonding agent to improve adhesion and mechanical properties of concrete patching mortars.

F. Cement:
   .
   1. ASTM C150, Type I or III Portland.

G. Aggregate:
   1. Sand: Maximum size #30 mesh sieve.
   2. For exposed aggregate finish surfaces: Same as surrounding wall.

H. Water: Potable.

I. Nonshrink Grout: See Specification Section 03 31 30 and Specification Section 03 31 31.

2.3 MIXES

A. Bonding Grout: One (1) part cement to one (1) part aggregate.

B. Patching Mortar:
   1. One (1) part cement to two and one-half (2-1/2) parts aggregate by damp loose volume.
      a. Substitute white Portland cement for a part of gray Portland cement to produce color matching surrounding concrete.

PART 3 - EXECUTION

3.1 PREPARATION

A. For methods of curing, see Specification Section 03 31 31.

B. Surface Preparation:
   1. Clean surfaces in accordance with ASTM D4258 to remove dust, dirt, form oil, grease, or other contaminants prior to abrasive blasting, chipping, grinding or wire brushing.
   2. Prepare surfaces in accordance with ASTM D4259 and SSPC SP 13/NACE No. 6 to completely open defects down to sound concrete and remove laitance.
      a. Provide concrete surface profile (CSP) in accordance with ICRI 310.2:
         1) Areas to receive Repair Mortar:
            a) Areas larger than 1 SF or deeper than 1/4 IN Abrasive blast, scarify or needle scale to CSP No. 6-8.
      b. If additional chipping or wire brushing is necessary, make edges perpendicular to surface or slightly undercut.
      c. No featheredges will be permitted.
      d. Rinse surface with clean water to remove all dust, dirt, debris, loosened concrete, laitance, and other contaminants.

C. Preparation of Bonding Grout Mixture:
   1. Mix cement and aggregate.
   2. Mix bonding agent and water together in separate container in accordance with manufacturer's instructions.
   3. Add bonding agent/water mixture to cement/aggregate mixture.
   4. Mix to consistency of thick cream.
   5. Bonding agent itself may be used as bonding grout if approved by manufacturer and Engineer.

D. Preparation of Patching Mortar Mixture:
   1. Mix specified patching mortar per manufacturer's published recommendations.
   2. For repairs exceeding 2 IN in depth, mix with clean, pre-dampened 3/8 IN pea gravel in accordance with the manufacturer's recommendations.

E. Polymer modified cementitious coating:
   1. Mix in accordance with manufacturer's recommendations using bonding agent acceptable to coating manufacturer.

3.2 INSTALLATION AND APPLICATION

A. Do not repair surface defects or apply wall or floor finishes when temperature is or is expected to be below 50 DEGF.
   1. If necessary, enclose and heat area to between 50 and 70 DEGF during repair of surface defects and curing of patching material.
      a. Use only clean fuel, indirect fired heating apparatus.
      b. Exhaust combustion byproducts outside of work area.

B. Chemical Sealer Application:
   1. General:
      a. Immediately prior to Substantial Completion, thoroughly clean floor in accordance with ASTM D4258 and prepare to receive chemical sealer.
         1) Remove previously applied membrane curing compounds.
         2) Remove soil, oils, stains, discoloration, or any other imperfection having a negative impact on the appearance of the finished floor.
      b. Apply product to floor areas indicated on the Drawings.
      c. Apply in accordance with manufacturer's published installation instructions.

C. Repairing Surface Defects:
   1. This method is to be used on vertical concrete surfaces as indicated in the Concrete Finishes for Vertical Wall Surfaces paragraph of this Specification Section and similar concrete surfaces not otherwise specified to receive another finish or coating.
      a. For surfaces indicated to receive finish or coating other than those specified herein; refer to the applicable Specification Section for surface preparation requirements:
         1) High Performance Industrial Coatings: See Specification Section 09 96 00.
   2. Fill and repair surface defects and tie-holes using patching mortar mix specified in the MATERIALS Article in PART 2.
      a. Prime exposed reinforcing steel, embeds or other steel surfaces with primer as recommended by patching mortar manufacturer.
      b. Scrub bond coat:
         1) Wet substrate to a saturated surface dry (SSD) condition.
         2) Mix patching mortar to a scrub coat or slurry consistency per manufacturer's published recommendations and apply to entire area.
      c. As an alternate to the scrub bond coat, concrete may be primed with manufacturer's recommended epoxy primer.
      d. Patching Mortar Application:
         1) Mix and apply Patching Mortar per manufacturer's recommendations within the open time of the product scrub coat or any bonding agents.
         2) Finish to level of surrounding concrete surface utilizing techniques recommended by manufacturer.

3. Consolidate patching mortar into place and strike off so as to leave patch slightly higher than surrounding surface.
4. Leave undisturbed until mortar has stiffened before finishing level with surrounding surface.
   a. Do not use steel tools in finishing a patch in a formed wall which will be exposed to view.
5. Cure patching mortar in accordance with ACI 308.

D. Concrete Finishes for Vertical Wall Surfaces:
   1. General:
      a. Give concrete surfaces finish as specified below after removal of formwork and repair of surface defects.
      b. Finish numbers not listed are "Not Used".
   2. Finish #1 - As cast rough form finish:
      a. Selected forming materials are not required.
      b. Prepare surface in accordance with the PREPARATION Article in PART 3 of this Specification Section.
      c. Repair the following surface defects using patching mortar specified in PART 2:
         1) Tie holes.
         2) Honeycombs deeper than 1/4 IN.
         3) Air pockets deeper than 1/4 IN.
         4) Rock holes deeper than 1/4 IN.
      d. Chip or rub off fins exceeding 1/4 IN in height.
      e. Provide at unexposed surfaces such as:
         1) Foundations.
         2) Below-grade walls not to be waterproofed.
         3)
   3. Finish #2 - As cast form finish:
      a. Form facing material shall produce a smooth, hard, uniform texture.
         1) Use forms specified for surfaces exposed to view in accordance with Specification Section 03 11 13.
      b. Prepare surface in accordance with the PREPARATION Article in PART 3 of this Specification Section.
         1) Chip or rub off fins exceeding 1/8 IN in height.
         2) Abrasive blast surfaces in accordance with ASTM D4259 and SSPC SP 13/NACE No. 6 to completely open defects down to sound concrete and remove laitance.
            a) Provide ICRI 310.2 Concrete Surface Profile (CSP) No. 3, minimum across the entire surface.
               (1) For contiguous repair areas larger than 1 SF or deeper than 1/4 IN Abrasive blast, scarify or needle scale to CSP No. 6-8.
            b) If additional chipping or wire brushing is necessary, make edges perpendicular to surface or slightly undercut.
            c) No feather edges will be permitted.
         3) Rinse surface with clean water and allow surface water to evaporate prior to repairing surface defects.
         4) Repair the following surface defects using patching mortar specified in PART 2:
            a) Tie holes.
            b) Honeycombs deeper than 1/4 IN or larger than 1/4 IN DIA.
            c) Air pockets deeper than 1/4 IN or larger than 1/4 IN DIA.
            d) Rock holes deeper than 1/4 IN or larger than 1/4 IN DIA.
            e) Scabbing.
         5) Brush blast repaired areas to match adjacent surface texture.
      c. Provide this finish for:
         1) Interior walls of pipe galleries, pump rooms, tipping floors.
         2) Underside of horizontal elements adjacent to the finished surface.
         3) Exposed surfaces not specified to receive another finish.
   4. Finish #5 – Smooth Form Finish:

a. Form facing material shall produce a smooth, hard, uniform texture.
    1) Use forms specified for surfaces exposed to view in accordance with Specification Section 03 11 13.
    2) Comply with ACI 303R for formwork accuracy and form joint handling to prevent grout leakage.
b. Prepare surface in accordance with the PREPARATION Article in PART 3 of this Specification Section.
    1) Tie holes.
    2) Scabbing.
    3) Chip or rub off fins exceeding 1/16 IN in height.
    4) Honeycombs, air pockets, rock holes and other holes deeper than 1/16 IN or larger than 1/16 IN diameter..
c. Provide this finish on all exposed to view:
    1) Exterior building surfaces to be painted or remain exposed for view.
    2) Interior walls, columns and similar vertical surfaces to remain exposed for view.
    3) Underside of horizontal elements adjacent to the finished surface.

E. Related Unformed Surfaces (Except Slabs):
1. Strike smooth and level tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces after concrete is placed.
2. Float surface to a texture consistent with that of formed surfaces.
    a. If more than one (1) finish occurs immediately adjacent to unformed surface, provide surface with most stringent formed surface requirement.
3. Continue treatment uniformly across unformed surfaces.

F. Concrete Finishes for Horizontal Slab Surfaces:
1. General:
    a. Tamp concrete to force coarse aggregate down from surface.
    b. Screed with straightedge, eliminate high and low places, bring surface to required finish elevations; slope uniformly to drains.
    c. Dusting of surface with dry cement or sand during finishing processes not permitted.
2. Unspecified slab finish:
    a. When type of finish is not indicated, use following finishes as applicable:
        1) Surfaces intended to receive bonded applied cementitious applications: Scratched finish.
        2) Surfaces intended to receive roofing except future floors, or waterproofing membranes: Floated finish.
        3) Floors and roof surfaces which are future floors intended as walking surfaces or for reception of floor coverings: Troweled finish.
        4) Garage floors and ramps: Broom or belt finish.
        5) Exterior slabs, sidewalks, platforms, steps and landings, and ramps, not covered by other finish materials: Broom or belt finish.
        6) All slabs to receive a floated finish before final finishing.
3. Scratched slab finish: After concrete has been placed, consolidated, struck off, and leveled to a Class B tolerance, roughen surface with stiff brushes or rakes before final set.
4. Floated finish: This finish shall apply to the Tipping Floor flat work. Do not power trowel this area. Use only hand trowels to harden the finish. Do not overwork finishing in this area.
    a. After concrete has been placed, consolidated, struck off, and leveled to a Class B tolerance, do no further work until ready for floating.
    b. Begin floating when water sheen has disappeared and surface has stiffened sufficiently to permit operations.
        1) Use wood or cork float.
    c. During or after first floating, check planeness of entire surface with a 10 FT straightedge applied at not less than two (2) different angles.
5. Cut down all high spots and fill all low spots to produce a surface with Class B tolerance throughout.
    a. Refloat slab immediately to a uniform texture.

6. Troweled finish:
    a. Float finish surface to true, even plane.
    b. Power trowel, and finally hand trowel.
    c. First troweling after power troweling shall produce a smooth surface which is relatively free of defects, but which may still show some trowel marks.
    d. Perform additional trowelings by hand after surface has hardened sufficiently.
    e. Final trowel when a ringing sound is produced as trowel is moved over surface.
    f. Thoroughly consolidate surface by hand troweling.
    g. Finish in accordance with the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section.
        1) Leave finished surface essentially free of trowel marks, uniform in texture and appearance.
    h. On surfaces intended to support floor coverings, remove any defects that would show through floor covering.
7. Broom or belt finish: Immediately after concrete has received a float finish as specified, give it a transverse scored texture by drawing a broom or burlap belt across surface.
8. Underside of concrete slab finish:
    a. Match finish as specified for adjacent vertical surfaces.
    b. If more than one (1) finish occurs immediately adjacent to underside of slab surface, provide surface with most stringent formed surface requirement.

3.3 FIELD QUALITY CONTROL

A. Tolerances:
1. Finished floor slabs:
    a. Provide Floor Flatness (F_F) and Floor Levelness (F_L) in accordance with ACI 117.
        1) Measure in accordance with ASTM E1155.
    b. Slabs not indicated to be sloped:
        1) F_F: Equal or greater than 35.
        2) F_L: Equal or greater than 25.
    c. Slabs indicated to be sloped or curved:
        1) Measure in accordance with ASTM E1486.
        2) Provide slopes or curves as indicated on the Drawings.
    d. Slabs indicated to receive polished concrete floor:
        1) F_F: Equal or greater than 45.
        2) F_L: Equal or greater than 35.
        3) Refer to Room Finish Schedule on Drawings.
2. Horizontal surfaces other than finished floor slabs, including but not limited to, top of footings, top of walls, concrete fill in tankage, channels and similar applications:
    a. Gap between a 10 FT straightedge placed anywhere and the finished surface shall not exceed:
        1) Class A tolerance: 1/4 IN.
        2) Class B tolerance: 3/8 IN.
        3) Class C tolerance: 1/2 IN.
    b. Accumulated deviation from intended true plane of finished surface shall not exceed 1/2 IN.

B. Unacceptable finishes shall be replaced or, if approved in writing by Engineer, may be corrected provided strength and appearance are not adversely affected.
1. High spots to be removed by grinding and/or low spots filled with a patching compound or other remedial measures to match adjacent surfaces.

C. Provide services of manufacturer's technical representative:
1. A certified manufacturer's representative experienced in the use of the products used shall be present on a full-time basis to observe and oversee all operations associated with the installation.

2. Contractor, along with manufacturer, shall be fully responsible for the proper application, including all means and methods incidental thereto necessary for a sound, secure and complete installation.
3. Manufacturer's representative shall be present for installation of:
   a. Dry-shake Hardener.
   b. Heavy-duty Metallic Aggregate Topping.

3.4 PROTECTION

A. All horizontal slab surfaces receiving chemical sealer shall be kept free of traffic and loads for minimum of 72 HRS following installation of sealer.

END OF SECTION

DIVISION 05

METALS

SECTION 05 50 00
METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Custom fabricated metal items and certain manufactured units not otherwise indicated to be supplied under work of other Specification Sections.
   2. Design of all temporary bracing not indicated on Drawings.
   3. Design of systems and components, including but not limited to:
      a. Stairs.
      b. Landings.
      c. Ladders.
      d. Modular framing system.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 03 15 19 - Anchorage to Concrete.
   4. Section 03 31 30 - Concrete, Materials and Proportioning.
   5. Section 05 52 05 - Steel Railings.
   6. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Aluminum Association (AA):
      a. ADM 1, Aluminum Design Manual.
   2. American Association of State Highway and Transportation Officials (AASHTO):
      a. HB, Standard Specifications for Highway Bridges.
   3. American Institute of Steel Construction (AISC):
      a. 325, Manual of Steel Construction.
      b. 360, Specifications for Structural Steel Buildings (referred to herein as AISC Specification).
   4. The American Ladder Institute (ALI):
      a. A14.3, Ladders - Fixed - Safety Requirements.
   5. American Society of Civil Engineers (ASCE):
      a. 7, Minimum Design Loads for Buildings and Other Structures.
   6. ASTM International (ASTM):
      a. A6, Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
      b. A36, Standard Specification for Carbon Structural Steel.
      c. A47, Standard Specification for Ferritic Malleable Iron Castings.
      d. A48, Standard Specification for Gray Iron Castings.
      e. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
      f. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished.
      g. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
      h. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
      i. A197, Standard Specification for Cupola Malleable Iron.
      j. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

k. A276, Standard Specification for Stainless Steel Bars and Shapes.
l. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
m. A312, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
n. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
o. A500, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
p. A501, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
q. A536, Standard Specification for Ductile Iron Castings.
r. A554, Standard Specification for Welded Stainless Steel Mechanical Tubing.
s. A572, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
t. A563, Standard Specification for Carbon and Alloy Steel Nuts.
u. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
v. A668, Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use.
w. A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
x. A786, Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
y. A992, Standard Specification for Steel for Structural Shapes.
z. A1064, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
aa. A1011, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
bb. B26, Standard Specification for Aluminum-Alloy Sand Castings.
cc. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
dd. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
ee. B308, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
ff. B429, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
gg. B632, Standard Specification for Aluminum-Alloy Rolled Tread Plate.
hh. F436, Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.
ii. F467, Standard Specification for Nonferrous Nuts for General Use.
jj. F468, Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.
kk. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
ll. F835, Standard Specification for Alloy Steel Socket Button and Flat Countersunk Head Cap Screws.
mm. F879, Standard Specification for Stainless Steel Socket Button and Flat Countersunk Head Cap Screws.
nn. F1789, Standard Terminology for F16 Mechanical Fasteners.
oo. F3125, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

7. American Welding Society (AWS):
   a. A5.1/A5.1M, Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
   b. D1.1, Structural Welding Code - Steel.
   c. D1.2, Structural Welding Code - Aluminum.

d. D1.6/D1.6M, Structural Welding Code - Stainless Steel.

8. National Association of Architectural Metal Manufacturers (NAAMM):
   a. AMP 510, Metal Stairs Manual.
   b. AMP 555, Code of Standard Practice for the Architectural Metal Industry (Including Miscellaneous Iron).
   c. MBG 531, Metal Bar Grating Manual.
9. NACE International (NACE).
10. Nickel Development Institute (NiDI):
    a. Publication 11 007, Guidelines for the welded fabrication of nickel-containing stainless steels for corrosion resistant services.
11. Occupational Safety and Health Administration (OSHA):
    a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.
12. Building code:
    a. California Building Code (CBC):
       1) California Building Code and associated standards, 2019 Edition including all amendments, referred to herein as Building Code.
    b. A117.1, Accessible and Usable Buildings and Facilities.

B. Qualifications:
1. Qualify welding procedures and welding operators in accordance with AWS.
2. Fabricator shall have minimum of ten (10) years experience in fabrication of metal items specified.
3. Engineer for contractor-designed systems and components: Professional Civil or Structural Engineer licensed in the State of California.
4. NACE certified inspector shall have minimum of two (2) years experience performing inspections as indicated.
   a. Have a current Level III coating inspector certification.

1.3 DEFINITIONS

A. Fasteners: As defined in ASTM F1789.

B. Galvanizing: Hot-dip galvanizing per ASTM A123/A123M or ASTM A153/A153M with minimum coating of 2.0 OZ of zinc per square foot of metal (average of specimens) unless noted otherwise or dictated by standard.

C. Hardware: As defined in ASTM A153/A153M.

D. Installer or Applicator:
1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
2. Installer and applicator are synonymous.

1.4 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Qualifications:
   a. NACE inspector qualifications.
3. Fabrication and/or layout drawings and details:
   a. Submit drawings for all fabrications and assemblies.
      1) Include erection drawings, plans, sections, details and connection details.
   b. Identify materials of construction, shop coatings and third party accessories.
4. Product technical data including:
   a. Acknowledgement that products submitted meet requirements of standards referenced.
   b. Manufacturer's installation instructions.
   c. Provide manufacturer's standard allowable load tables for the following:
      1) Grating and checkered plate.

2) Castings, trench covers and accessories.
3) Modular framing systems.

5. Contractor designed systems and components:
   a. Certification that manufactured units meet all design loads specified.
   b. Shop Drawings and engineering design calculations:
      1) Indicate design live loads.
      2) Sealed by a licensed Civil or Structural Professional Engineer, registered in the State of California.
      3) Engineer will review for general compliance with Contract Documents.
   c. Contractor designed systems and components include the following:
      1) Metal Stairs and associated landings.
      2) Ladders and associated landings.
      3) Gates.
      4) Steel checkered plate.

B. Informational Submittals:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Certification of welders and welding processes.
      a. Indicate compliance with AWS.
   3. NACE certification of surface preparation.
   4. NACE certification of paint application.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver and handle fabrications to avoid damage.

B. Store above ground on skids or other supports to keep items free of dirt and other foreign debris and to protect against corrosion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Abrasive stair nosings (embedded in concrete stairs):
      a. American Safety Tread.
      b. Balco.
   2. Headed studs and deformed bar anchors:
      a. Nelson Stud Welding Div., TRW Inc.
      b. Stud Welding Products, Inc.
   3. Mechanical anchor bolts:
      a. See Section 03 15 19.
   4. Epoxy adhesive anchor bolts:
      a. See Section 03 15 19.
   5. Concrete screw anchors:
      a. See Section 03 15 19.
   6. Castings, trench covers and accessories:
      a. Neenah Foundry Co.
      b. Deeter Foundry Co.
      c. Barry Craft Construction Casting Co.
      d. McKinley Iron Works.
   7. Aluminum ladders:
      a. Any manufacturer capable of meeting the requirements of this Specification Section.
   8. Galvanizing repair paint:

a. Clearco Products Co., Inc.
b. ZRC Products.

9. Modular framing system:
   a. Unistrut Building Systems.
   b. B-Line Systems.
   c. Kindorf.
   d. Superstrut.
10. Ladder safety extension post:
    a. Bilco.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. Steel:
1. Structural:
   a. W-shapes and WT-shapes: ASTM A992, Grade 50.
   b. All other plates and rolled sections: ASTM A36.
2. Pipe: ASTM A53, Types E or S, Grade B or ASTM A501.
3. Structural tubing:
   a. ASTM A500, Grade B (46 ksi minimum yield).
4. Bolts, high strength:
   a. ASTM F3125, Grade A325.
5. Nuts, high strength:
   a. ASTM A563.
6. Washers (hardened):
   a. ASTM F436.
   b. Provide two (2) washers with all bolts.
7. Bolts and nuts (unfinished):
   a. ASTM A307, Grade A.
8. Welding electrodes: AWS D1.1, E70 Series.
9. Steel forgings: ASTM A668.

B. Iron:
1. Ductile iron: ASTM A536.
2. Gray cast iron: ASTM A48 (minimum 30,000 PSI tensile strength).
3. Malleable iron: ASTM A47, ASTM A197.

C. Stainless Steel:
1. Stainless steel in welded applications: Low carbon 'L' type.
2. Minimum yield strength of 30,000 PSI and minimum tensile strength of 75,000 PSI.
   a. Bars, shapes: ASTM A276, Type 304.
   b. Tubing and pipe: ASTM A269, ASTM A312 or ASTM A554, Type 304 or 316.
   c. Strip, plate and flat bars: ASTM A666, Type 304 or 316.
   d. Bolts and nuts: ASTM F593, Type 304 or 316.
3. Minimum yield strength of 25,000 PSI and minimum tensile strength of 70,000 PSI.
   a. Strip, plate and flat bar for welded connections, ASTM A666, Type 304L or 316L.
4. Welding electrodes: In accordance with AWS for metal alloy being welded.

D. Aluminum:
1. Alloy 6061-T6, 32,000 PSI tensile yield strength minimum.
   a. ASTM B221 and ASTM B308 for shapes including beams, channels, angles, tees and zees.
   b. Weir plates, baffles and deflector plates, ASTM B209.
2. Alloy 6063-T5 or T6, 15,000 PSI tensile yield strength minimum.
   a. ASTM B221 and ASTM B429 for bars, rods, wires, pipes and tubes.
3. ASTM B26 for castings.
4. ASTM F468, alloy 2024 T4 for bolts.
5. ASTM F467, alloy 2024 T4 for nuts.

6. Electrodes for welding aluminum: AWS D1.2, filler alloy 4043 or 5356.

E. Washers: Same material and alloy as found in accompanying bolts and nuts.

F. Embedded Anchor Bolts:
   1. See Specification Section 03 15 19.

G. Mechanical Anchor Bolts and Adhesive Anchor Bolts:
   1. See Specification Section 03 15 19.

H. Headed Studs: ASTM A108 with a minimum yield strength of 50,000 PSI and a minimum tensile strength of 60,000 PSI.

I. Deformed Bar Anchors: ASTM A1064 with a minimum yield strength of 70,000 PSI and a minimum tensile strength of 80,000 PSI.

J. Iron and Steel Hardware: Galvanized in accordance with ASTM A153/A153M when required to be galvanized.

K. Galvanizing Repair Paint:
   1. High zinc dust content paint for regalvanizing welds and abrasions.
   2. ASTM A780.
   3. Zinc content: Minimum 92 PCT in dry film.
   4. ZRC "ZRC Cold Galvanizing" or Clearco "High Performance Zinc Spray."

L. Dissimilar Materials Protection: See Specification Section 09 96 00.

2.3 MANUFACTURED UNITS

A. Ladders:
   1. General:
      a. Fully welded type.
         1) All welds to be full penetration welds, unless otherwise specified.
      b. All ladders of a particular material shall have consistent construction and material shapes and sizes unless noted otherwise on the Drawings.
      c. Design ladder in accordance with OSHA Standards, ANSI A14.3, ASCE 7 and applicable Building Codes.
      d. Ladders shall be designed to support a minimum concentrated live load of 300 LBS at any point to produce the maximum stress in the member being designed.
         1) Apply additional 300 LB loads for each section of ladder exceeding 10 FT.
      e. Maximum allowable stresses per AA ADM 1.
      f. Maximum lateral deflection: Side rail span/240 when lateral load of 100 LBS is applied at any location.
   2. Material:
      a. Steel.
      b. Finish:
         1) Mill.
   3. Rails:
      a. Round pipe or rectangular tubing:
         1) Round pipe:
            a) 1-1/2 IN nominal diameter.
            b) Schedule 80.
         2) Rectangular tubing:
            a) Cross-section: 3 by 2 IN maximum.
            b) Thickness: 0.125 IN minimum.
      b. Spacing:
         1) Minimum clear distance between rails to be 18 IN.
         2) Step-through ladder extensions: 24 IN, centerline to centerline.
      c. Provide cap at exposed top and bottom of side rails.
         1) Provide weep holes as necessary to prevent the accumulation of moisture within hollow members.

d. Extend side rails of step-through ladders a minimum of 42 IN above the landing.

4. Rungs:
   a. Minimum 1 IN DIA or 1 IN square solid bar.
      1) Integral non-slip finish on all sides.
         a) Non-slip finish: Coarse knurling or extruded serrations.
         b) Shop or field-applied grit tape and cap type non-slip finishes are not acceptable.
   b. Rungs shall penetrate inside wall of side rails.
      1) Do not extend rungs beyond the outside face of the side rail.
      2) Provide fillet weld all around rung at inside face of side rail and plug weld at outside face of side rail.
   c. Rung spacing:
      1) Uniform, 12 IN.
      2) Top rung shall be level with landing or platform.
         a) Where top of ladder terminates at grating cover, floor access door, roof hatch or similar condition; locate top rung as close as practicable to, but not more than 6 IN below, adjacent walking surface.
      3) Spacing of bottom rung from grade or platform may vary but shall not exceed 14 IN.
5. Brackets:
   a. Angle or bent plate brackets welded to side rails:
      1) 3/8 IN by 2-1/2 IN by length required.
      2) Provide punched holes for 3/4 IN bolts or anchors.
      3) Minimum distance from centerline of rung to wall or any obstruction: 7 IN.
      4) Maximum spacing: 4 FT OC.
   b. For floor supported ladders, provide 3/8 by 2-1/2 by 4 IN rectangular bracket or 3/8 by 6 by 6 IN square plate welded to rails with punched holes for 3/4 IN bolts.
      1) Provide wall brackets on floor supported units if vertical run is over 4 FT.
6. Provide ladder cage where shown on the Drawings or required by OSHA.
   a. Cage construction shall meet all requirements of OSHA Standards and this Specification Section:
      1) Hoops: Minimum 1/4 by 2 IN bar at 48 IN OC spacing.
      2) Vertical bars: Minimum 1/4 by 1-1/2 IN bar.
      3) Weld all connections.
      4) Construct cage of same materials as the ladder on which it is mounted.
      5) Mount cage on ladder by welding.
7. Landings:
   a. Construct landing, railing and all supports of same material as the ladder.
   b. Design live load for landing platform and supporting structure:
      1) 100 psf, uniform load.
      2) 300 LBS concentrated load on 4 IN square area.
      3) All components to be adequate for the uniform load or the concentrated load, whichever requires the stronger component.
      4) Maximum deflection: 1/300 of span under a superimposed live load of 100 PSF.
   c. Grating:
      1) Per this Specification Section.
   d. Structural support: Channel or tubular sections with bracing, plates, angles, etc., to support guardrail and grating and to support landing from the side of the structure or building wall.
      1) Weld or bolt all connections using galvanized bolts, nuts and washers.
   e. Guardrails:
      1) Match ladder side rails.
         a) Space intermediate rails equally between top rail and top of kickplate.
      2) Provide 4 IN high x 3/8 IN thick toeboard each side of landing.
8. Gates:
   a. Constructed of same material and sizes as the railing system.

b. Hinges:
1) Stainless steel.
2) Heavy-duty, self-closing.
c. Gate stop:
1) Galvanized steel.

9. Ladder safety extension post:
a. Telescoping tubular galvanized steel section that automatically locks into place when fully extended.
b. Non-ferrous corrosion-resistant spring and hardware.
c. Factory assembled with all hardware necessary for mounting to ladder.
d. Bilco "LadderUp" safety post.

10. Deflector plate:
a. For steel ladders: Minimum .0625 IN steel plate, ASTM A6.
b. Profile as shown on Drawings.
c. Fabricate to shapes and sizes required to meet OSHA Standards.

B. Bollards:
1. 8 IN DIA extra strength steel pipe, ASTM A53.
a. Galvanized.
b. See Specification Section 09 96 00 for painting requirements.

C. Abrasive Stair Nosings:
1. Exterior cast-in-place concrete stairs:
a. One piece cast aluminum with wing anchors.
b. Diamond abrasive pattern.
c. Babcock Davis "BSTCA-C3W".

2. Interior stairs:
a. Two (2) component consisting of an embedded subchannel and an abrasive tread plate with integral photoluminescent strip.
b. Subchannel: 6063-T5 extruded aluminum.
1) Complete with concrete anchors.
c. Tread plate:
1) 6063-T5 extruded aluminum.
2) Solid epoxy abrasive filler.
a) Color: Safety yellow.
d. Balco "DXH-330."
e. Finish: Mill.

3. Length:
a. Concrete stairs and landings:
1) 4 IN less than overall stair width.
2) Where tread mounted railing post occurs, hold nosing back 4 IN clear from railing centerline.
b. Concrete filled metal pan stairs: Full length of tread.
c. Concrete landings at metal stairs: 4 IN less than clear width between stringers.

D. Metal Stairs:
1. Treads: Grating as specified.
a. Provide integral corrugated non-slip nosing.

2. Risers:
a. Grating treads:
1) Solid plate welded to trailing edge of tread or landing.
2) Minimum 3/16 IN thick by 4 IN high.

3. Landings:
a. Grating as specified.
b. Provide integral corrugated non-slip nosing at edge acting as stair tread/nosing.

4. Design live load for landing platform and supporting structure:

a. 100 psf, uniform load.
b. 300 LBS concentrated load on 4 IN square area.
c. All components to be adequate for the uniform load or the concentrated load, whichever requires the stronger component.
d. Maximum deflection: 1/300 of span under a superimposed live load of 100 PSF.

5. Design, fabricate, and install in compliance with NAAMM and applicable codes.
   a. NAAMM AMP 510:
      1) Exterior at site structures and equipment: Industrial Class.
      2) Interior or exterior at buildings: Service Class.
6. Handrails and guardrails: Refer to Specification Section 05 52 05.
7. Material:

   a. Steel: ASTM A36, galvanized after fabrication.

E. Steel Checkered Plate:
   1. Provide galvanized checkered plate and edge supports.
   2. Conform to ASTM A786.
      a. Diamond pattern: No.3 (large) or No.4 (medium).
      b. Use one (1) pattern throughout Project.
      c. Material: 36 ksi minimum yield strength.
   3. Design live load (unless noted otherwise on Drawings):
      a. 100 PSF, uniform load.
      b. 300 LBS concentrated load on 4 IN square area.
      c. All components to be adequate for the uniform load or the concentrated load, whichever requires the stronger component.
      d. Maximum deflection: 1/300 of span under a superimposed live load of 50 PSF.
   4. Reinforce as necessary with steel angles welded to underside of checkered plate.
   5. Plate sections:
      a. Maximum 3 FT wide.
      b. Minimum 1/4 IN thick.
      c. Maximum 100 LBS per section if required to be removable.
   6. Provide joints at center of all openings unless shown otherwise.
      a. Reinforce joints and openings with additional angles to provide required load carrying capacity.
   7. Unless shown otherwise, frame for opening with steel checkered plate cover:
      a. Steel support angles:
         1) 3 by 2 by 1/4 IN minimum size with long leg vertical.
         2) 5/8 IN DIA adhesive anchor bolts spaced at maximum of 24 IN OC along each side with not less than two (2) anchor bolts per side.
      b. Steel concrete insert seats:
         1) 2 by 2 by 1/4 IN minimum size.
         2) Auto-welded studs or strap anchors, ASTM A108 at 18 IN OC with not less than two (2) studs or anchors per side.
      c. Drill and tap frame to receive 3/8 IN DIA fasteners at not more than 24 IN OC with not less than two (2) fasteners per side.
         1) Fasteners: Flat countersunk cap screws, ASTM F835.
            a) Galvanized, ASTM A153/A153M.

F. Steel Grating:
   1. NAAMM MBG 531.
   2. Bearing bars:
      a. Rectangular 1-1/2 by 3/16 IN unless otherwise noted on Drawings.
      b. Maximum 1-3/16 IN OC spacing.
   3. Cross bars:
      a. Welded, swagged or pressure locked to bearing bars.
      b. Maximum 4 IN OC spacing.
   4. Top edges of bars: Serrated or grooved.

5. Removable grating sections: Not wider than 3 FT and not more than 100 LBS.
6. Finish:
   a. Galvanized.
   b. Clips and bolts: Galvanized.
   c. Seat angles: Galvanized steel.
7. Ends and perimeter edges: Banded.
8. Openings through grating: Reinforced to provide required load carrying capacity and banded with 4 IN high toe plate.
9. Provide joints at openings between individual grating sections.

G. Heavy-Duty Castings, Trench Covers, and Accessories:
1. Prefabricated, cast iron ASTM A48 or ductile iron ASTM A536.
2. Design load: AASHTO HS-20 wheel loading for indicated span.
3. Machine horizontal mating surfaces.

H. Access Cover:
1. Tank type manhole frame and solid lid: ASTM A48 or ASTM A536, cast iron.
2. Unless shown otherwise, design of cover shall be such that top of frame extends several inches above slab to prevent surface water from entering tank.
3. Equip lid with four (4) stainless steel screws to secure lid to frame.

I. Loose Lintels:
1. Steel, ASTM A36 or ASTM A572 Grade 50, sizes as indicated on Drawings.
2. Hot-dip galvanized per ASTM A123/A123M.

J. Modular Framing System:
1. Materials:
   a. Steel: ASTM A1011, stainless steel, Grade 33.
      1) Hot-dipped galvanized, ASTM A123 or ASTM A153.
2. Channels and inserts:
   a. Steel or stainless steel: Minimum 12 GA.
   b. Channels to have one (1) side with a continuous slot with in-turned lips.
      1) Width: 1-5/8 IN.
      2) Depth and configuration as necessary for loading conditions.
3. Fittings: Same material as system major components.
4. Fasteners:
   a. Nuts: Toothed groves in top of nuts to engage the in-turned lips of channel.
   b. Bolts: Hex-head cap screws.
   c. Same material as system major components.
5. End caps:
   a. At each exposed end of each piece mounted on walls, or guardrails, or suspended from framing 7 FT or less above the floor or platform.
      a) Plastic for all exposed ends 7 FT or more above floor or platform.
      b) Plastic or metallic for all other exposed ends.
6. Provide dissimilar materials protection in accordance with Specification Section 09 96 00.
7. Repair all cut ends or otherwise damaged areas of galvanized steel in accordance with ASTM A780.

2.4 FABRICATION

A. Verify field conditions and dimensions prior to fabrication.

B. Form materials to shapes indicated with straight lines, true angles, and smooth curves.
1. Grind smooth all rough welds and sharp edges.
   a. Round all corners to approximately 1/32 - 1/16 IN nominal radius.

C. Provide drilled or punched holes with smooth edges.
1. Punch or drill for field connections and for attachment of work by other trades.

D. Weld Shop Connections:

1. Welds to be continuous fillet type unless indicated otherwise.
2. Full penetration butt weld at bends in stair stringers and ladder side rails.
3. Weld structural steel in accordance with AWS D1.1 using Series E70 electrodes conforming to AWS A5.1/A5.1M.
4. Weld aluminum in accordance with AWS D1.2.
5. Weld stainless steel in accordance with AWS D1.6 and NiDI 11 007.
    a. Treat all welded areas in accordance with ASTM A380.
6. All headed studs to be welded using automatically timed stud welding equipment.
7. Grind smooth welds that will be exposed.

E. Passivate stainless steel items and stainless steel welds after they have been ground smooth .
    1. ASTM A380.

F. Conceal fastenings where practicable.

G. Fabricate work in shop in as large assemblies as is practicable.

H. Tolerances:
    1. Rolling:
        a. ASTM A6.
        b. When material received from the mill does not satisfy ASTM A6 tolerances for camber, profile, flatness, or sweep, the Contractor is permitted to perform corrective work by the use of controlled heating and mechanical straightening, subject to the limitations of the AISC Specification.
    2. Fabrication tolerance:
        a. Member length:
            1) Both ends finished for contact bearing: 1/32 IN.
            2) Framed members:
                a) 30 FT or less: 1/16 IN.
                b) Over 30 FT: 1/8 IN.
        b. Member straightness:
            1) Compression members: 1/1000 of axial length between points laterally supported.
            2) Non-compression members: ASTM A6 tolerance for wide flange shapes.
        c. Specified member camber (except compression members):
            1) 50 FT or less: Minus 0/plus 1/2 IN.
            2) Over 50 FT: Minus 0/plus 1/2 IN (plus 1/8 IN per 10 FT over 50 FT).
            3) Members received from mill with 75 PCT of specified camber require no further cambering.
            4) Beams/trusses without specified camber shall be fabricated so after erection, camber is upward.
            5) Camber shall be measured in fabrication shop in unstressed condition.
        d. At bolted splices, depth deviation shall be taken up by filler plates.
            1) At welded joints, adjust weld profile to conform to variation in depth.
            2) Slope weld surface per AWS requirements.
        e. Finished members shall be free from twists, bends and open joints.
            1) Sharp kinks, bends and deviation from above tolerances are cause for rejection of material.

I. Fabricate grating, checkered plate, stairs, ladders and accessories using galvanized steel unless shown otherwise on Drawings.
    1. Finish:
        a. Mill, unless noted otherwise.
        b. Coat surfaces in contact with dissimilar materials.
            1) See Specification Section 09 96 00.

J. Fabricate grating in accordance with NAAMM MBG 531.
    1. Maximum tolerance for difference in depth between grating depth and seat or support angle depth: 1/8 IN.

2. Distance between edge of grating and face of embedded seat angle or face of wall or other structural member: 1/4 IN.
    a. Tolerance: NAAMM MBG 531.
3. Removable sections: Not wider than 3 FT and not heavier than 100 LBS.
4. Ends and perimeter edges: Banded, with alternate bearing bars welded to band.
    a. Provide full depth banding unless noted otherwise.
    b. Banding at trenches and sumps to be 1/4 IN less than grating depth to allow for drainage.
5. Openings through grating: Reinforced to provide required load carrying capacity and banded with 4 IN high toe plate.
6. Provide joints at openings between individual grating sections.
7. Fabricate grating so that bearing bars and cross bars in adjacent sections are aligned.

K. Fabricate checkered plate and miscellaneous metals in accordance with NAAMM AMP 555.
1. Workmanship: Class 2 Class 1 unless noted otherwise.

L. See Specification Section 09 96 00 for preparation and painting of ferrous metals and other surfaces.

2.5 SOURCE QUALITY CONTROL

A. Surface Preparation:
1. Refer to Specification Section 09 96 00 for surface preparation requirements.
2. All miscellaneous metal fabrication item surfaces shall be inspected and approved by NACE certified coatings inspector prior to application of shop-applied coatings.
    a. Inspection shall be performed to determine depth of blast profile and cleanliness of surface.
    b. Fabricator shall reblast and or re-clean surfaces as required until acceptable.

B. Shop Applied Coating Application:
1. Refer to Specification Section 09 96 00 for coating requirements.
2. After surface has been accepted in writing by NACE certified coatings inspector, fabricator may proceed with application of coatings.
3. Application of coatings shall be observed and certified by NACE certified coatings inspector.

C. Shop Inspection and Testing:
1. Owner will employ and pay for the services of a qualified independent testing agency to inspect and test all structural steel work for compliance with Contract Documents.
2. Contractor responsible for testing to qualify shop and field welders and as needed for Contractor's own quality control to ensure compliance with Contract Documents.
3. Independent testing agency shall have a minimum of five (5) years performing similar work and shall be subject to Owner's approval.

D. Responsibilities of Testing Agency:
1. Inspect shop and field welding in accordance with AWS Code including the following non-destructive testing:
    a. Visually inspect all welds.
    b. In addition to visual inspection, test 50 PCT of full penetration welds and 20 PCT of fillet welds with liquid dye penetrant or mag particle.
    c. Test 20 PCT of liquid dye penetrant tested full penetration welds with ultrasonic or radiographic testing.
2. Inspect high-strength bolting in accordance with the RCSC Specification for Structural Joints Using High-Strength Bolts, Section 9.
    a. Verify direct tension indicator gaps, if applicable.
3. Inspect structural steel which has been erected.
4. Inspect stud welding in accordance with AWS Code.
5. Prepare and submit inspection and test reports to Engineer.
    a. Assist Engineer to determine corrective measures necessary for defective work.

PART 3 - EXECUTION

3.1 PREPARATION

A. Provide items to be built into other construction in time to allow their installation.
   1. If such items are not provided in time for installation, cut in and install.

B. Prior to installation, inspect and verify condition of substrate.

C. Correct surface defects or conditions which may interfere with or prevent a satisfactory installation.
   1. Field welding aluminum is not permitted unless approved in writing by Engineer.

3.2 INSTALLATION

A. Set metal work level, true to line, plumb.
   1. Shim and grout as necessary.

B. Contractor is solely responsible for safety.
   1. Construction means and methods and sequencing of work is the prerogative of the Contractor.
   2. Take into consideration that full structural capacity of many structural members is not realized until structural assembly is complete; e.g., until slabs, decks, and diagonal bracing or rigid connections are installed.
   3. Partially complete structural members shall not be loaded without an investigation by the Contractor.
   4. Until all elements of the permanent structure and lateral bracing system are complete, temporary bracing for the partially complete structure will be required.

C. Adequate temporary bracing to provide safety, stability and to resist all loads to which the partially complete structure may be subjected, including construction activities and operation of equipment is the responsibility of the Contractor.
   1. Plumb, align, and set structural steel members to specified tolerances.
   2. Use temporary guys, braces, shoring, connections, etc., necessary to maintain the structural framing plumb and in proper alignment until permanent connections are made, the succeeding work is in place, and temporary work is no longer necessary.
   3. Use temporary guys, bracing, shoring, and other work to prevent injury or damage to adjacent work or construction from stresses due to erection procedures and operation of erection equipment, construction loads, and wind.
   4. Contractor shall be responsible for the design of the temporary bracing system and must consider the sequence and schedule of placement of such elements and effects of loads imposed on the structural steel members by partially or completely installed work, including work of all other trades.
      a. If not obvious from experience or from the Drawings, confer with the Engineer to identify those structural steel elements that must be complete before the temporary bracing system is removed.
   5. Remove and dispose of all temporary work and facilities off-site.

D. Examine work-in-place on which specified work is in any way dependent to ensure that conditions are satisfactory for the installation of the work.
   1. Report defects in work-in-place which may influence satisfactory completion of the work.
   2. Absence of such notification will be construed as acceptance of work-in-place.

E. Field Measurement:
   1. Take field measurements as necessary to verify or supplement dimensions indicated on the Drawings.
   2. Contractor is responsible for the accurate fit of the work.

F. Check the elevations of all finished footings or foundations and the location and alignment of all anchor bolts before starting erection.
   1. Use surveyor's level.

2. Notify Engineer of any errors or deviations found by such checking.

G. Framing member location tolerances after erection shall not exceed the frame tolerances listed in the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section.

H. Erect plumb and level; introduce temporary bracing required to support erection loads.

I. Use light drifting necessary to draw holes together.
   1. Drifting to match unfair holes is not allowed.

J. Welding:
   1. Conform to AWS D1.1 and requirements of the FABRICATION Article in PART 2 of this Specification Section.
   2. When joining two (2) sections of steel of different ASTM designations, welding techniques shall be in accordance with a qualified AWS D1.1 procedure.

K. Shore existing members when unbolting of common connections is required.
   1. Use new bolts for rebolting connections.

L. Clean stored material of all foreign matter accumulated prior to the completion of erection.

M. Bolt Field Connections: Where practicable, conceal fastenings.

N. Field Welding:
   1. Follow AWS procedures.
   2. Grind welds smooth where field welding is required.

O. Field cutting grating or checkered plate to correct fabrication errors is not acceptable.
   1. Replace entire section.

P. Remove all burrs and radius all sharp edges and corners of miscellaneous plates, angles, framing system elements, etc.

Q. Unless noted or specified otherwise:
   1. Connect steel members to steel members with 3/4 IN DIA ASTM F3125, Grade A325 high strength bolts.
   2. Connect steel members to concrete and masonry using stainless steel mechanical anchor bolts or adhesive anchor bolts unless shown otherwise.
      a. Provide dissimilar materials protection.
   3. Provide washers for all bolted connections.
   4. Where exposed, bolts shall extend a maximum of 3/4 IN and a minimum of 1/2 IN above the top of installed nut.
      a. If bolts are cut off to required maximum height, threads must be dressed to allow nuts to be removed without damage to the bolt or the nuts.

R. Install and tighten ASTM F3125, Grade A325 high-strength bolts in accordance with the AISC 325, Allowable Stress Design (ASD).
   1. Provide hardened washers for all Grade A325 bolts.
      a. Provide the hardened washer under the element (nut or bolt head) turned in tightening.

S. After bolts are tightened, upset threads of ASTM A307 bolts or anchor bolts to prevent nuts from backing off.

T. Do not field splice fabricated items unless said items exceed standard shipping length or change of direction requires splicing.
   1. Provide full penetration welded splices where continuity is required.

U. Provide each fabricated item complete with attachment devices as indicated or required to install.

V. Anchor such that work will not be distorted nor fasteners overstressed from expansion and contraction.

W. Set beam and column base plates accurately on nonshrink grout as indicated on Drawings.

1. See Division 03 Specification Sections for non-shrink grout and anchorage.
2. Set and anchor each base plate to proper line and elevation.
    a. Use metal wedges, shims, or setting nuts for leveling and plumbing columns and beams.
        1) Wedges, shims and setting nuts to be of same metal as base plate they support.
        2) Tighten nuts on anchor bolts.
    b. Fill space between bearing surface and bottom of base plate with nonshrink grout.
        1) Fill space until voids are completely filled and base plates are fully bedded on wedges, shims, and grout.
    c. Do not remove wedges or shims.
        1) Where they protrude, cut off flush with edge of base plate.
    d. Fill sleeves around anchor bolts solid with non-shrink grout.

X. Tie anchor bolts in position to embedded reinforcing steel using wire.
1. Tack welding prohibited.
    a. Coat projecting bolt threads and nuts with heavy coat of clean grease.
2. Anchor bolt location tolerance:
    a. Per Section 03 15 19.

Y. Install bollards as detailed on Drawings.
1. Fill pipe with concrete and round off at top.

Z. Provide abrasive stair nosings in each tread and landing of all concrete stairs and at each concrete stair landing having metal stair structure attaching to the concrete landing.
1. Center stair nosings in stair width.

AA. Accurately locate and place frames for openings before casting into floor slab so top of plate is flush with surface of finished floor.
1. Keep screw holes clean and ready to receive screws.

BB. Attach grating to end and intermediate supports with grating saddle clips and bolts.
1. Maximum spacing: 2 FT OC with minimum of two (2) per side.
2. Attach individual units of aluminum grating together with clips at 2 FT OC maximum with a minimum of two (2) clips per side.

CC. Coat aluminum surfaces in contact with dissimilar materials in accordance with Specification Section 09 96 00.

DD. Repair damaged galvanized surfaces in accordance with ASTM A780.
1. Prepare damaged surfaces by abrasive blasting or power sanding.
2. Apply galvanizing repair paint to minimum 6 mils DFT in accordance with manufacturer's instructions.

EE. Anchor ladder to concrete structure with minimum 3/4 IN stainless steel anchor bolts with minimum 6 IN embedment.

FF. Anchor ladder to masonry structure with minimum 3/4 IN stainless steel anchor bolts with minimum 6 IN embedment.
1. When anchoring into masonry, fill masonry cores with grout at anchor locations and each masonry core within 8 IN of anchor
2. When anchoring into cavity wall construction, provide minimum 6 IN embedment into concrete or masonry back-up wall.
    a. At each anchor location, provide sleeve between back face of veneer and cavity face of concrete or masonry back-up wall.
    b. Cut cavity insulation as required and seal around sleeve.
        1) Sleeve to be 1 IN DIA schedule 40 stainless steel tubing, TP-304L, ASTM A269.
            a) Minimum wall thickness to be .065 IN.
        2) Continuously weld 4 by 4 by 1/4 IN Type 304 stainless steel, ASTM A666 flange onto each end of pipe.
            a) Drill 1 IN hole in flange to match pipe.

b) Attach sleeve to concrete or masonry back-up with 1/4 IN concrete screw anchors.

3) Grout solid, area around bolt where bolt penetrates veneer.

4) Accurately locate sleeves to align with bolt locations on ladder.

GG. Anchor ladder to metal stud walls using minimum 1/2 IN stainless steel bolts, nuts and washers.

1. Verify that stud wall has been provided with adequate backing to accept ladder anchors.

HH. Install ladder safety extension post in accordance with manufacturer's instructions.

1. Mount device opposite the climbing side.
2. Provide ladder safety extension device for all ladders unless noted otherwise.

II. Mount ladder fall protection system with rail offset from ladder side rail approximately 3 IN.

JJ. Install factory pre-fabricated stairs in location indicated in the Contract Documents and approved submittals.

3.3 FIELD QUALITY CONTROL

A. Tolerances shall meet structural requirements of AISC 303-10 Code of Standard Practice for Steel Buildings and Bridges for erecting items of structural nature.

B. Tolerances (unless otherwise noted on the Drawings):

1. Frame placement, after assembly and before welding or tightening.
   a. Deviation from plumb, level and alignment: 1 IN 500, maximum.
   b. Displacement of centerlines of columns: 1/2 IN maximum, each side of centerline location shown on Drawings.
   c. Displacement of centerlines of columns: 1/2 IN maximum, each side of centerline location shown on Drawings.

C. OWNER Pays for Field Inspection and Testing:

1. Owner will employ and pay for services of an independent testing agency to inspect and test structural steel shop and field work for compliance with this Specification Section.
2. Contractor provides sufficient notification and access so inspection and testing can be accomplished.
3. Contractor pays for retesting of failed tests and for additional testing required when defects are discovered.

3.4 CLEANING

A. After fabrication, erection, installation or application, clean all miscellaneous metal fabrication surfaces of all dirt, weld slag and other foreign matter.

B. All stainless steel products in addition to Paragraph A. above:

1. Remove all heat tint, rusting, discoloration by passivation, ASTM A380, or other acceptable means as listed in NiDI 11 007 as approved by the Engineer.

C. Provide surface acceptable to receive field applied paint coatings specified in Specification Section 09 96 00.

END OF SECTION

SECTION 05 51 00
METAL STAIRS AND RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish labor, materials, tools, equipment, and services for Steel Stairs and Railings, as indicated, in accordance with provisions of Contract Documents.

B. Completely coordinate with work of other trades.

1.2 QUALITY ASSURANCE

A. Provide Steel Stairs and Railings engineered to support dead, live, lateral and seismic loads indicated:
   1. Include calculations for load-bearing components of stairs and landings.
   2. Comply with Section 01 45 33, Special Inspections and Testing Program.
   3. Comply with Section 01 30 00, Special Conditions
   4. Required details defining method of fastening throughout system and attachments to supporting primary structure included in engineering requirement.
   5. Physical adequacy of structural design and conformance with applicable building codes are responsibility of stair fabricator.

B. ASTM International:
   1. ASTM A27 Standard Specification for Steel Castings, Carbon, for General Application
   2. ASTM A36 Standard Specification for Carbon Structural Steel
   3. ASTM A47 Standard Specification for Ferritic Malleable Iron Castings
   4. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
   5. ASTM A148 Standard Specification for Steel Castings, High Strength, for Structural Purposes
   6. ASTM A276 Standard Specification for Stainless Steel Bars and Shapes
   7. ASTM A307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
   8. ASTM A325 Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
   9. ASTM A354 Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners
   10. ASTM A480 Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
   11. ASTM A484 Standard Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings
   12. ASTM A500 Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
   13. ASTM A501 Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
   14. ASTM A668 Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use
   15. ASTM E303 Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester

C. American Institute of Steel Construction (AISC)
   1. Steel Construction Manual

D. American Iron and Steel Institute (AISI):
   1. Specification for the Design of Cold-Formed Steel Structural Members.

E. American Welding Society (AWS):
   1. ANSI/AWS D1.1 Structural Welding Code - Steel.
   2. ANSI/AWS D1.3 Structural Welding Code - Sheet Steel.

F. National Association of Architectural Metals Manufacturers (NAAMM):
   1. NAAMM AMP-555, Code of Standard Practice for the Architectural Industry
      a. Class 1, Architectural.
   2. NAAMM AMP 521, Pipe Railings Systems Manual, and NAAMM AMP-510, Metal Stairs Manual.

G. Workmanship Standards:
   1. Railing System Joints: Continuous fillet weld. Type 1 Railing System Joint Construction.
   2. Comply with National Ornamental & Miscellaneous Metals Association (NOMMA).

1.3 SUBMITTALS

A. See Section 01 33 00 for requirements.

B. Product Data:
   1. For each type of material and accessory.

C. Shop Drawings:
   1. Layout drawings indicating rise and run.
   2. Include full sections, details, handrails, guardrails and anchoring methods.

D. Project Information:
   1. Structural calculations for stairs, handrails, guardrails and embeds indicating design conforms to specified design criteria, sealed by the Specialty Structural Engineer.
      a. Submit concurrent with Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Steel Stairs and Railing:
   1. Shop fabricated.

B. Galvanizing Repair Paint:
   1. Base:
      a. Tnemec.
   2. Optional:
      a. ZRC Worldwide.
      b. Sherwin-Williams.

C. Shop Primer:
   1. Base:
      a. As recommended by finish coat manufacturer for substrate.
   2. Optional:
      a. Sherwin-Williams.
      b. Tnemec.

D. Non-shrink Grout:
   1. Base:
      a. Dayton Superior Corporation.
   2. Optional:
      a. Sauereisen.
      b. CGM Building Products (Por-Rok).

E. Abrasive Warning Tape:
   1. Base:
      a. 3M.

F. Other manufacturers desiring approval comply with Section 01 61 00.

2.2 DESIGN CRITERIA

A. Design, fabricate, and install in compliance with applicable codes.
   1. Enclosed Stairs: Commercial Class per latest edition NAAMM AMP-510, Metal Stairs Manual.
   2. Non-enclosed and monumental stairs: Architectural Class per latest edition NAAMM AMP-510, Metal Stairs Manual.

B. Fabricate and design stair and landing assembly to support larger of following loads, whichever results in strongest components:
   1. Design Concentrated Moving Load: 300 LBS.
   2. Design Uniform Load: 100 PSF.
   3. Form surface with slip resistant materials.
      a. See Section 03 35 00.

C. Handrails and Guardrails:
   1. Form to profiles indicated.
   2. Utilize following loads for design of indicated members and their direct or indirect connection to building superstructure.
      a. Handrails and top rail of Guardrails, Uniform Load: 50 LBS/LF minimum applied in any direction.
      b. Handrails, Concentrated Load: 200 LBS minimum applied in any direction at any point along rail.
      c. Guardrail, Concentrated Load: 200 LBS minimum applied in any direction at any point along rail.
      d. Uniform and concentrated loads need not be concurrently applied.
   3. Intermediate Rails, Balusters, Panels, and other Infill Materials:
      a. Design to withstand a horizontal applied normal load of 50 LBS minimum on an area not to exceed 1 SQFT including openings and space between rails.

D. Support stairs at locations indicated.

2.3 MATERIALS

A. Hangers:
   1. Minimum 1/2 IN diameter steel rod.
   2. Connect hangers to beams only.
   3. Hanger-slab connections are not permitted.
   4. Maximum 2 IN eccentricity from beam centerline to hanger centerline.
   5. Connect hangers to structure with through-bolt type connections when in tension.
      a. Recess top plate and nut in slab and grout smooth.
   6. Expansion anchor type connections in tension are not allowed.

B. Support Brackets and Posts:
   1. Attach to structure as required, use welded connections wherever possible.
   2. Use concrete expansion anchors for shear connections only.

C. Stringers:
   1. Channel shape: 3/16 IN x 12 IN deep steel plate, minimum.
   2. Outside stringers shall span flight length plus landing.
      a. Intermediate supports are not allowed without prior approval.

D. Treads:
   1. Minimum 14 GA steel pans with angle supports as required.

E. Risers:
   1. Minimum 14 GA steel.

F. Landings:
   1. Minimum 10 GA pans with angle supports as required.

G. Metal Lath:
   1. Self-furring diamond mesh with dimples or embossed ribs.
   2. Maintain metal lath, 1/4 IN minimum, above tread and landing steel pans.

H. Abrasive Warning Tape:
   1. Base Product: Safety-Walk 630 General Purpose Tread by 3M.
   2. Use at first and last stair nosings of stair runs.
   3. Self-adhering tape with slip resistant mineral surface.
   4. Color: Safety Yellow.
   5. Width: 2 IN, except where noted otherwise.
   6. Thickness: 0.03 IN.
   7. Do not use where rubber stair treads or carpet is scheduled.

I. Handrails:
   1. Round Tube: HSS 1.66.x 0.140; ASTM A500.
   2. Minimum Clearance from wall: 2-1/4IN
   3. Maximum projection from wall: 4-1/2 IN.
   4. Maximum span between mounting brackets and/or newel posts: 8 FT.
   5. Return ends of wall mounted rails to wall.
   6. Make rails smooth with no projections to prevent a hand from sliding along entire length.

J. Guardrails:
   1. Increase sizes where appropriate to resist design loads.
   2. Refer to drawings for depiction of guardrails.
   3. Maximum span between mounting brackets and newel posts: 8 FT.
   4. Newel posts:
      a. Round tube: HSS 1.66.x 0.140; ASTM A500.
      b. Round tube: Schedule 40 Pipe: 1-1/4 IN STD; ASTM A53.
   5. Top rails and bottom rails:
      a. Round tube: HSS 1.66.x 0.140; ASTM A500.
      b. Schedule 40 is acceptable substitution for HSS 1.66.
   6. Balusters/pickets:
      a. Definition: Vertical elements spanning between top rails and bottom rails in a guardrail panel.
      b. Round bar: 1/2 IN.
   7. Intermediate Rails:
      a. Construct parallel to top and bottom rails and spanning the length of a guardrail panel.
      b. Use only in non-public areas.
      c. Round tube: HSS 1.50.x 0.083; ASTM A500.

K. Non-shrink Grout:
   1. Compressive strength: 6,000 PSI at 7 days.
   2. Base Product: 1107 Advantage Grout by Dayton Superior Corporation.

L. Anchorage Devices:
   1. Items required securing wood to metal, wood to masonry, metals to masonry, or concrete, metal-to-metal or metal to other items.
   2. Galvanized or stainless where built into exterior walls.
   3. Select fasteners for type, grade, and class required.
   4. Bolts and Nuts: Regular hexagon head ASTM A307, Grade A.
   5. Lag Bolts: Square or octagonal head type.
   6. Machine Screws: Cadmium plated steel.
   7. Wood Screws: Flat head carbon steel.
   8. Plain Washers: Round, carbon steel.
   9. Lock Washers: Helical spring carbon steel.
   10. Lead expansion shields for machine screws and bolts 1/4 IN and smaller: Head out embedded nut type.
      a. For machine screws and bolts larger than 1/4 IN: Manufacturers' standard.

2.4 FABRICATION

A. Form to shapes indicated with straight lines, sharp angles, and smooth curves.

B. Drill or punch holes with smooth edges for temporary field connections and attachment by work of other trades.

C. Qualify welding processes and welding operators in accordance with American Welding Society.

D. Make permanent shop and field connections with continuous fillet type welds.

E. Grind exposed welds smooth and blend seamlessly into pipe.

F. Conceal fastenings where practicable.

G. Shop fabricate in as large assemblies as practicable.

H. Meet requirements specified under Structural Steel for fabricating items of structural nature or use.

2.5 FINISHES

A. Shop Primer for Interior (non-wet) Items:
   1. Coordinate with finish systems specified in Sections 09 91 10 and 09 96 00.
   2. Apply primer for interior finish paint to following surfaces not receiving other coating:
      a. Surfaces exposed on interior.
   3. Clean thoroughly before priming; remove mill scale, rust, dirt, oil, and grease in accordance with SSPC-SP3.
   4. Apply in accordance with paint manufacturer's instructions.
      a. Apply minimum 0.002 IN, dry film thickness.

B. Field Applied Finish Paint:
   1. See Sections 09 91 10 and 09 96 00.

C. Hot-dip Galvanized (HDG) Coating for Exterior items:
   1. Galvanize following items:
      a. Handrails, guardrails and items installed outside building enclosure on site, roof, and walls.
      b. Items installed in wet or humid areas of greater than70 PCT RH, inside building.
      c. Apply HDG coating after cutting, drilling, grinding, welding and other fabrication has been completed.
   2. Clean thoroughly prior to galvanizing.
   3. Galvanize in accordance with ASTM A123.

D. Galvanizing Repair Coating:
   1. Tnemec Series 94-H20 Hydro-Zinc.
   2. ZRC Worldwide, Galvilite 221.
   3. Sherwin Williams Zinc Clad III HS 100.

E. Finish Painting:

PART 3 - SEE SECTIONS 09 91 10 AND 09 96 00.EXECUTION

3.1 INSPECTION

A. Verify suitability of substrate to accept installation.

B. Installation constitutes acceptance of responsibility for performance.

C. Verify wall backing has been installed where required for handrails and similar wall-mounted items.

3.2 INSTALLATION

A. General:
   1. Shim and grout as required to set work plumb, level, and true to line.
   2. Weld field connections and grind smooth.
   3. Conceal fastenings where practical.
   4. Secure metal to wood with lag screws and washers.
   5. Secure metal to concrete with embedded anchors, setting compounds, caulking and sleeves, or setting grout.
   6. Meet design requirements for erecting structural components.
   7. Do not field splice fabricated items unless size requires splicing.
   8. Weld splices and grind smooth.
   9. Provide fabricated items complete with attachment devices as required to install.

B. Galvanic Repair:
   1. Repair abraded areas with galvanizing paint in accordance with manufacturer's recommendations.
   2. Surface preparation: Remove contaminates in accordance with SSPC SP-1.

C. Handrails:
   1. Furnish handrails complete with brackets.
   2. Coordinate locations and installation of wall backing.
   3. Where posts are indicated to be set in sleeves, provide galvanized steel sleeves having a minimum wall thickness of 1/8 IN.
   4. Set newels or balusters in sleeves with non-shrink grout.
   5. Where setting is required for exterior, hold non-shrink grout back 1/4 IN from surface and fill flush with self-leveling sealant.

D. Abrasive Warning Tapes:
   1. Schedule installation immediately prior to Substantial Completion.
   2. Clean and prepare surfaces to receive tape prior to application.
   3. Apply tape in accordance with manufacturer's instructions.
   4. Where tape is damaged by construction activities, remove, clean, and reapply new material.

END OF SECTION

SECTION 05 52 05
STEEL RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Steel handrail, stair rail and guardrail.
   2. Steel guardrail gates.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 05 50 00 - Metal Fabrications.
   4. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. U.S. Department of Justice, Architectural and Transportation Barriers Compliance Board (Access Board):
      a. Americans with Disabilities Act (ADA):
         1) Accessibility Guidelines for Buildings and Facilities (ADAAG).
   2. ASTM International (ASTM):
      a. A36, Standard Specification for Carbon Structural Steel.
      b. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
      c. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
      d. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
      e. A501, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
   3. American Welding Society (AWS):
      a. D1.1, Structural Welding Code - Steel.
   4. National Association of Architectural Metal Manufacturers (NAAMM):
      a. AMP 521, Pipe Railing Systems Manual.
   5. Occupational Safety and Health Administration (OSHA):
      a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.
   6. Building code:
      a. California Building Code (CBC):
         1) California Building Code and associated standards, 2019 Edition including all amendments, referred to herein as Building Code.

B. Qualify welding procedures and welding operators in accordance with AWS.

1.3 DEFINITIONS

A. Hardware: As defined in ASTM A153/A153M.

B. Galvanizing: Hot-dip galvanizing per ASTM A123/A123M or ASTM A153/A153M with minimum coating of 2.0 OZ of zinc per square foot of metal (average of specimens) unless noted otherwise or dictated by standard.

C. Guardrail: A system of building components located near the open sides of elevated walking surfaces for the purpose of minimizing the possibility of an accidental fall from the walking surface to the lower level.

D. Handrail: A horizontal or sloping rail intended for grasping by the hand for guidance or support.

E. Railing: A generic term referring to guardrail, handrail and/or stair rails.

F. Stair Rail: A guardrail, installed at the open side of stairways with either a handrail mounted to the inside face of the guardrail, or where allowed by applicable codes, with the top rail mounted at handrail height and serving the function of a handrail.

1.4 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Fabrication and/or layout drawings.
   a. Plan showing profile, location, section and details of each railing, and type and details of anchorage system.
   b. Location and type of expansion joints.
   c. Materials of construction including shop-applied coatings.
3. Product technical data including:
   a. Acknowledgement that products submitted meet requirements of standards referenced.
   b. Manufacturer's installation instructions.

B. Informational Submittals:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Certification of welders and welding procedures indicating compliance with AWS.
3. Certification that railings have been designed and fabricated to meet the loading requirements specified.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver and handle railings to preclude damage.

B. Store railings on skids, keep free of dirt and other foreign matter which will damage railings or finish and protect from corrosion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Welded railing systems:
   a. Any manufacturer meeting this Specification Section.
2. Galvanizing repair paint:
   a. ZRC Products.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. Pipe: ASTM A53, Types E or S, Grade B, or ASTM A501.

B. Steel Sheet, Bar (Pickets) and Plate: ASTM A36.

C. Galvanizing Repair Paint:
1. High zinc dust content paint for regalvanizing welds and abrasions.
2. Dried film shall contain not less than 95 PCT zinc dust by weight.
3. ZRC Products "ZRC."

D. Expansion and Adhesive Anchors: See Specification Section 05 50 00.

E. Welding Electrodes: AWS D1.1, E70 Series.

2.3 FABRICATION

A. General:
   1. Verify field conditions and dimensions prior to fabrication.
   2. For fabrication of items which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness.
      a. Remove blemishes by grinding and buffing or by welding and grinding, prior to cleaning, treating and application of surface finishes.
   3. Form exposed work with smooth, short radius bends, accurate angles and straight edges.
      a. Ease exposed edges to a radius of approximately 1/32 IN.
      b. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
   4. Form exposed connections with flush, smooth, hairline joints, using galvanized steel splice locks to splice sections together or by welding.
   5. Provide for anchorage of type indicated on the Drawings or as required by field conditions.
      a. Drill or punch holes with smooth edges.
   6. Design railing and anchorage system in accordance with NAAMM AMP 521 to withstand loading as required by Building Code.
   7. Design railings in accordance with accessibility requirements per the Building Code and ADAAG.

B. Custom fabricate pipe railings to dimensions and profiles indicated.
   1. Guardrails:
      a. 1-1/2 IN nominal diameter pipe.
      b. Top rails and intermediate rails: Schedule 40.
      c. Vertical posts: Schedule 80.
   2. Handrails mounted to walls or guardrail vertical posts: 1-1/4 IN nominal diameter Schedule 40 pipe.
   3. Where details are not indicated, space intermediate rails to requirements of the Building Code or OSHA Standards, whichever requires the more restrictive design.
   4. Space vertical posts as required by loading requirements but not more than 6 FT OC.
      a. Avoid locating vertical posts at changes in direction of railing.
      b. Hold vertical post back from corner and provide radiused corners.
   5. Space handrail brackets as required by loading requirements but not more than 6 FT OC.
   6. Base plate for vertical guardrail posts mounted to top of concrete surface:
      a. 3/8 x 6 x 6 IN square plate welded to the vertical post.
      b. Predrilled to accept four (4) anchors.
   7. Base plate for vertical guardrail post mounted to metal structure:
      a. 3/8 x 2-1/2 x 8 IN plate welded to the vertical post.
      b. Predrilled to accept two (2) fasteners.
   8. Mounting bracket for vertical guardrail post mounted to vertical concrete surface or web of metal structural member:
      a. Pair of 3/8 IN angles or bent plates welded to vertical posts.
      b. Predrilled to accept two (2) fasteners each.
      c. Provide 1/4 x 4 IN high toeboards at elevated walkways and platforms, where indicated on the Drawings or required by OSHA Standards.
         1) Clearance between bottom of toeboard and walking surface shall not exceed 1/4 IN.
      d. Guardrail gates:
         1) Constructed of same material and sizes as the guardrail system.
         2) Width of gate as shown on Drawings.
         3) Hinges:
            a) Self-closing.

(1) Stainless steel torsion spring.
b) Similar to Wagner, Model "IR100."
4) Gate latch and stop:
a) Spring-loaded pin latch.
(1) Stainless steel spring.
b) Similar to Wagner, Model "IR101."

C. Welded Railing Fabrication:
1. All welding to be continuous in accordance with AWS D1.1.
a. All welded railing joints shall have full penetration welds.
2. All exposed welds to be ground and buffed smooth and flush to match and blend with adjoining surfaces.
a. NAAMM AMP 521, Type 2.
3. No ragged edges, surface defects, or undercutting of adjoining surfaces will be accepted.
4. Fit exposed ends of guardrails and handrails with solid terminations.
a. Return ends of handrails to wall but do not attach to wall.
5. Preassemble items in shop to greatest extent possible to minimize field splicing and assembly of units at project site.

D. Install weeps to drain moisture from hollow sections of railing at exterior locations and in high humidity areas.
1. Drill 1/4 IN weep hole in railings closed at bottom:
a. 1 IN above walkway surface at bottom of posts.
1) 1 IN above solid rod at removable railing sections.
b. At low point of intermediate rails.
c. Drill hole prior to galvanizing.
d. Do not drill weep holes:
1) In bottom of base plate.

E. Expansion Joints:
1. Joints to be designed to allow expansion and contraction of railing and still meet design loads required.
a. Top rail splices and expansion joints shall be located within 8 IN of post or other support.
b. Where railings span building expansion joints; provide a railing expansion joint in the span crossing the building expansion joint.
2. Provide expansion joints in any continuous run exceeding 20 FT in length.
a. Space expansion joints at not more than 40 FT on center.
3. Provide minimum 0.10 IN of expansion joint for each 20 FT length of top rail for each 25 DegF differential between installation temperature and maximum design temperature.
a. Maximum expansion joint width at time of installation shall not exceed 3/8 IN.
1) Provide additional expansion joints as required to limit expansion joint width.
4. Provide slip-joint with internal sleeve.
a. Extend slip joint min 2 IN beyond joint at maximum design width.
b. Fasten internal sleeve securely to one side
1) Provide allen-head set screw located in bottom of rail.
2) Rivets or exposed screw heads are not acceptable.

F. Finish:
1. Hot-dip galvanize after fabrication.
2. Powder coated:
a. Hot-dip galvanize after fabrication.
b. Prepare galvanized surfaces in accordance with ASTM D6386.
c. PVDF powder coating:
1) Minimum 70 PCT resin content.
2) Meet requirements of AAMA 2605.
d. Color: Per Owner.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prior to installation, inspect and verify condition of substrate.

B. Correct surface defects or conditions which may interfere with or prevent a satisfactory installation.

3.2 INSTALLATION

A. Install handrails and guardrails to meet loading requirements of the Building Code.

B. Install products in accordance with NAAMM AMP 521 and manufacturer's instructions.

C. Set work accurately in location, alignment and elevation; plumb, level, and true.
   1. Measure from established lines and items which are to be built into concrete, masonry or similar construction.

D. Align railings prior to securing in place to assure proper matching at butting and expansion joints and correct alignment throughout their length.
   1. Provide shims as required.

E. Install proper sized expansion joints based on temperature at time of installation and differential coefficient of expansion of materials in all railings as recommended by manufacturer.
   1. Lubricate expansion joint splice bar for smooth movement of railing sections.

F. Provide removable railing sections where indicated on Drawings.

G. Attach handrails to walls or guardrails with brackets designed for condition.
   1. Provide brackets which provide a minimum 1-1/2 IN clearance between handrail and nearest obstruction.
      a. Handrails shall not project more than 4-1/2 IN into required stairway width.
   2. Anchor handrail brackets to concrete walls with 1/2 IN stainless steel adhesive anchors and stainless steel hex head bolts.

H. Anchor railings to concrete with minimum 1/2 IN stainless steel adhesive anchors with stainless steel bolts, nuts and washers unless noted otherwise in the Contract documents.
   1. Where exposed, bolts shall extend minimum 1/2 IN and maximum 3/4 IN above the top nut.
      a. If bolts are cut off to required height, threads must be dressed to allow nuts to be removed without damage to the bolt or the nut.
      b. Bevel the top of the bolt after cutting to provide a smooth surface.

I. Anchor railings to metal structure with minimum 3/4 IN stainless steel bolts, nuts and washers.

J. Install toeboards to fit tight to the walking surface.
   1. Attach to railing vertical post with manufacturer's standard mounting clamp:
      a. Adjustable.
      b. Designed to engage in extruded slot on back of toeboard.
   2. Provide splice bars, corner splices and brackets:
      a. Manufacturer's standard items as required for a complete installation.
   3. Notch toeboards at base plates or other obstructions.
   4. Bottom of toeboard shall not exceed 1/4 IN above walking surface.

K. Repair damaged galvanized surfaces in accordance with ASTM A780.
   1. Properly prepare surface in accordance with galvanizing repair paint manufacturer's recommendations.
   2. Apply minimum 6 mils DFT of galvanizing repair paint in accordance with manufacturer's recommendations.

L. Prepare and paint railings in accordance with Specification Section 09 96 00.

M. Provide railings as required for stair construction identified in Specification Section 05 50 00.

N. Install guardrail gate plumb and level in location shown on Drawings.
   1. Center gate in opening.
   2. Top of gate to match top of guardrail.
   3. Fasten hinges to gate and jamb post:
      a. Minimum three (3) 1/4 IN stainless steel countersunk machine screws per leaf.
      b. Drill and tap into railing and gate vertical posts.
   4. Provide not less than two (2) hinges per gate.
   5. Install gate latch and stop on strike side of opening.
      a. Fasten to gate with 1/4 IN stainless steel countersunk machine screws.
      b. Drill and tap into gate vertical post.
      c. Drill hole in railing vertical post to receive latch pin.
   6. Adjust to provide smooth operation:
      a. Self-closing and self-latching.

END OF SECTION

DIVISION 06

WOOD, PLASTICS, AND COMPOSITES

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Rough carpentry.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 03 15 19 – Anchorage to Concrete

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. The Engineered Wood Association (APA):
      a. PRP-108, Performance Standards and Qualification Policy for Structural Use Panels.
      b. U450, Storage and Handling of APA Trademarked Panels.
      c. Y510, Plywood Design Specification.
   2. ASTM International (ASTM):
      a. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
      b. D153, Standard Test Methods for Specific Gravity of Pigments.
      c. D2898, Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing.
      d. D4442, Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.
      e. D4444, Standard Test Method for Laboratory Standardization and Calibration of Hand-Held Moisture Meters.
      f. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
   3. American Wood Protection Association (AWPA):
      a. M2, Standard for Inspection of Preservative Treated for Industrial Use.
      b. M3, Standard for the Quality Control of Preservative Treated Products for Industrial Use.
      c. M4, Standard for the Care of Preservative-Treated Wood Products.
      d. P5, Standard for Waterborne Preservatives.
      e. U1, Use Category System: User Specification for Treated Wood.
   4. American National Standards Institute/Single Ply Roofing Industry (ANSI/SPRI):
      a. ES-1, Wind Design Standard for Edge Systems Used with Low Slope Roof Systems.
   5. Environmental Protection Agency (EPA).
   6. FM Global (FM):
      a. 1-49, Property Loss Prevention Data Sheets - Perimeter Flashing.
   7. National Institute of Standards and Technology (NIST):
      a. PS 1, Quantitative NMR (Benzoic Acid).
      b. PS 20, American Softwood Lumber Standard.
   8. Underwriters Laboratories, Inc. (UL):
      a. 723, Standard for Test for Surface Burning Characteristics of Building Materials.

B. Qualifications:
   1. Wood Treatment Plant: AWPA M3.
   2. Treated Wood Inspection: AWPA M2.

C. Miscellaneous:
   1. Factory marking:

a. Lumber:
    1) Identify type, grade, moisture content, inspection service, producing mill, and other qualities specified.
    2) Marking may be omitted, as allowed by the building code, if certificate of inspection is provided for each shipment.

1.3 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Fabrication drawings of all fabricated items.
3. Product technical data including:
    a. Acknowledgement that products submitted meet requirements of standards referenced.
    b. Manufacturer's installation instructions for all products specified.
4. Certifications:
    a. Chemicals used in treatment process are registered with and approved by EPA.
    b. Moisture content of material prior to treatment: 25 PCT maximum.
    c. Material has been kiln-dried after treatment (KDAT) to the moisture content specified.
5. Documentation of treatment of treated material in accordance with standards referenced.

1.4 DELIVERY AND STORAGE

A. Delivery, storage and handling of untreated wood products:
1. Lumber: As recommended by the grading agency indicated on the grade stamp.
2. Plywood: APA U450.

B. Delivery, storage, handling and disposal of treated wood products: AWPA M4.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. General:
1. Lumber (for framing, blocking, nailers, furring, grounds and similar members):
    a. NIST PS 20.
    b. Species:
        1) Treated material: As indicated in the appropriate AWPA standard.
            a) Provide species of FRTM as necessary to achieve UL rating listed.
    c. Grade:
        1) For nominal sizes up to and including 2 x 4: Standard and better.
        2) For nominal sizes up to 2 IN thick and wider than 4 IN: #2 and better.
2. Non-structural plywood:
    a. NIST PS 1.
    b. C-C plugged:
        1) Exposure: EXT.
        2) Thickness: 5/8 IN.
        3) Touch sanded.

B. Preservative Treated Material:
1. Moisture content:
    a. Prior to treatment: 25 PCT.
    b. Kiln-dry after treatment (KDAT), ASTM D4442 and ASTM D4444:

1) Lumber: 19 PCT maximum.
2) Plywood: 18 PCT maximum.

2. Preservative:
   a. Waterborne: AWPA P5.
   b. As indicated in the appropriate AWPA standard.
3. Pressure-treat material in accordance with AWPA U1.
4. Wherever practicable, material to be treated shall be manufactured in its final form prior to treatment.

C. Fire-Retardant Treated Material (FRTM):
1. Acceptable manufacturer:
   a. Hoover Treated Wood Products, Inc.:
      1) Interior: "Pyro-Guard".
      2) Exterior: "Exterior Fire-X".
2. Maximum moisture content:
   a. Prior to treatment: 25 PCT.
   b. Kiln-dry after treatment (KDAT), ASTM D4442 and ASTM D4444:
      1) Lumber: 19 PCT (KDAT).
      2) Plywood: 15 PCT (KD-15).
3. Fire-retardant preservative:
   a. Provide protection against decay:
      1) EPA registered for use as a wood preservative.
   b. Shall not bleed-through or adversely affect bond of any finish.
4. Pressure-treat material in accordance with AWPA U1.
5. UL Classified:
   a. FR-S, UL 723.
   b. Exterior: No increase in classification when subjected to the Standard Rain Test, ASTM D2898.
   c. Provide UL mark on each piece of FRTM.
6. Maximum flame spread rating: 25, ASTM E84.
7. Wherever practicable, material to be treated shall be manufactured in its final form prior to treatment.

D. Fasteners and Anchors:
1. Nails and screws:
   a. Dry, non-corrosive exposure: Hot dipped galvanized meeting ASTM D153 or Type 304 stainless steel.
   b. Wet, corrosive, marine, and/or below grade: Type 316 stainless steel.
2. Adhesive anchors, expansion anchors, self-tapping concrete anchors, bolts, nuts, and washers: See Specification Section 03 15 19.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify measurements, dimensions, and shop drawing details before proceeding.

B. Coordinate location of studs, nailers, blocking, grounds and similar supports for attached work.

C. Eliminate sharp projections which would puncture roofing, flashing or underlayment material.

3.2 ERECTION AND INSTALLATION

A. General:
1. Provide preservative treated material for all wood used:
   a. Outside building.
   b. Below grade.
2. Provide fire-retardant treated material for all wood used:
   a. Inside building.

b. Exterior building walls.
c. Roof construction.
d. Parapet walls.
e. Roofing nailers.

B. Attach work securely by anchoring and fastening as indicated or required to support applied loading.
1. Anchor wood to concrete using adhesive or expansion anchors as specified in Specification Section 03 15 19.
a. Separate wood from direct contact to concrete with polyethylene foam gasket strip.
1) Size: 1/4 IN by width of wood member.
2) Owens Corning "SillSealR".
2. Anchor wood to metal using bolts and nuts as specified in Specification Section 03 15 19.
3. Provide flat washers under all bolt heads and nuts.
4. Fasten plywood in accordance with APA recommendations.
5. Use fasteners of size that will not penetrate members where opposite side will be exposed to view or receive finish materials.
6. Install fasteners without splitting of wood; predrill as required.
7. Do not drive threaded friction type fasteners.
8. Tighten bolts and lag screws at installation and retighten as required.

C. Set work to required levels and lines, plumb, true.
1. Shim as required.
2. Cut and fit accurately.

D. Provide wood grounds, nailers, or blocking where required for attachment of other work and surface applied items.
1. Form to shapes indicated or required.
a. FRTM lumber:
1) Do not rip or mill.
2) Cross-cutting and drilling are allowable in accordance with manufacturer's recommendations and UL requirements.
3) Resurfacing, planing or fabrication of special shapes or profiles shall be done prior to treatment.
b. FRTM plywood:
1) Cross-cutting, ripping and drilling are allowable in accordance with manufacturer's recommendations and UL requirements.
c. Light sanding of FRTM as permitted by UL to remove raised grain or prepare for finishing is allowable.
d. Field treat cuts and holes in preservative treated material in accordance with AWPA M4 and manufacturer's published recommendations.
2. Grounds:
a. Dressed, key beveled lumber minimum 1-1/2 IN wide of thickness required to bring face of ground even with finish material.
b. Remove temporary grounds when no longer required.
3. Install roofing nailers as necessary for attachment of flashing, curbs, fascia, coping, and related accessories:
a. Match height of nailers to insulation.
b. Anchor nailers to resist force of 300 PLF unless required otherwise by FM Global or roofing manufacturer.
1) Metal decking attachment:
a) Attach base nailer to metal roof deck using self-tapping stainless steel sheet metal screws (STSMS) with plate washers or with minimum 3/8 IN Type 304 stainless steel hex head bolts with nuts and washers.
b) Countersink heads of bolts flush with top of nailer.
2) Concrete decking attachment:

a) Attach base nailer to concrete roof deck using minimum 3/8 IN stainless steel adhesive anchors with minimum 3 IN embedment.
b) Countersink heads of bolts flush with top of nailer.

3) Provide size and spacing of anchorage as required to meet loading criteria specified.
a) Fasten blocking for perimeter flashing in accordance with ANSI/SPRI ES-1 and FM Global 1-49.

c. Provide 1/2 IN vent spaces between lengths of nailers.
d. Install nailers over vapor retarder.

E. When wood has been exposed to moisture allow to completely dry out prior to covering with additional wood or another material.

F. Correct or replace wood which shows bowing, warping or twisting to provide a straight, plumb and level substrate for applications of other materials.

END OF SECTION

SECTION 06 41 00
ARCHITECTURAL CABINETWORK (MILLWORK)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Architectural cabinetwork within the scale house buildings.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 07 92 00 - Joint Sealants.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Americans with Disability Act (ADA):
      a. Accessibility Guidelines for Buildings and Facilities (ADAAG) as expressed in the 2019 California Building Code Chapter 11B
   2. American National Standards Institute (ANSI):
      a. A161.2, Decorative Laminate Countertops, Performance Standards for Fabricated High Pressure.
      b. A208.1, Particleboard.
      c. A208.2, Medium Density Fiberboard (MDF) for Interior Applications.
   3. American National Standards Institute/American Hardboard Association (ANSI/AHA):
      a. A135.4, Basic Hardboard.
   4. ASTM International (ASTM):
      a. D4442, Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.
      b. D4444, Standard Test Method for Laboratory Standardization and Calibration of Hand-Held Moisture Meters.
      c. F1861, Standard Specification for Resilient Wall Base.
   5. Architectural Woodwork Institute (AWI):
      a. Architectural Woodwork Quality Standards:
         1) Section 300, Standing and Running Trim.
   6. American Wood Protection Association (AWPA):
      a. U1, Use Category System: User Specification for Treated Wood.
   7. Builders Hardware Manufacturers Association (BHMA).
   8. Hardwood Plywood and Veneer Association (HPVA):
      a. HP-1, Standard for Hardwood and Decorative Plywood.
   9. National Electrical Manufacturers Association (NEMA):
      a. LD 3, High-Pressure Decorative Laminates (HPDL).
   10. Woodwork Institute of California (WIC).

B. Qualifications:

C. Miscellaneous:
   1. Construction details, fastening, tolerances and workmanship: WIC custom grade standards with exceptions indicated.

1.3 DEFINITIONS

A. Architectural Cabinetwork: Millwork.

B. Exposed Surfaces:
   1. All surfaces visible when doors and drawers are closed, inside of doors, and:

a. Countertop and backsplash and their exposed edges.

C. Concealed Surfaces:
1. Surfaces not visible after installation, and:
a. Web frames.
b. Dust panels.

D. Semi-Exposed Surfaces:
1. All other surfaces not exposed or concealed.

1.4 SYSTEM DESCRIPTION

A. Fabricated cabinets including all hardware, countertops, and finishing thereof.

1.5 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Product technical data including:
a. Acknowledgement that products submitted meet requirements of standards referenced.
b. Manufacturer's installation instructions.
3. Fabrication drawings and details showing compliance with this Specification Section.

B. Samples:
1. Plastic laminate color and finish samples for Engineer's selection.
2. PVC edging: Manufacturer's complete line of color samples.
3. Resilient base manufacturer's full range of colors and styles for Engineer's selection.

C. Informational Submittals:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Millwork fabricator experience qualifications.
3. Listing of millwork fabricators projects within last two years with similar scope.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver countertops to the Project Site and store in the area in which items will be installed.
1. Building areas to receive countertops shall be enclosed, weathertight and conditioned to a relative humidity between 25 PCT and 55 PCT before, during and after installation.
2. Remove any plastic packaging or wrapping from countertops upon delivery to Project Site.
3. Protect stored items from damage with vapor-permeable covering during storage.
4. Allow material to acclimate to the surrounding environment a minimum of 96 HRS prior to installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Plastic laminate:
a. Formica Corporation.
b. Nevamar by Panolam Surface Systems.
c. Wilsonart Engineered Surfaces.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. Plastic Laminate:
1. NEMA LD 3 high-pressure laminate, matte finish.

2. Countertops and backsplashes and their edges: Grade GP50, 0.050 IN thick.
3. All other exposed surfaces: Grade GP28, 0.028 IN thick.

B. Particleboard:
1. Three-ply, medium density industrial particleboard.
2. ANSI A208.1: Grade M-2 or M-3.
3. Density: 45 PCF minimum.
4. Particleboard used for countertops:
a. ANSI A161.2.
b. Moisture resistant.

C. Fiberboard:
1. Medium density wood fiberboard.
2. ANSI A208.2: Interior Grade M.

D. Hardboard:
1. Tempered, smooth on both sides.
2. ANSI/AHA A135.4: Class 1, S2S.

E. Plywood: Softwood plywood, A grade.

F. Hardwood:
1. Solid, S4S.
2. WIC, custom grade, , for exposed surfaces.
3. Exposed: Species to match veneer plywood unless noted otherwise on Drawings.
4. Other locations: Any hardwood.

G. PVC Edging:
1. Polyvinyl chloride edge banding, machine applied and trimmed:
a. Hot melt glue per PVC manufacturer's recommendations.
b. T-edging will not be allowed.

H. Preservative Treated Lumber:
1. Preservative: Waterborne.
2. Moisture content:
a. Prior to treatment: 25 PCT.
b. Kiln-dry after treatment (KDAT), ASTM D4442, ASTM D4444: 19 PCT maximum.
3. Pressure treat material in accordance with AWPA U1, Use Category UC2.

I. Sealant:
1. Silicone.
2. See Specification Section 07 92 00.

2.3 FABRICATION

A. General:
1. Custom shop or factory built countertops, complete with all accessories, in sizes and configurations indicated.

B. Plastic laminate countertops:
1. Use maximum size sheet of laminate to eliminate joints in laminate.
2. Backsplash: Glued and screwed onto top, with edges scribed.
3. If joints in plastic laminate are required locate not closer than 24 IN to sinks.
4. Joints in counter length: Factory fitted, splined, glued, and mechanically fastened.
5. Apply laminate front edge before top laminate.
6. 3/4 IN thick, built up to 1-1/4 IN at edges.
7. Colors:
a. Allow for different countertop colors.
8. PVC edging:
a. Thickness:
1) Case body: 1 MM.

2) Door and drawer edges: 3 MM.

b. Color:
   1) 1 MM thick: Match adjacent plastic laminate.
   2) 3 MM thick: Accent color to be selected by Engineer from manufacturer's complete line of color samples.
   3) Allow for two different edging colors.

9. Use no blocking or fasteners in exposed or semi-exposed locations.
   a) Stainless steel, BHMA 630.
10. Countertop support brackets:
    a. Cold rolled steel.
    b. Size:
       1) Nominal 22 IN deep by 14 IN high.
       2) 3/4 IN wide.
    c. Tested to meet or exceed ANSI performance standards as established by BHMA.
       1) Load Rating: 1200 LBS per pair.
    d. Similar to Knape & Vogt "208 Series Ultimate L-Bracket."
    e. Finish:
       1) Corrosion resistant powder coating.
       2) Color: White.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify dimensions at site.

B. Verify locations of items specified in other Specification Sections.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Provide balanced construction on each plastic laminated item.

C. Use manufacturer's printed instructions or drawings in all cases where items or details are not indicated.

D. Provide all trim, fillers, closures, stands, supports, sleeves, collars, escutcheons, brackets, braces or other miscellaneous items required for complete installation.

END OF SECTION

DIVISION 07

THERMAL AND MOISTURE PROTECTION

SECTION 07 21 00
BUILDING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Building insulation.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 09 29 00 - Gypsum Board.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. C272/C272M, Standard Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions
      b. C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
      c. C518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
      d. C578, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
      e. C665, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
      f. D1621, Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
      g. E96/E96M, Standard Test Methods for Water Vapor Transmission of Materials.
   2. Underwriters Laboratories, Inc. (UL):
      a. Building Materials Directory.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Manufacturer's recommendations on sealants, tapes and mastics.

B. Informational Submittals:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Certification from insulation manufacturer stating that insulation proposed is acceptable for intended use per the Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Rigid extruded polystyrene board insulation:
      a. Dow.
      b. DiversiFoam Products.

c. Owens Corning.
2. Blanket or batt thermal insulation:
a. Owens Corning.
b. USG Corporation.
c. CertainTeed.
3. Vapor retarder:
a. Raven Industries, Inc.
b. Reef Industries, Inc.
c. Fortifiber Building Systems Group, Inc by Henry Company.
d. Alumiseal.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. General:
1. Foam plastic insulation used in buildings and structures shall comply with the requirements of the building code.
a. Surface burning characteristics: ASTM E84.
b. Flame spread index: Maximum 75.
c. Smoke developed: Maximum 450.

B. Rigid Polystyrene Board Insulation:
1. Extruded: ASTM C578, Type IV.
a. Water vapor transmission: ASTM E96/E96M, 1.1 perm-IN maximum.
b. Water absorption: ASTM C272/C272M, 0.3 PCT maximum.
c. Thermal resistance: ASTM C518 at 75 DEGF mean temperature, 5.0/IN.
2. Provide insulation designed for intended use.
a. Perimeter insulation and protection board.
1) Similar to Dow "Styrofoam PERIMATE."
2) Compressive strength: ASTM D1621, 30 PSI.
3) Thickness:
a) Perimeter insulation: 2 IN.
b) Protection board: 1 IN.
4) Edges:
a) Long edge: Shiplap.
b) Short edge: Square.
b. Cavity insulation:
1) Similar to Dow "CAVITYMATE."
2) Compressive strength: ASTM D1621, 15 PSI.
3) Thickness: 2 IN.
4) Edges: Square.

C. Sealant and Mastic (for setting polystyrene and/or polyisocyanurate insulation board): Manufacturer's recommended standard.

D. Blanket or Batt Thermal Insulation:
1. Glass or other inorganic fibers and resinous binders formed into flexible blankets or semi-rigid sheets.
2. Unfaced:
a. ASTM C665, Type 1.
3. Minimum thickness as noted on Drawings.

E. Vapor Retarder:
1. Fire rated, reinforced, 3 ply, Class 1 material.
2. Perm rating: Not exceeding 0.035 grains/HR-FT^2-IN-Hg when determined in accordance with ASTM E96/E96M.
3. Griffolyn "TX-1200FR."

F. Vapor Retarder Tape: As recommended by vapor retarder manufacturer.

G. Sound Control Insulation:
   1. Mineral wool batts.
      a. ASTM C665, Type I.
      b. UL listed when used in fire rated construction.
   2. Density: Minimum 2.5 PCF.
   3. Sound Reduction, ASTM C423.
      a. Minimum NRC for 3 IN thick material: 1.05.
   4. Thickness: As noted on Drawings.
   5. Thermafiber "SAFB".

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. General:
   1. Insulate full thickness over surfaces to be insulated.
   2. Fit tightly around obstructions, fill voids.
   3. Cover all penetrations (electrical junction boxes, switch boxes, piping, conduits, etc.) with insulation, taking care not to compromise the workings of the device.
   4. Fit butted joints of batt or blanket insulations tightly together.
   5. Apply single or double layer to achieve total thickness.
      a. If double layer is provided, stagger all joints minimum 12 IN.
   6. Do not use broken or torn pieces of insulation.
   7. Install so that completed installation is vapor tight.
      a. Seal all joints.
      b. Seal to abutting materials to maintain vapor retarder integrity.
      c. Provide manufacturer's recommended vapor retarder tape for use with faced batt insulation or separate vapor retarder.
         1) If vapor retarder tape fails to adhere to any surface, apply sprayed-on adhesive as recommended by tape manufacturer to promote adhesion.
      d. Provide manufacturer's recommended solvent-free sealant compatible with insulation board for rigid board insulation.
         1) Tape is not acceptable for use with rigid board insulation.

C. Blanket or Batt Insulation using Separate Vapor Retarder Sheet in Exterior Stud Wall Systems:
   1. Verify that all piping, conduit, electrical box and other in-wall work is complete prior to installing insulation and vapor retarder.
   2. Install insulation friction fit between studs.
   3. Tightly butt ends.
   4. Install vapor retarder to warm side of building exterior wall.
      a. Completely seal each wall area to surrounding construction.
   5. Install vapor retarder vertically.
      a. Use widest practical sheet.
      b. Install in continuous sheets, floor to structure above, without horizontal joints.
      c. Fold flaps of vapor retarder over studs.
      d. Tape flaps together continuously.
      e. Tape bottom and top edges to structure continuously.
      f. After installation of any additional conduit, boxes, piping or other items within wall system, repair all tears or penetrations of vapor retarder with vapor retarder tape prior to installation of gypsum board.

D. Rigid Board Insulation in Cavity Walls:
   1. Do not proceed with installation until subsequent work which conceals insulation is ready to be performed.
   2. Set each piece of insulation flush with the abutting piece to eliminate ledges in the face of the insulation.

3. Install mastic on face of concrete or masonry back-up in accordance with mastic and insulation manufacturer's recommendation.
4. Press courses of insulation between wall ties (horizontal reinforcing) with edges butted tightly both ways.
5. Set units firmly into mastic.
6. Seal all horizontal and vertical joints with sealant recommended by insulation manufacturer.
7. Do not use damaged insulation.

3.2 FIELD QUALITY CONTROL

A. Repair or replace damaged insulation and/or vapor retarder as directed by Engineer.

B. Provide minimum cover of 5/8 IN Type Xgypsum board over foam insulation exposed to the building interior.

END OF SECTION

SECTION 07 26 00
UNDER SLAB VAPOR RETARDER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Under slab vapor retarder for Scalehouses and Transfer Station Building Mechanical/Electrical wing.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):
      a. 302.2R, Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.
   2. ASTM International (ASTM):
      a. E1643, Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
      b. E1745, Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Product data sheet on vapor retarder sheet and vapor retarder tape.
      c. Product data sheets for all accessories proposed for use.
      d. Manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Vapor retarder:
      a. Fortifiber Building Systems Group, Inc. by Henry Company.
      b. Layfield Group, Ltd.
      c. ISI Building Products.
      d. Raven Industries, Inc.
      e. Reef Industries, Inc.
      f. Stego Industries, LLC.
      g. W.R. Meadows, Inc.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 PERFORMANCE REQUIREMENTS

A. Vapor Retarder:
   1. ASTM E1745, Class A.
   2. Thickness: Minimum 15 MIL.

3. Water vapor permeance: 0.02 maximum.

2.3 ACCESSORIES

A. Pipe Boots: Manufacturer's standard boot fabricated to maintain the integrity of the vapor retarder system at pipe penetrations through slab.

B. Vapor Retarder Tape: As recommended by vapor retarder manufacturers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Base material over which vapor retarder is to be installed shall be level, compacted and free of debris, foreign objects or other deleterious materials.

B. Surfaces at perimeter and penetrations of vapor barrier shall be clean, smooth and free of sharp objects, fins or projections.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions, ASTM E1643 and ACI 302.2R.

B. Provide vapor retarder under slab on grade concrete at Scalehouses and Transfer Station building mechanical/electrical area.
   1. Place continuous vapor retarder above granular fill subgrade material, unless noted otherwise. Refer to the drawings for details.

C. Lap minimum 6 IN and seal in accordance with ASTM E1643 and manufacturer's recommendations.

D. Extend to extremities of area and seal to adjacent elements.

E. Seal all penetrations: Provide pipe boot for all pipes or conduit penetrating the floor slab.

3.3 FIELD QUALITY CONTROL

A. Ensure proper precautions are implemented to prevent damage to installed vapor retarder membrane prior to and during pouring of concrete floor slab.

B. Inspect vapor retarder immediately prior to placement of concrete.
   1. Patch all punctures, tears, holes, etc.
      a. Patch small punctures with vapor retarder tape as allowed by ASTM E1643 and manufacturer's recommendations.
      b. Repair larger damage with additional layer of vapor retarder.
         1) Lap repairs minimum 6 IN beyond extent of damage in all directions.
         2) Seal perimeter of patch with vapor retarder tape or as recommended by manufacturer.

END OF SECTION

SECTION 07 53 25
ADHERED ELASTOMERIC (EPDM) SHEET ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Adhered elastomeric roofing for mechanical wing flat roof.
2. Roof insulation.
3. Vapor retarder.

B. Related Specification Sections include but are not necessarily limited to:
1. Division 00 - Procurement and Contracting Requirements.
2. Division 01 - General Requirements.
3. Section 06 10 00 - Rough Carpentry.
4. Section 07 62 00 - Flashing and Sheet Metal.
5. Section 13 34 19 Metal Building Systems.
6. Section 26 05 00 - Electrical - Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
1. ASTM International (ASTM):
   a. C578, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
   b. C642, Standard Test Method for Density, Absorption, and Voids in Hardened Concrete.
   c. D395, Standard Test Methods for Rubber Property - Compression Set.
   d. D573, Standard Test Method for Rubber - Deterioration in an Air Oven.
   e. D746, Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
   f. D4637/D4637M, Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane.
   g. D6294/D6294M, Standard Test Method for Corrosion Resistance of Ferrous Metal Fastener Assemblies Used in Roofing and Waterproofing.
   h. E96/E96M, Standard Test Methods for Water Vapor Transmission of Materials.
2. FM Global (FM):
   a. Approval Guide:
      1) 1-28, Wind Design.
      2) Fire Resistance Ratings of Building Materials.
   b. 4470, Approval Standard for Single-Ply, Polymer-Modified Bitumen Sheet, Built-Up Roof (BUR) and Liquid Applied Roof Assemblies for use in Class 1 and Noncombustible Roof Deck Construction.
3. Underwriters Laboratories, Inc. (UL):
   a. Building Materials Directory.

B. Qualifications:
1. Applicator factory trained and approved in writing by roofing manufacturer.
2. Applicator shall have a minimum of 10 years of experience installing roof membrane systems similar to system specified.
   a. Minimum of five years of the 10 years of experience shall have been spent installing roof systems manufactured by the company proposed for use.

1.3 DEFINITIONS

A. Installer or Applicator:
1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.

2. Installer and applicator are synonymous.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Fabrication and/or layout drawings:
      a. Scaled outline of roof showing slopes, walkway pad layout, edge details, penetrations and details, and any special condition not covered on the Drawings.
         1) Minimum plan scale: 1/8 IN = 1 FT.
         2) Minimum detail scale: 1-1/2 IN = 1 FT.
      b. Provide tapered insulation shop drawings illustrating installation patterns and dimensions for each tapered module.
   3. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Product data sheet on all components of roof system.

B. Maintenance Information:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

C. Informational Submittals:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Certifications Prior to Installation:
      a. Certification of applicator qualifications.
      b. Certificates showing testing agency approval of assembly for ratings indicated.
      c. Letter from roofing manufacturer and insulation manufacturer stating that roof insulation being used is compatible with roofing system and will perform properly for intended use.
      d. Letter from mechanical fastener manufacturer stating that fasteners being used are compatible with roofing system and will perform properly for intended use.
      e. Letter from roofing manufacturer and insulation manufacturer stating that treated wood specified is compatible with roofing system and is acceptable for intended use.
      f. Letter from adhesive manufacturer and insulation manufacture stating that adhesive being used is compatible with roof insulation and will perform properly for intended use.
   3. Certifications for final closeout:
      a. Certification by roofing manufacturer's representative that roof has been installed properly.
      b. Warranty.

1.5 WARRANTY

A. Manufacturer's 10 year labor and materials watertight warranty signed by roofing material's manufacturer and applicator.
   1. Warranty to cover all materials provided by roofing manufacturer.
   2. Warranty to include provision to allow Owner to make emergency repairs.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Roofing system:
      a. Carlisle SynTec Systems.

b. Firestone Building Products Company.
c. Johns Manville by Berkshire Hathaway.

2. Vapor retarder:
   a. Carlisle SynTec Systems.
   b. Firestone Building Products Company.
   c. Johns Manville by Berkshire Hathaway.
3. Adhesive:
   a. As recommended by roofing manufacturer and approved by insulation manufacturer.
4. Polyisocyanurate insulation: See Section 07 21 00.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 DESIGN CRITERIA

A. Roof Assembly Design Criteria:
1. Fire resistance:
   a. UL Class A roof covering.
2. Hail and wind uplift resistance:
   a. FM 1-28: Class 1-120.

B. Roofing System: Fleece back single-ply rubber membrane (EPDM) fully adhered over insulation, over vapor retarder.

2.3 SYSTEM COMPONENTS

A. Use only materials approved by roofing materials manufacturer.

B. Roofing Membrane:
1. EPDM rubber sheet with non-woven polyester fleece backing.
2. 0.060 IN thick.
3. Color: White.
4. ASTM D4637/D4637M.

C. Roof Insulation: See Section 07 21 00.
1.
2. Thickness: As noted on Drawings.
3. Taper to provide slope of 1/4 IN/FT or as noted on Drawings.
4. Apache "1S0FOIL".

D. Vapor Retarder:
1. Maximum perm rating: 0.10 GMS H20/100 SQIN/24 HRS, ASTM E96/E96M, Procedure A.
2. Acceptable to roof membrane manufacturer and insulation manufacturer.
3. Compatible with adhesives being used.

E. Flashing: 0.060 IN thick EPDM.

F. Wood Blocking and Nailers: See Specification Section 06 10 00.

G. Adhesives, Tapes, Cements and Sealants: Roofing manufacturer's standard.

H. Provide all miscellaneous accessories as required.

I. Fasteners:
1. Ferrous components:
   a. Test in accordance with ASTM D6294/D6294M.
   b. Meet or exceed FM 4470.
2. Provide stainless steel for all exposed fasteners.

2.4 ACCESSORIES

A. Use manufacturer's standard prefab rubber accessories where available.
1. Nailing strips: As detailed and required by manufacturer.

2. Pipe flashings: Provide for each pipe penetration; include all clamps and adhesive.
3. Walkway pads:
    a. Manufacturer's standard molded rubber pad with slip resistant surface.
    b. Minimum 24 x 24 x 3/16 IN.
    c. Rolled walkway pad minimum 24 IN wide x 3/16 IN thick may be used at contractor option.
4. Pipe, duct and conduit supports:
    a. 100 PCT recycled rubber.
        1) Density: ASTM C642, minimum 0.50 OZ/CUIN.
        2) Compressive deformation:
            a) ASTM D395.
            b) 5 PCT at 70 PSI and 72 DEGF.
        3) Brittleness at low temperature: ASTM D746, -50 DEGF.
        4) Weathering: ASTM D573, 70 HRS at 120 DEGF.
    b. Uniform load capacity: 500 LB per lineal FT.
    c. Size:
        1) Width: 6 IN.
        2) Length and height as necessary for item being supported.
    d. Compatible with modular framing.
    e. Provide modular framing, pipe supports, pipe clamps or other accessories as necessary for items being supported.
    f. Similar to Cooper B-Line "DURA-BLOK."

B. Provide all miscellaneous accessories as required.

2.5 MAINTENANCE MATERIALS

A. Provide Owner with patch repair kit containing as a minimum.
1. Lap sealant.
2. Piece of roofing membrane 2 x 2 FT.
3. Adhesive and primer.

B. Instruct Owner's personnel on making emergency patch and repairs to roof.

C. Owner to notify roofing manufacturer within three working days if emergency repairs are made by Owner personnel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Provide wood nailers and blocking as necessary for a complete installation.

C. Installation of Vapor Retarder:
1. Install vapor retarder over decking, using adhesive recommended by roofing manufacturer.
    a. Extend up face of parapet wall to top of insulation.
2. Lap side joints 4 IN, lap ends 6 IN and seal all laps with adhesive.
3. Repair all damage and tears in accordance with vapor retarder manufacturer's recommendations.

D. Installation of Sheathing:
1. Lay sheathing tightly butted and cut to fit around all penetrations.
2. Attach sheathing to deck with adhesive recommended by and in accordance with manufacturer recommendations.
3. Seal around all penetrations with sealant acceptable to sheathing, roof membrane, and insulation manufacturer.

E. Provide roofing manufacturer’s recommended sleeper at all duct support structures, condensing units or similar equipment.
   1. Fasten sleeper to deck as necessary to resist uplift.
   2. Flash sleeper to roof membrane as recommended by roofing manufacturer.

F. Installation of Insulation:
   1. Cut insulation neatly to fit around all roof penetrations and projections.
   2. Butt joints tightly.
   3. Attach insulation using adhesive in accordance with manufacturer's recommendations for uplift rating required.
   4. Provide tapered insulation where shown or required.
   5. Provide cricket behind all roof penetrations larger than 12 IN.

G. Installation of Roofing:
   1. Install roofing using adhesive recommended by roofing manufacturer.
   2. Seal seams with lap sealant same day they are laid.
      a. Extend roofing or flashing up face of parapet, over top of wood blocking and down face of wall to bottom of wood blocking:
         1) Provide in one piece with no horizontal joints.
   3. Install flashing at all vertical surfaces, roof interruptions and penetrations.
      a. Flash all roof penetrations in accordance with roofing manufacturer's standard details.
   4. Install walking surfaces where indicated.

3.2 FIELD QUALITY CONTROL

A. Provide services of manufacturer's field service representative as required.

B. Protect installed insulation from water using water cut-offs in bad weather and at end of work period.

C. Remove and replace wet insulation and sheathing.

END OF SECTION

SECTION 07 62 00
FLASHING AND SHEET METAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Architectural flashing and sheet metal work.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 07 53 25 - Adhered Elastomeric (EPDM) Sheet Roofing.
   2. Section 07 92 00 - Joint Sealants.
   3. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Architectural Manufacturers Association (AAMA):
      a. 2605, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
   2. American National Standards Institute/Single Ply Roofing Industry (ANSI/SPRI):
      a. ES-1, Wind Design Standard for Edge Systems Used with Low Slope Roof Systems.
   3. ASTM International (ASTM):
      a. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
      b. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
      c. B32, Standard Specification for Solder Metal.
      d. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
   4. FM Global (FM).
   5. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
      a. Architectural Sheet Metal Manual.

B. Qualifications:
   1. Sheet metal fabricator shall have minimum 10 years experience in fabrication of sheet metal items similar to items specified.
   2. Sheet metal installer shall have minimum five years experience installing sheet metal items specified.

1.3 DEFINITIONS

A. Installer or Applicator:
   1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
   2. Installer and applicator are synonymous.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   2. Fabrication and/or layout drawings.
      a. Scaled drawing showing expansion joint locations, special conditions, profile, fastening and jointing details.
         1) Minimum plan scale: 1/8 IN = 1 FT.
         2) Minimum detail scale: 1-1/2 IN = 1 FT.

3. Fabricator qualifications.
4. Installer qualifications.

B. Informational Submittals:
1. Warranty: Manufacturer's sample warranty language.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Butyl sealant:
a. Pecora Corporation.
b. Sika.
c. Tremco Commercial Sealants & Waterproofing.

2.2 MATERIALS

A. Sheet Metal:
1. Galvanized Steel: ASTM A653/A653M.
2. Stainless Steel: ASTM A666.
a. Type 304.

B. Fasteners: Non-ferrous compatible with sheet metal.

C. Solder: ASTM B32.

D. Sealants:
1. Non-curing Butyl Sealant:
a. Pecora "BA-98".
b. Sika "SikaLastomer 511".
c. Tremco "TremPro JS-773".
2. Building sealants:
a. See Specification Section 07 92 00.

E. Fasteners: Non-ferrous compatible with sheet metal.

F. Retainer Clips and Continuous Cleats: Galvanized steel or stainless steel.

G. Solder: ASTM B32.

H. Dissimilar Metal Protection: Comply with Specification Section 09 96 00.

2.3 FABRICATED ITEMS

A. General:
1. Shop fabricate items to maximum extent possible.
a. Fabricate true and sharp to profiles and sizes indicated on Drawings.
1) Shop fabricate and weld or solder all corners.

B. Scupper and Conductor Head:
1. Roofing manufacturer’s recommended through-wall scupper design.
a. Size and location(s) as shown on Drawings.
2. Conductor head profile per SMACNA Figure 1-25F.
a. Provide 1 IN x 4 IN overflow opening with drip edge on front face of conductor.
3. 4 IN long outlet tube.
a. Size and shape to match downspout.
4. Debris screen:
a. Installed in top of conductor head.
b. 1/4 x 1/4 IN aluminum mesh screen.
c. Screen shall be removable without damage to screen or conductor head.

C. Retainer Clips and Continuous Cleats:
   1. 0.050 IN stainless steel.

D. Downspouts:
   1. Rectangular closed-face style similar to SMACNA Figure 1-32B.
      a. Locate lock-seam on back face.
   2. Fabricated in longest practical lengths.

PART 3 - EXECUTION

3.1 PREPARATION

A. Provide items to be built into other construction to Contractor in time to allow their installation.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions, SMACNA, and as indicated on Drawings.

B. Solder steel to achieve weathertight joints and required details.
   1. Do not solder slip joints.
   2. Touch-up damaged prefinished items.

C. Set top edges of membrane flashing and sheet metal flashing into reglets wherever practicable.
   1. Surface applied terminations will be allowed only where specifically detailed or otherwise approved in writing by the Engineer.
   2. Provide counterflashing at all reglets.
   3. Seal reglets and counterflashings in accordance with Specification Section 07 92 00.

D. Fasten materials at intervals recommended by SMACNA.

E. Install slip joints to allow for thermal movement as recommended by SMACNA and manufacturer.
   1. Maximum spacing: 10 FT OC.
   2. Provide slip joint 24 IN from corners.
   3. Provide slip joint at each vertical expansion joint location in wall.
      a. Provide break in continuous cleat at each vertical expansion joint.
      b. The above expansion joints do not include brick veneer expansion joints.

F. Seal slip joints with two beads of non-curing butyl sealant on each side of slip joint overlap.

G. Form flashings to provide spring action with exposed edges hemmed or folded to create tight junctures.

H. Provide dissimilar metals and materials protection where dissimilar metals come in contact or where sheet metal contacts mortar, concrete masonry or concrete.

I. Provide all miscellaneous sheet metal items not specifically covered elsewhere, as indicated or required to provide a weathertight installation.
   1. Provide all components necessary to create weather-tight junctures between roofing and sheet metal work.

J. Installation of Scupper and Conductor Head:
   1. Flash the opening in the parapet wall and install the scupper and conductor head as indicated in drawings.
   2. Seal all joints to provide complete weathertight installation.
   3. Flash roofing material onto scupper per roofing manufacturer's recommendations.

K. Installation of Downspouts:
   1. Install downspouts in locations shown on the Drawings.
   2. Provide downspout anchor straps per SMACNA Figure 1-35 as appropriate for downspout style.

3. Provide gutter to downspout connection per SMACNA Figure 1-33B, Detail 1.
4. Seal all joints in downspout for a complete watertight system.
5. Angle bottom of downspout out away from building to direct discharge onto concrete splashblock.
6. Anchor hanger straps to building wall with stainless steel screws and anchor sleeves appropriate for wall construction.
   a. Provide minimum of two anchors per strap.
7. Maximum spacing of hanger straps shall be 10 FT with minimum of two hanger straps per vertical piece of downspout.
8. Spacing and location of hanger straps shall be consistent from downspout to downspout.

END OF SECTION

SECTION 07 84 00
FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Firestopping of joints, through-wall penetrations, and membrane penetrations of fire-resistance rated construction.
   2. Selection of firestopping assemblies.
   3. Engineering Judgments.
   4. Special Inspections.

B. Related Specification Sections include but are not necessarily limited to:

1.2 DEFINITIONS

A. Firestopping: Material or combination of materials used to retain integrity of fire rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies.

1.3 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. E814, Standard Method of Fire Tests of Through Penetration Fire Stops.
      b. E1399, Standard Test Method for Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems.
      c. E1966, Standard Test Method for Fire Resistive Joint Systems.
   2. International Firestop Council (IFC).
      a. Recommended IFC Guidelines for Evaluating Firestop Systems in Engineering Judgments (EJs), referred to herein as IFC Recommended Guidelines.
   3. National Fire Protection Association (NFPA).
      a. 820, Fire Protection in Wastewater Treatment and Collection Facilities.
   4. Underwriters Laboratories, Inc. (UL):
      a. 263, Fire Tests of Building Construction and Materials.
      b. 1479, Fire Tests of Through Penetration Fire Stops.
      c. 2079, Standard for Tests for Fire Resistance of Building Joint Systems.

B. Qualifications:
   1. Firestop system installations must meet the requirements of ASTM E814, UL 1479 or UL 2079 tested assemblies that provide a fire rating equal to that of the construction being penetrated.
   2. Proposed firestop systems shall conform to applicable governing codes having local jurisdiction.
   3. For those fire stop applications that exist for which no qualified tested system is available through a manufacturer, an engineering judgment derived from similar qualified tested system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment documents shall follow the requirements set forth by the International Firestop Council.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Product technical data, including:
      a. Manufacturer’s listed design number.
      b. Manufacturer's installation instructions.

c. Manufacturer's specification and technical data for each material including the composition and limitations.
d. Data sheet for all products and accessories used.
e. Detailed drawings of special conditions:
    1) Provide UL listing for each type of firestopping assembly to be used.
    2) When UL listing is not available, provide a written Engineering Judgment in accordance with IFC Recommended Guidelines.
        a) Engineering Judgments shall be sealed by a Fire Protection Engineer licensed in California.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver materials undamaged in manufacturer's clearly labeled original, unopened containers, identified with brand, type, and UL label where applicable.

B. Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.

C. Store materials under cover and protect from weather and damage in compliance with the manufacturer's requirements, including temperature.

D. Do not use damaged or expired materials.

1.6 PROJECT CONDITIONS

A. Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.

B. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.

C. Do not proceed with the installation of firestop materials when the ambient temperature is outside the manufacturer's recommended limitations for installation and curing times as printed on the product label and product data sheet.

D. During installation provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Expanding silicone elastomer:
    a. Any manufacturer UL listed for system used.
2. Firestop sealant:
    a. Dow Corning.
    b. 3M Company.
    c. Specified Technologies Inc.
    d. Hilti.
3. Moldable putty:
    a. 3M Company.
    b. Specified Technologies Inc.
    c. Hilti.
    d. Rector Seal.
4. Expanding Foams:
    a. 3 M Company.
    b. Hilti.

2.2 MATERIALS

A. General:
   1. Use only materials that have been UL 1479 or ASTM E814 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire rating involved for each separate item.

B. Expanding Silicone Elastomer: UL listed.
   1. Fill, Void or Cavity Materials: Product category XHHW.
   2. Through Penetration Firestop Systems: Product category XHEZ.

C. Firestop Sealant: UL listed one part silicone installed as required by the listed design.

D. Moldable Putty: UL listed, product category QCSN or CLIV, Wall Opening Protective Materials.

E. Backer rod and/or compressible filler: UL listed, product category XHHW, Fill, Void or Cavity Materials.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. Selection and installation of firestopping assemblies is entirely the responsibility of the Contractor.
   2. All firestopping shall be provided in accordance with the building code and UL listing requirements as necessary to provide the required fire-resistance rating.
   3. When UL listing is not available, install in accordance with approved written Engineering Judgment.
   4. All firestopping products shall be installed in accordance with the manufacturer's instructions.
   5. Where firestopping will be exposed to view, provide colors matching adjacent construction or, if approved by manufacturer, and after inspection and approval by AHJ, paint to match.
   6. Where firestopping is not exposed to view, provide manufacturer's standard color.

B. Openings and Penetrations:
   1. Provide firestopping assembly tested in accordance with ASTM E814 or UL 1479 for all openings, through-penetrations, and membrane penetrations in fire-rated construction.
      a. Provide Flame (F), Thermal (T), Smoke (L), and Water (W) rated assemblies as necessary to meet building code requirements.

C. Building Joint Systems:
   1. Provide firestopping assembly tested in accordance with ASTM E1966 and ASTM E1399, or UL 2079 for all joint assemblies in or between fire-resistance-rated walls, floors or floor/ceiling assemblies and roofs or roof/ceiling assemblies.

D. Refer to Specification Section 01 73 20 for openings and penetrations requiring fire stopping.

3.2 IDENTIFICATION AND DOCUMENTATION

A. Prior to acceptance by the Owner, provide written statement that all fire-rated penetrations have been sealed using products specified in accordance with UL requirements for required rating.

B. Provide documents to the Owner of all listed systems installed and all engineering judgments.

3.3 FIELD QUALITY CONTROL

A. Provide Special Inspection of all firestopping in accordance with California Building Code BC Chapter 17 and Specification Section 01 45 33.

END OF SECTION

SECTION 07 92 00
JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Sealing all joints which will permit penetration of dust, air or moisture.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 07 84 00 - Firestopping.
   4. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):
      a. 302.1R, Guide for Concrete Floor and Slab Construction.
   2. ASTM International (ASTM):
      a. C834, Standard Specification for Latex Sealants.
      b. C920, Standard Specification for Elastomeric Joint Sealants.
      c. C1521, Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints.
   3. NSF International (NSF):
      a. 61, Drinking Water System Components -- Health Effects.
   4. Underwriters Laboratories, Inc. (UL).

B. Qualifications: Sealant applicator shall have minimum five years experience using products specified on projects with similar scope.

C. Mock-Ups:
   1. Before sealant work is started, a mock-up of each type of joint shall be sealed where directed by the Engineer.
      a. The approved mock-ups shall show the workmanship, bond, and color of sealant materials as specified or selected for the work and shall be the minimum standard of quality on the entire project.
      b. Each sample shall cure for a minimum of seven days at which time the sealant manufacturer's authorized factory representative shall perform adhesion tests on each sample joint.
         1) Perform adhesion tests per ASTM C1521.
         2) If mock-up is not acceptable or if adhesion test fails, provide additional mock-up and adhesion testing as required until acceptable to Engineer.

1.3 DEFINITIONS

1. Corrosive Areas Include: Tipping Room.
2. Tunnel

B. Defect(ive): Failure of watertightness or airtightness.

C. Finish sealant: Sealant material per this specification applied over face of compressible sealant or expanding foam sealant specified, to provide a finished, colored sealant joint.

D. Installer or Applicator:
   1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
   2. Installer and applicator are synonymous.

E. "Interior wet areas":
   1. Men's Room.
   2. Women's Room
   3. Fire Pump Room
   4. Tipping Room
   5. Tunnel

F. "Seal," "sealing" and "sealant": Joint sealant work.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Manufacturer's recommendations for joint cleaner, primer, backer rod, tooling and bond breaker.
   3. Certification from sealant manufacturer stating product being used is recommended for and is best suited for joint in which it is being applied.
   4. Certification of applicator qualification.

B. Test Results:
   1. Provide adhesion test results for each sealant sample including adhesion results compared to adhesion requirements.
   2. Manufacturer's authorized factory representative recommended remedial measures for all failing tests.

C. Samples:
   1. Cured sample of each color for Engineer's color selection.
   2. Color chart not acceptable.

D. Informational Submittals:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver material in manufacturer's original unopened containers with labels intact: Labels shall indicate contents and expiration date on material.

1.6 PROJECT CONDITIONS

A. Schedule installation of sealant work after completion of penetrating item installation but prior to covering or concealing of openings.

B. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.

C. Do not proceed with the installation of firestop materials when the ambient temperature is outside the manufacturer's recommended limitations for installation and curing times as printed on the product label and product data sheet.

D. During installation provide masking and drop cloths to prevent sealant materials from contaminating any adjacent surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Compressible sealant:
      a. Schul International Company, LLC.
      b. Emseal by Sika.
      c. Norton.
      d. Sandell Moisture Protection Systems.
   2. Expanding foam sealant:
      a. M-D Building Products, Inc.
      b. DAP Products, Inc.
      c. FAI International, Inc.
   3. Polyether sealants:
      a. BASF Corporation.
      b. Chem Link.
      c. Tremco Commercial Sealants & Waterproofing.
   4. Polysulfide rubber sealant:
      a. Pecora Corporation.
      b. BASF Corporation.
      c. PolySpec by ITW Polymers Sealants.
   5. Polyurea joint filler:
      a. Dayton Superior Corporation.
      b. Euclid Chemical Company.
      c. L&M by LATICRETE International, Inc.
      d. BASF Corporation.
   6. Polyurethane sealants:
      a. Pecora Corporation.
      b. Sika.
      c. BASF Corporation.
      d. Tremco Commercial Sealants & Waterproofing.
   7. Silicone sealants:
      a. Chem Link.
      b. GE Silicones.
      c. Dow.
      d. Tremco Commercial Sealants & Waterproofing.
   8. Backer rod, compressible filler, primer, joint cleaners, bond breaker:
      a. As recommended by sealant manufacturer.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. Sealants - General:
   1. Provide colors matching materials being sealed.
   2. Where compound is not exposed to view in finished work, provide manufacturer's color which has best performance.
   3. Nonsagging sealant for vertical and overhead horizontal joints.
   4. Sealants for horizontal joints: Self-leveling pedestrian/traffic grade.
   5. Joint cleaner, primer, bond breaker: As recommended by sealant manufacturer.
   6. Sealant backer rod and/or compressible filler:
      a. Closed cell polyethylene, polyethylene jacketed polyurethane foam, or other flexible, nonabsorbent, non-bituminous material recommended by sealant manufacturer to:
         1) Control joint depth.
         2) Break bond of sealant at bottom of joint.
         3) Provide proper shape of sealant bead.

4) Serve as expansion joint filler.

B. Compressible Sealant:
   1. Foamed polyurethane strip saturated with polymerized polybutylene waterproofing coated on front face with nonreactive release agent that will act as bond breaker for applied sealant.
      a. Schul "Sealtite B".
   2. Adhesive: As recommended by sealant manufacturer.

C. Expanding Foam Sealant:
   1. One or two component moisture cured expanding urethane.
   2. Shall not contain formaldehyde.
   3. Density: Minimum 1.5 PCF.
   4. Closed cell content: Minimum 70 PCT.
   5. R-value: Minimum 5.0/IN.
   6. Flame spread: Less than 25.
   7. Smoke developed: Less than 25.

D. Polyether Sealant:
   1. Silyl-terminated polyether polymer.
   2. ASTM C920, Type S, Grade NS, Class 50, Use NT, M, A, and O.
      a. BASF MasterSeal 150.
      b. Chem Link DuraLink.
      c. Tremco Dymonic FC.

E. Polysulfide Rubber Sealant:
   1. One or two component.
   2. Meet ASTM C920.
      a. Pecora Synthacalk GC2+.
      b. PolySpec THIOKOL 2235.

F. Polyurea Joint Filler:
   1. Two component, semi-rigid material for filling formed or saw-cut control joints in interior concrete slabs.
      a. Dayton Superior Corporation "Joint Fill, Joint Seal, Joint Saver II" as required for condition and recommended by manufacturer.
      b. Euclid Chemical Company "EUCO QWIK" joint.
      c. L&M "Joint Tite 750".
      d. BASF MasterSeal “CR100" control joint filler.
   2. Comply with ACI 302.1R performance recommendations regarding control and construction joints.
   3. Color: Gray.

G. Polyurethane Sealant:
   1. One or two components.
   2. Paintable.
   3. Meet ASTM C920 Type S or Type M, Grade NS or P, Class 25, Use NT, T, M, A and O.
      a. Pecora Dynatrol-IXL, Dynatrol II, Urexpan NR-200, NR-201.
      b. Sika Chemical Corporation Sikaflex-1a, Sikaflex-2C NS/SL.
      c. BASF MasterSeal NP-1, NP-II, SL-1 SL-2.
      d. Tremco Dymonic or Dymeric, Vulkem 116,227,45,245.

H. Silicone Sealant:
   1. One component.
   2. Meet ASTM C920, Type S, Grade NS, Class 25, Use NT, G, A, O.
      a. Chem Link DuraSil.
      b. GE Silpruf, Silglaze II.
      c. GE Sanitary 1700 sealant for sealing around plumbing fixtures.
      d. Dow 786 for sealing around plumbing fixtures.
      e. Dow 7565, 790, 791, 795.

f. Tremco Spectrem 1, Spectrem 3, Tremsil 600.

3. Mildew resistant for sealing around plumbing fixtures.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before use of any sealant, investigate its compatibility with joint surfaces, fillers and other materials in joint system.

B. Use only compatible materials.

C. Where required by manufacturer, prime joint surfaces.
   1. Limit application to surfaces to receive sealant.
   2. Mask off adjacent surfaces.

D. Provide joint depth for joints receiving polyurea joint filler in accordance with manufacturer's recommendations.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions and UL requirements.

B. Clean all joints.

C. Make all joints water and airtight.

D. At changes in direction of joints, joint intersections and where sealant joints interface with other construction, install continuous sealant as necessary to ensure a weather-tight seal.

E. Make depth of sealing compounds, except expanding foam and polyurea sealant, not more than one-half width of joint, but in no case less than 1/4 IN nor more than 1/2 IN unless recommended otherwise by the manufacturer.

F. Provide correctly sized backer rod, compressible filler or compressible sealant in all joints to depth recommended by manufacturer:
   1. Take care to not puncture backer rod and compressible filler.
   2. Provide joint backer rod as recommended by the manufacturer for polyurea joint filler.

G. Apply bond breaker where required.

H. Tool sealants using sufficient pressure to fill all voids.

I. Upon completion, leave sealant with smooth, even, neat finish.

J. Where piping, conduit, ductwork, etc., penetrate wall, seal each side of wall opening.

K. Install compressible sealant to position at indicated depth.
   1. Size so that width of material is twice joint width.
   2. Take care to avoid contamination of sides of joint.
   3. Protect side walls of joint (to depth of finish sealant).
   4. Install with adhesive faces in contact with joint sides.
   5. Install finish sealant where indicated.

L. Install expanding foam sealant to minimum 4 IN depth or thickness of wall being penetrated if less than 4 IN or as indicated on Drawings.
   1. Provide adequate fire rated backing material as required.
   2. Hold material back from exposed face of wall as necessary to allow for installation of backer rod and finish sealant.
      a. Allow expanding foam sealant to completely cure prior to installing backer rod and finish sealant.
   3. Trim off excess material flush with surface of the wall if not providing finished sealant.

3.3 SEALANT WORK

A. General:
   1. Work includes but is not limited to: Sealing all joints which will permit penetration of dust, air, or moisture.
   2. Refer to SCHEDULE for materials to be used.
   3. See Specification Section 07 84 00 for firestopping.

B. Concrete joints:
   1. Flooring joints.
   2. Isolation joints.
   3. Joints between paving or sidewalks and building.
   4. Construction, control and expansion joints.
   5. Joints between precast roof units and between precast roof units and walls.
   6. Joints between precast wall panels.
   7. Precast panel bearing joints:
      a. At panels bearing at or above grade, seal both sides of panel base joint.
      b. At panels bearing below grade:
         1) Seal exterior panel base joint prior to backfilling and/or placement of site paving.
         2) Provide compressible filler and sealant or backer rod and sealant as appropriate for interior slab condition.

C. Masonry:
   1. Masonry control joints.
   2. Brick expansion joints.
   3. Cast stone coping and sill head joints.
   4. Glass masonry joints.
   5. Between masonry and other materials.

D. Flashing, reglets and retainers.

E. Wood siding and trim.

F. Exterior Insulation and Finish System joints.

G. Openings:
   1. Perimeters of door and window frames, louvers, grilles, etc.
   2. Door thresholds shall be set in a full bed of sealant.
   3. Glass and glazing: See specification Section 08 81 00.

H. Interior finishes:
   1. Perimeter and penetrations of sound insulated walls.
   2. Casework and millwork: See Specification Section 06 41 00.
   3. Expansion and control joints in tile work.

I. Plumbing fixtures.

J. Penetrations of walls, floors and decks.

K. Other joints where sealant, expanding foam sealant or compressible sealant is indicated.

3.4 FIELD QUALITY CONTROL

A. Adhesion Testing:
   1. Perform adhesion tests in accordance with ASTM C1521 per the following criteria:
      a. Water bearing structures: One test per every 1000 LF of joint sealed.
      b. Exterior precast concrete wall panels: One test per every 2000 LF of joint sealed.
      c. Chemical containment areas: One test per every 1000 LF of joint sealed.
      d. Building expansion joints: One test per every 500 LF of joint sealed.
      e. All other type of joints except butt glazing joints: One test per every 3000 LF of joint sealed.

f. Manufacturer's authorized factory representative shall recommend, in writing, remedial measures for all failing tests.

3.5 SCHEDULE

A. Furnish sealant as indicated for the following areas:
1. Exterior areas:
   a. Above grade: Polyether.
   b. Below grade: Polyurethane.
2. Interior areas:
   a. Noncorrosive areas:
      1) Wet exposure: Polyether.
         a) Toilet rooms, locker rooms, janitor closets or similar areas: Mildew resistant silicone.
      2) Dry exposure: Polyether, unless noted otherwise.
         a) Sound insulated construction: Acoustical sealant.
   b. Corrosive areas:
      1) Wet exposure: Polysulfide.
      2) Dry exposure: Polyurethane.
   c. Casework, countertops and solid surface materials: Silicone.
      1) Sinks, fixtures or other areas subject to potential splash, spillage or condensation: Mildew Resistant Silicone.
3. Immersion:
   a. Prolonged contact with or immersion in:
      1) Potable water:
         a) Polysulfide.
         b) NSF 61 approved.
      2) Nonpotable water, wastewater or sewage: Polysulfide.
4. Compressible sealant: Where indicated.
5. Exterior wall penetrations: Expanding urethane foam, with finish sealant.
   a. Finish sealant:
      1) Exterior side:
         a) Above grade: Polyether.
         b) Below grade: Polyurethane.
      2) Interior side:
         a) Noncorrosive area:
            (1) Wet exposure: Polyether.
            (2) Dry exposure: Polyether, unless noted otherwise.
         b) Corrosive area:
            (1) Wet exposure: Polysulfide
            (2) Dry exposure: Polyurethane.
6. Interior concrete slab formed or saw-cut control joints: Polyurea joint filler.

END OF SECTION

DIVISION 08

OPENINGS

SECTION 08 11 00
HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Metal doors and frames.
   2. Metal borrowed lite window frames.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 08 70 00 - Finish Hardware.
   4. Section 13 34 19 - Metal Building Systems
   5. Section 09 96 00 - High Performance Industrial Coatings.
   6. Section 09 91 10 - Architectural Painting.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   2. National Association of Architectural Metal Manufacturers (NAAMM):
      a. Hollow Metal Manufacturers Association (HMMA).
   3. Steel Door Institute (SDI):
      a. 117, Manufacturing Tolerances for Standard Steel Doors and Frames.
      b. All SDI publications.
   4. Steel Door Institute/American National Standards Institute (SDI/ANSI):
      a. A250.6, Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
      b. A250.7, Nomenclature for Standard Steel Doors and Steel Frames.
      c. A250.8, Specifications for Standard Steel Doors and Frames.
      d. A250.10, Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
      e. A250.11, Recommended Erection Instructions for Steel Frames.

B. Qualifications: Manufacturer must be current member of SDI, and NAAMM (HMMA).

C. Wipe coat galvanized steel is not acceptable as substitute for galvanizing finish specified.

1.3 DEFINITIONS

A. As identified in SDI/ANSI A250.7.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   3. Schedule of doors and frames using same reference numbers as used on Drawings.
   4. SDI certification.

B. Contract Closeout Information:

1. Operation and Maintenance Data:
    a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store doors and frames in accordance with SDI/ANSI A250.11.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
    1. Metal doors and frames:
        a. Ceco Door by ASSA ABLOY.
        b. Steelcraft by Allegion PLC.
        c. Curries by ASSA ABLOY.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. Steel Sheet: Hot-dipped galvannealed steel, ASTM A653, A60 coating.

B. Frames: Hot-dipped galvannealed steel, ASTM A653, A60 coating.

C. Supports and Reinforcing: Hot-dipped galvannealed steel, ASTM A653, A60 coating.

D. Inserts, Bolts and Fasteners: Manufacturer's standard.

E. Primer: Manufacturer's standard coating meeting SDI/ANSI A250.10.

F. Galvannealed Coating Repair: See Specification Section 09 96 00.

G. Thermal Insulation: Polyurethane, CFC free.

2.3 ACCESSORIES

A. Frame Anchors:
    1. Jamb anchors:
        a. Masonry wire anchors: Minimum 0.1875 IN wire, galvanized.
        b. Existing wall anchor: Minimum 18 GA, galvanized.
        c. Stud partition and base anchors: Minimum 18 GA, galvanized.

2.4 FABRICATION

A. General:
    1. SDI/ANSI A250.8.
    2. Fabricate rigid, neat in appearance and free from defects.
    3. Form to sizes and profiles indicated on Drawings.
        a. Beveled edge.
    4. Fit and assemble in shop wherever practical.
    5. Mark work that cannot be fully assembled in shop to assure proper assembly at site.
    6. Continuously wire weld all joints, dress exposed joints smooth and flush.
    7. Fabricate doors and frames to tolerance requirements of SDI 117.
    8. Fit doors to SDI clearances.
    9. All doors shall be handed.
    10. Hinge cut-out depth and size on doors and frames shall match hinge specified in Specification Section 08 70 00.
    11. Design and fabricate doors to requirements of the building code.

B. Hollow Metal Doors:
    1. General:

a. 1-3/4 IN thick.
b. Fabricate with flush top caps.
1) Thickness and material to match door face.
2) Exterior doors: Seal weld top cap to door face and grind smooth and flush.
3) Interior doors:
a) Attach top cap to door with concealed fasteners or by welding.
b) Factory seal if attached with fasteners.
c) No exposed fasteners will be accepted.
c. Continuously wire weld all joints and dress, smooth and flush.
2. Exterior:
a. Doors 48 IN wide, or less: SDI/ANSI A250.8, Level 3, and physical performance level A, Model 2.
1) Face sheet minimum thickness: 16 GA.
2) Insulated: Minimum R10.
b. Sound insulated, minimum STC-35.

C. Hollow Metal Frames:
1. Door frames:
a. Provide 2 IN face at all heads, jambs and mullions for frames in stud walls.
b. Provide 4 IN face at head where noted on Drawings or required by wall construction.
c. 26 GA galvannealed steel boxes welded to frame at back of all hardware cutouts.
d. Steel plate reinforcement welded to frame for hinge, strikes, closers and surface-mounted hardware reinforcing.
1) All plate reinforcement shall meet size and thickness requirements of SDI/ANSI A250.8.
e. Split type frames not acceptable.
1) All horizontal and vertical mullions and transom bars shall be welded to adjacent members.
f. Conceal all fasteners.
g. Frames shall be set up, all face joints continuously wire welded and dressed smooth.
h. Exterior (up to 4 FT wide): 16 GA.
i. Exterior (over 4 FT wide): 14 GA.
j. Interior: 16 GA.
k. Provide removable spreaders at bottom of frame.

D. Prepare for finish hardware in accordance with hardware schedule, templates provided by hardware supplier, and SDI/ANSI A250.6.
1. Locate finish hardware in accordance with SDI/ANSI A250.8.
2. See Specification Section 08 70 00 for hardware.
3. Prepare doors for swing direction indicated.
a. Preparing doors for non-handed hinges is not acceptable.

E. After fabrication, clean off mill scale and foreign materials and prime with rust inhibiting primer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install doors and frames in accordance with SDI/ANSI A250.11, the building code and manufacturer's instructions.

B. Plumb, align, and brace frames securely until permanently anchored.
1. After completion of walls, remove temporary braces and spreaders.
2. Anchor frames with minimum of three anchors per jamb.
a. Number and location of anchors shall be in accordance with SDI and frame manufacturer's recommendations.

C. At new masonry or metal stud construction, place frames in conjunction with construction of walls or partitions.
   1. Masonry construction: Anchor frames using masonry wire anchors.
   2. Metal stud construction:
      a. Anchor frames using steel stud anchors.
      b. Attach wall anchors with self-tapping screws.

D. At concrete, precast concrete or existing masonry construction, place frames in rough opening using existing opening anchors.

E. Use plastic plugs to keep silencer holes clear during construction.

F. Immediately after erection, sand smooth rusted or damaged areas.
   1. Touch-up with rust-inhibiting primer.
   2. Finish paint door and frame in accordance with Specification Section 09 96 00.

G. Install three silencers on strike jamb of single door frame and two on head of double door frame.
   1. See Specification Section 08 70 00.

H. Protect doors and frames during construction.

END OF SECTION

SECTION 08 56 80
ALUMINUM SLIDING SERVICE WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Aluminum, heavy-duty commercial sliding service windows as indicated in drawings.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.

C. Completely coordinate with work of other trades and the modular building fabrication (Section 13 34 33).

1.2 QUALITY ASSURANCE

A. Manufacturer Qualifications:

B. Applicator Qualifications:

C. Referenced Standards:
   1. ASTM International (ASTM):
      a. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   2. American National Standards Institute (ANSI):
      a. B40.100, Pressure Gauges and Gauge Attachments.

1.3 DELIVERY, STORAGE AND HANDLING

A. Deliver windows crated to provide protection during transit and job storage

B. Inspect windows upon delivery for damage. Unless minor defects can be made to meet the Architect's specifications and satisfaction, damaged parts should be removed and replaced.

C. Store windows at building site under cover in dry location.

1.4 SUBMITTALS

A. See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

B. Shop Drawings:
   1. Plans and elevations showing location and dimension of components.
   2. Details of connections, design elements, and relation to adjacent items.
   3. Submit for fabrication and installation of windows. Include details, elevations and installation requirement of finish hardware and cleaning.

C. Product Data:
   1. Submit Manufacturer's technical product data substantiating that products comply.
   2. Acknowledgement that products submitted meet requirements of standards referenced.
   3. Manufacturer's installation instructions.
   4. Fabrication and/or layout drawings.
   5. Certifications.
   6. Test reports.

D. Certification:
   1. Provide printed data in sufficient detail to indicate compliance with the contract documents.

E. Contract Closeout Information:

1. Operation and Maintenance Data:
    a. See Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

1.5 PROJECT CONDITIONS

A. Field measurements:
    1. Check opening by accurate field measurement beforefabrication. Show recorded measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of work.

1.6 WARRANTY

A. All material and workmanship shall be warranted against defects for a period of one (1) year from the original date of purchase.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design:
    1. Design is based on aluminum (DW) series, deluxe sliding service window manufactured by C.R. Laurence Co., Inc. (800) 421-6144.

B. Submit request for substitution in accordance with Section 01 25 13.

2.2 MATERIALS

A. Frames:
    1. 4 IN Aluminum frame modules shall be constructed of 6063-T5 extruded aluminum. Replacement and servicing of glass shall be from the clerk side of the window by means of an access panel in the top header and does not require the removal of the frame from the opening. Window glides on top-hung heavy-duty ball bearing slides. Poly-pile weather stripping and self-latching handle. Overall frame sizes are to be in accordance with the contract drawings.

B. Finish:
    1. All aluminum to be clear anodized, duranodic bronze, powder or Kynar painted (specify color).

C. Glazing:
    1. The glazing is ¼ IN to ½ IN in thickness. Options include tempered, wire, laminated, tinted, and insulating glass (specify type of glazing material desired).

D. Options:
    1. Laminated Shelf, stainless steel shelf, keyed lock, full bottom track, or burglar bar. (specify desired options).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install window in accordance with manufacturer’s printed instructions and recommendations. Repair damaged units as directed (if approved by the manufacturer and the architect) or replace with new units.

3.2 CLEANING

A. Clean frame and glazing surfaces after installation, complying with requirements contained in the manufacturer's instructions. Remove excess glazing sealant compounds, dirt or other substances.

3.3 PROTECTION

A. Institute protective measures required throughout the remainder of the construction period to ensure that all the windows do not incur any damage or deterioration, other than normal weathering, at the time of acceptance.

END OF SECTION

SECTION 08 70 00
FINISH HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Finish hardware.
   2. Inspection and testing of door operation.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 08 11 00 - Metal Doors and Frames.

1.2 QUALITY ASSURANCE

A. All door hardware shall be provided by a single hardware supplier.
   1. Hardware is to be provided under this Specification Section, unless noted otherwise, for doors specified in:
      a. Specification Section 08 11 00.

B. Referenced Standards:
   1. Americans with Disabilities Act (ADA):
      a. Accessibility Guidelines for Buildings and Facilities (ADAAG).
   2. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI/BHMA):
      a. A156.1, Butts and Hinges.
      b. A156.3, Exit Devices.
      c. A156.4, Door Controls -Closers.
      d. A156.6, Architectural Door Trim.
      e. A156.8, Door Controls - Overhead Stops and Holders.
      f. A156.13, Mortise Locks.
      g. A156.16, Auxiliary Hardware.
      h. A156.18, Materials and Finishes.
      i. A156.21, Thresholds.
   3. American National Standards Institute/Steel Door Institute (ANSI/SDI).
      a. A250.8, Specifications for Standard Steel Doors and Frames (SDI-100).
   4. Door and Hardware Institute (DHI).
   5. National Fire Protection Association (NFPA):
      a. 101, Life Safety Code.

C. Qualifications:
   1. Installation shall be inspected by a certified Architectural Hardware Consultant (AHC).

1.3 DEFINITIONS

A. AHC: Architectural Hardware Consultant, certified by DHI.

B. Installer or Applicator:
   1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
   2. Installer and applicator are synonymous.

C. All weather: Capable of operation from -50 to +120 DEGF.

D. Active Leaf: Right-hand leaf when facing door from keyed side unless noted otherwise on Drawings.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Qualifications
      a. AHC qualifications.
   3. Certification from AHC stating:
      a. All door hardware has been reviewed by AHC and verified to be compatible with doors and frames.
      b. All electrified door hardware has been reviewed by AHC and has been coordinated with power supply and access control system.
      c. No submittals will be reviewed until Engineer has received AHC certification.
   4. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   5. Schedule of all hardware being used on each door.
      a. Number hardware sets and door references same as those indicated on Drawings.
   6. Technical data sheets on each hardware item proposed for use.
   7. Warranty information for all hardware devices having extended warranties.

B. Informational Submittals:
   1. Certifications:
      a. Certification from AHC stating all door hardware has been provided per approved Shop Drawings, has been installed in accordance with manufacturer's recommended installation instructions and all doors have been inspected and tested and found to be in proper working order.
         1) Door assemblies required to swing in the direction of egress have been inspected and tested in accordance with NFPA 101.

1.5 WARRANTY

A. Provide all individual manufacturers' extended warranties as advertised.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Hinges:
      a. Hager Companies.
      b. McKinney Manufacturing Co.
      c. Stanley by dormakaba Holding, Inc.
   2. Locksets and latchsets:
      a. Best Access Solutions, Inc. by dormakaba Holding, Inc.
      b. Corbin Russwin, Inc. by ASSA ABLOY.
   3. Exit devices:
      a. Corbin Russwin, Inc. by ASSA ABLOY.
      b. PRECISION by dormakaba Holding, Inc.
      c. SARGENT Manufacturing Company by ASSA ABLOY.
      d. Von Duprin by Allegion PLC.
   4. Closers:
      a. Corbin Russwin, Inc. by ASSA ABLOY.
      b. LCN by Allegion PLC.
      c. Norton by ASSA ABLOY.
   5. Door stops and holders:
      a. Trimco.

b. Rockwood by ASSA ABLOY.
c. IVES by Allegion PLC.

6. Overhead stops:
   a. Glynn-Johnson by Allegion PLC.
   b. Rockwood by ASSA ABLOY.
   c. Trimco.
   d. Rixson by ASSA ABLOY.
7. Weatherstripping and thresholds:
   a. Pemko by ASSA ABLOY.
   b. Reese Enterprises, Inc.
   c. Zero International, Inc.
   d. National Guard Products.
8. Door bolts, coordinators and strikes:
   a. IVES by Allegion PLC.
   b. Trimco.
   c. Hager Companies.
   d. Rockwood by ASSA ABLOY.
   e. dormakaba.
9. Other materials: As noted.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. General: As indicated in the FABRICATION Article in PART 2 of this Specification Section.

B. Fasteners: Stainless steel or aluminum.

C. Closers:
1. Standard closer:
   a. Shell: Aluminum or cast iron.
   b. Arms and piston: Forged steel.

D. Kickplates:
1. Stainless steel.

E. Thresholds: Aluminum.

F. Overhead Stops and Wall Stops: Stainless steel or aluminum.

G. Keys: Brass or bronze.

H. Weatherstripping and Smoke Seals: Polypropylene, neoprene, or EPDM.

I. Pulls and Push Plates: Stainless steel.

J. Silencers: Rubber.

2.3 COMPONENTS

A. Hinges:
1. Butt hinges:
   a. ANSI/BHMA A156.1.
      1) A5111: Stainless steel, full-mortise, anti-friction bearing, Grade 1.
   b. Ball bearing.
   c. Flat button tips.
   d. Butt hinges:
      1) Hager BB1199.
      2) McKinney T4B3386.
   e. Hinge size:
      1) Doors up to and including 46 IN wide: 4.5 IN x 4.5 IN.
      2) Doors over 46 IN up to and including 60 IN wide: 5 IN high x 4.5 IN.

B. Mortise Locks and Latches:
   1. ANSI/BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 1.
      a. Meet requirements of ADA.
   2. Antifriction two-piece mechanical latchbolt with stainless steel anti-friction insert.
      a. One-piece stainless steel deadbolt, minimum 1-1/4 IN x 9/ 16 IN thick with 1 IN throw.
      b. 2-3/4 IN backset.
      c. Cylinder: Brass, 6-pin, with interchangeable core.
      d. ADA compliant thumb turn lever.
   3. Locking, latching and retracting mechanism and lock case:
      a. Steel, unless noted otherwise.
         1) Chrome or zinc dichromate plated.
   4. Trim design: Corbin Russwin, Inc. "NSP".
      a. Functions as indicated in following table in accordance with ANSI/BHMA A156.13.

MORTISE LOCK NUMBERS		
ANSI	FUNCTION	CORBIN RUSSWIN, INC.
F01	Passage	ML2010
F19	Privacy	ML2030
F05	Classroom	ML2055
F07	Storeroom	ML2057
F13	Entrance or Office	ML2065
	Electronic Lockset	ML20905 x M92

C. Exit Devices:
   1. ANSI/BHMA A156.3, Grade 1.
   2. Single doors: Rim.
   3. Pairs of doors: Surface vertical rods.
   4. Trim: Sargent “ET”.
      a. Lever operation.
      b. Lever style: Sargent "L".
   5. Sargent "80 Series".
      a. Function as indicated on Hardware Schedule.

D. Door Closers:
   1. ANSI/BHMA A156.4, Grade 1.
   2. Size door closers to comply with ANSI recommendations for door size and location.
   3. Fabricate all closers with integral back check.
   4. Provide integral stop unless noted otherwise.
      a. Do not provide integral stop at closers indicated to be installed on pull side of door.
      b. Provide all weather fluid for all closers used in exterior doors.
   5. Full cover.
      a. Manufacturer's standard plastic cover.
   6. Arms, brackets, and plates: As required for complete installation.
   7. Closers:
      a. LCN 4040 Series or Norton 7500 Series or Corbin Russwin, Inc. DC6200 Series.
   8. Provide manufacturer's standard 10 year warranty.

E. Door Stops:
   1. ANSI/BHMA A156.16.
      a. Wall stops: IVES WS406-CVX or WS406-CCV.

F. Kickplates:
   1. ANSI/BHMA A156.6.
   2. 10 IN high x 2 IN less than door width.
   3. Beveled on all edges.
   1. Thickness:
      a. Stainless steel: 0.050 IN.

G. Thresholds:
   1. ANSI/BHMA A156.21.
   2. One-piece unit.
   3. Height: See drawings for detail.
   4. Width: 6 IN
   5. Provide required bolt cutouts.

H. Weatherstripping:
   1. Weather seal at jambs and head:
      a. Self-adhesive strip: Reese #797.
      b. Color: Black
   2. Sweep at bottom of doors:
      a. Reese 701.
      b. Color: Dark bronze anodized.
   3. Weather seal astragal at meeting edges of pairs of doors:
      a. Reese 92 each leaf.
      b. Color: Dark bronze anodized.

2.4 ACCESSORIES

A. Silencers:
   1. Hollow metal frames: Trimco 1229A or Rockwood 608.
   2. Self-adhesive silencers are not acceptable.

B. Keying:
   1. Establish keying with Owner.
      a. Provide and set up complete visible card indexed system with key tags and control slips.
      b. Tag and identify keys.
      c. Provide two keys for each lock or cylinder.
      d. Master key and key in groups as directed.
      e. Provide construction master keys for all exterior doors.

C. Strikes:
   1. Curved lips.
      a. Extended lips when required.
   2. Furnish strike boxes.
   3. Appropriate for function and hardware listed.

2.5 FABRICATION

A. General:
   1. Generally prepare for Phillips head machine screw installation.
   2. Exposed screws to match hardware finish or, if exposed in surfaces of other work, to match finish of other work as closely as possible.
   3. Provide concealed fasteners unless thru bolted.
   4. Through bolt closers on all doors.
   5. Furnish items of hardware for proper door swing.
   6. Furnish lock devices which allow door to be opened from inside room without a key or any special knowledge.

B. Hardware:
   1. Fabricate hardware for fire rated openings in compliance with UL and NFPA 80.

a. This requirement takes precedence over other requirements for such hardware.
b. Provide only hardware which has been tested and listed by UL for types and sizes of doors.

2. Provide following ANSI/BHMA A156.18 finishes:
   a. Locksets, latchsets and strikes: 630.
   b. Door pulls, push bars, push plates: 630.
   c. Kickplates:
      1) Stainless steel: 630.
   d. Exit devices: 630 where available; 626 if 630 is not available.
      1) Provide 630 finish on trim.
   e. Butt hinges: 630.
   f. Door stops, dead locks, mortise bolts, and miscellaneous hardware: 630 where available, 626 if 630 not available.
   g. Door overhead stops: 630.
   h. Closers: 600 prime coat with 689 finish coat, unless noted otherwise.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's installation instructions.
   1. Perform installation by or under the direct supervision of an AHC.

B. Provide all hardware in accordance with the building code.

C. Fit hardware before final door finishing.

D. Permanently install hardware after door finishing operations are complete.

E. Locate hardware in accordance with ANSI/SDI A250.8.

F. Butt Hinges:
   1. Provide non-removable pin (NRP) at:
      a. Exterior doors.
      b. Reverse handed doors equipped with locks.
   2. Quantities:
      a. Door height 61 - 90 IN: Three.
      b. Door height 91 - 114 IN: Four.
      c. Door height 115 - 144 IN: Five.
      d. Doors over 48 IN wide and over 96 IN high:
         1) Provide top butt hinge within 6 IN of the top of the door to top of hinge.
         2) Provide one additional butt hinge approximately 6 IN below the bottom of the top butt hinge.
   3. Provide power transfer as necessary where electrified lockset or exit device is specified or as otherwise indicated in Hardware Schedule.

G. Closers:
   1. Mount closers on push side of doors unless noted otherwise.

H. Provide coordinator when required by hardware specified.

I. Overhead Stops:
   1. Provide overhead stop when corrosion resistant closer is specified.
   2. Provide concealed overhead stop on doors scheduled to receive closer mounted on pull side of door.
   3. Provide at interior doors not scheduled to receive a closer as follows:
      a. Doors that swing more than 105 DEG without encountering a wall or obstruction.
         1) Stop shall limit swing of door from impacting wall or obstruction.
      b. Inactive leafs of pairs of doors.

J. Wall Mount Door Stops:
   1. Provide where specifically indicated on Hardware Schedule and at doors not otherwise indicated to receive:
      a. Overhead stop.
      b. Closer with integral stop.

K. Floor mounted stops are not acceptable unless noted otherwise in this Specification Section.

L. Provide silencers for door frames.
   1. Hollow metal frames: See Specification Section 08 11 00.

M. Provide weather seal, door sweep and threshold at all exterior doors and where scheduled on interior doors.
   1. Set thresholds in a full bed of sealant.
   2. Mount door sweeps on exterior face of door.
   3. Mount weather seal astragal at meeting edges of pairs of doors on the exterior face of the doors.

N. Provide smoke seals on all fire rated doors.

O. Mount kickplates on push side of doors.

3.2 FIELD QUALITY CONTROL

A. Adjust and check each operating item of hardware to assure proper operation or function.
   1. Lubricate moving parts with lubricant recommended by manufacturer.

B. During week prior to startup, make a final check and adjustment of all hardware items.
   1. Clean and lubricate as necessary to assure proper function and operation.
   2. Adjust door control devices to compensate for operation of heating and ventilating equipment.

C. Inspection and Testing:
   1. AHC shall inspect and test all door assemblies and provide written certification that door assemblies are in proper working order.
      a. Door assemblies required to swing in the direction of egress shall be inspected and tested in accordance with NFPA 101.
   2. Submit documentation and certification of testing in accordance with the certifications paragraph in the SUBMITTALS Article in PART 1 of this Specification Section.

3.3 HARDWARE SCHEDULE

A. Hardware Group 1 (HDW 1)
   1. 1.5 pair butt hinges
   2. 1 mortise latch set – office
   3. 1 closer
   4. 1 kick plate
   5. 1 threshold
   6. Weatherstriping
   7. 1 cylinder
   8. Silencers
   9. Door sweep.
   10. Wall stop

B. Hardware Group 2 (HDW 2)
   1. 1.5 pair butt hinges
   2. 1 mortise latch set – privacy
   3. 1 closer
   4. 1 threshold
   5. Weatherstriping
   6. Silencers
   7. Door sweep.

8. Wall stop

C. Hardware Group 4 (HDW 4)
   1. 1.5 pair butt hinges
   2. 1 latch set – passage
   3. 1 closer
   4. 1 threshold
   5. Weatherstripping
   6. Silencers
   7. Door sweep.
   8. Door stop

D. Hardware Group 3 (HDW 3)
   1. 3 pair butt hinges
   2. 2 rim panic bar (one at each leaf)
   3. 4 Surface rods (two to head, two to threshold).
   4. 4 Dust proof strikes
   5. 1 Astragal
   6. 2 closers with coordinator
   7. Weatherstripping
   8. 2 kick plates
   9. 2 cylinders – rim
   10. 1 threshold
   11. Silencers
   12. Door stop

END OF SECTION

SECTION 08 81 00
GLASS AND GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Glass and glazing.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 07 92 00 - Joint Sealants.
   4. Section 08 11 00 - Hollow Metal Doors and Frames.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI):
      a. Z97.1, Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.
   2. ASTM International (ASTM):
      a. C864, Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
      b. C1036, Standard Specification for Flat Glass.
      c. C1048, Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.
      d. C1376, Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass.
      e. E119, Standard Test Methods for Fire Tests of Building Construction and Materials.
      f. E2190, Standard Specification for Insulating Glass Unit Performance and Evaluation.
   3. Code of Federal Regulations (CFR):
      a. Title 16 - Commercial Practices, Chapter ii - Consumer Product Safety Commission (CPSC), Subchapter B - Consumer Product Safety Act Regulations:
         1) 16 CFR 1201, Safety Standard for Architectural Glazing Materials.
   4. Glass Association of North America (GANA):
      a. Glazing Manual.
   5. Insulating Glass Certification Council (IGCC).
   6. Insulating Glass Manufacturers Alliance (IGMA):
      a. TM-3000, North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use.
   7. National Fire Protection Association (NFPA).
      a. 80, Standard for Fire Doors and Other Opening Protectives.
      b. 251, Standard Methods of Tests of Fire Resistance of Building Construction and Materials.
      c. 252, Standard Methods of Fire Tests of Door Assemblies.
      d. 257, Standard on Fire Test for Window and Glass Block Assemblies.
   8. Underwriters Laboratories, Inc. (UL):
      a. 9, Standard for Fire Tests of Window Assemblies.
      b. 10B, Standard for Fire Tests of Door Assemblies.
      c. 263, Standard for Fire Tests of Building Construction and Materials.

1.3 DEFINITIONS

A. Installer or Applicator:
   1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.

2. Installer and applicator are synonymous.

B. Safety Glazing: Glazing meeting the requirements of the building code and CPSC 16 CFR 1201.

C. Other terms as identified in CSPC 16 CFR 1201.

1.4 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Product technical data including:
a. Acknowledgement that products submitted meet requirements of standards referenced.
b. Manufacturer's installation instructions.
c. Certification that glass has been tested and approved for use in fire resistance rated doors or walls.
1) Copies of all test criteria.
3. Certification that insulating glass units meet requirements of IGCC and are certified by IGCC to ASTM E2190.

B. Samples:
1. Two, 12 x 12 IN sample of each type, color, and thickness specified.
a. Samples are not required for clear monolithic glass.

C. Informational Submittals:
1. Warranty.

1.5 WARRANTY

A. Provide manufacturer's written 10 year warranty to cover deterioration of glass, glass units, coatings and ceramic frit.
1. Insulating glass units shall be warranted against failure of hermetic seal resulting in fogging or film formation on the interior glass surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Glass:
a. Guardian Glass by Guardian Industries.
b. Insulite Glass Co., Inc.
c. NSG/Pilkington.
d. Oldcastle Building Envelope.
e. Vitro Architectural Glass.
f. Viracon.
2. Gaskets, glazing compounds, setting blocks, spacers, sealant, sealant tape, etc., as recommended by glass manufacturer, glass unit fabricator.
a. Provide materials as required by NFPA for use in fire-rated units.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. General:
1. ASTM C1036.
a. Clear glass: Type I, Class 1, Quality Q3.
b. Tinted glass: Type I, Class 2, Quality Q3.
2. Thickness: 1/4 IN, unless noted otherwise.

B. Heat Strengthened and Fully Tempered Glass: ASTM C1048.
   1. General use: Kind HS.
   2. Safety glazing: Kind FT.
      a. Meet requirements of ANSI Z97.1 and CSPC 16 CFR 1201.
   3. Condition:
      a. Clear or tinted vision glass: Condition A.
      b. Spandrel Glass (ceramic coated): Condition B.
      c. Coated vision glass: Condition C.
         1) ASTM C1376, Kind CV or CO.

2.3 MANUFACTURED UNITS

A. Insulating Glass Units:
   1. ASTM E2190, Class A.
   2. Two lites of glass separated by a hermetically sealed air space.
      a. Spacer: Stainless steel "warm edge" spacer.
         1) Thickness: 1/2 IN.
         2) Color: Black.
      b. Perimeter Sealant: Silicone.
         1) Color: Black.

2.4 ACCESSORIES

A. Glazing Compounds:
   1. Non-sag, non-stain type.
   2. Pigmented to match frame units not requiring painting.
   3. Compatible with adjacent surfaces.
   4. One- or two-part polyurethane or silicone sealant for use in setting glass.
      a. Provide glazing compounds which will not be affected by chemicals stored in rooms where glazing compounds are used.

B. Sealant Tape: Butyl rubber sealant tape or ribbon having a continuous neoprene shim.

C. Gaskets:
   1. Flexible polyvinyl chloride or neoprene.
      a. ASTM C864.
      b. Provide gaskets which will not be affected by chemicals stored in rooms where gaskets are used.
   2. Extruded of profile and hardness required to receive glass and provide a watertight installation.
   3. Provide gaskets in accordance with NFPA in fire resistance rated glazing.

D. Setting Blocks and Spacers:
   1. Neoprene or EPDM, compatible with sealants used.
      a. ASTM C864.

E. Compressible Filler Stock: Closed cell polyethylene or polyethylene jacketed polyurethane foam.

F. Shims, Clips, Screws and Other Miscellaneous Items: As required by condition.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with recommendations of manufacturer, GANA Glazing Manual and IGMA TM-3000.

B. Install setting blocks in adhesive or sealant.

C. Install spacers inside and out, of proper size and spacing, for all glass sizes larger than 50 united inches, except where gaskets are used for glazing.

D. Provide 1/8 IN minimum bite of spacers on glass.

E. Spacer thickness to equal sealant width.

F. Prevent sealant exudation from glazing channels of insulating glass which is more than 1/2 IN thick; colored, heat absorbing, coated or laminated glass sizes larger than 75 united inches; and other glass more than 9/32 IN thick or larger than 125 united inches.
   1. Leave void at heel (or install filler) at jambs and head.
   2. Do not leave void (or install filler) at sill.

G. Miter cut and bond gasket ends together at corners.

H. Immediately after installation, attach crossed streamers to framing held away from glass.

I. Use polysulfide-based glazing sealants in window assembly and as perimeter sealant around frames in areas which may be exposed to chlorine gas or chlorine liquid splash or spillage.
   1. See Specification Section 07 92 00 for sealants.

J. Install fire resistance rated glass in accordance with manufacturer's recommendations and in accordance with applicable fire testing criteria.

3.2 FIELD QUALITY CONTROL

A. Do not install glass with edge damage.

B. Do not apply anything to surfaces of glass.

C. Remove and replace damaged glass.

3.3 CLEANING

A. Maintain glass reasonably clean during construction, so that it will not be damaged by corrosive action and will not contribute to deterioration of other materials.

B. Wash and polish glass on both faces not more than seven days prior to acceptance of work in each area.
   1. Comply with glass manufacturer's recommendations.

3.4 SCHEDULES

A. General:
   1. Provide safety glazing for all applications where required by the building code and CPSC 16 CFR 1201.
   2. Provide heat strengthened glazing for all general use applications where safety glazing is not required.

B. Glass Type 1: Clear Monolithic Glass.

C. Glass Type 2: Tinted Monolithic Glass.
   1. Color: Clear.

D. Glass Type 5: Insulating Low-E Units.
   1. Exterior lite: 1/4 IN
      a. Color: Clear.
   2. 1/2 IN dehydrated air space.
   3. Interior lite: 1/4 IN clear.
   4. Performance Requirements:
      a. Transmittance:
         1) Visible light: 79 PCT.
         2) Solar energy: 61 PCT.
         3) UV: 46 PCT.
      b. Reflectance:

1) Exterior: 14 PCT.
2) Interior: 14 PCT.
3) Solar: 11PCT.

c. U-Value
1) Winter: .47.
2) Summer: 0.49

d. Shading Coefficient: .81.
e. Relative Heat Gain: 169 BTU/(hr x sqft).
f. Solar Heat Gain Coefficient (SHGC): 0.70

END OF SECTION

SECTION 08 90 00
LOUVERS AND VENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Louvers and vents.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 07 92 00 - Joint Sealants.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Air Movement and Control Association (AMCA).
   2. ASTM International (ASTM):
      a. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

1.3 DEFINITIONS

A. PVDF: Polyvinylidene fluoride.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Drawing showing location of each louver or vent, indicating size and arrangement of blank-off plates if required.
   3. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Color chart showing manufacturer's full line of colors including exotic and special colors for color selection by Engineer.

B. Factory applied high performance organic coatings utilizing PVDF resins shall be provided with manufacturer's standard 10 year warranty against color fade, chalking and film integrity.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Louvers:
      a. Airolite Company LLC.
      b. Construction Specialties, Inc.
      c. Ruskin Company.
      d. Industrial Louvers, Inc.
      e. American Warming and Ventilating.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MANUFACTURED UNITS

A. Wall Louvers:
   1. 4 IN deep.
   2. Drainable with blades at 37-1/2 DEG.
   3. Continuous blade appearance.
   4. ASTM B221 extruded aluminum, alloy 6063 T5, minimum 0.081 IN thick.
   5. Minimum free area: 8.58 SQFT for 4 x 4 FT louver.
   6. Maximum pressure drop: 0.10 IN of water at 700 FPM.
   7. Water penetration: 0.01 OZ/SQFT at 873 FPM.
   8. AMCA certified.
   9. Basis of Design: Ruskin "ELF 375DX", or equal.
   10. Insect screen:
      a. 18-16 mesh aluminum.
      b. Install in standard aluminum frame.

B. Door Louvers:
   1. Inverted V style blades, at 45 degrees.
   2. Continuous blade appearance.
   3. ASTM B221 extruded aluminum, alloy 6063 T5, minimum 0.081 IN thick.
   4. Minimum free area: 40%
   5. Maximum pressure drop: 0.10 IN of water at 700 FPM.
   6. Water penetration: 0.01 OZ/SQFT at 873 FPM.
   7. AMCA certified.
   8. Gray primer finish
   9. As manufactured by Dayton, or equal.

C. Anchors, Fasteners, Reinforcing: Aluminum or stainless steel.

D. Finish:
   1. Meet requirements of AAMA 2605.
      a. PVDF coating with minimum 70 PCT resin content.
      b. Color: Match roof color.

E. Size: Refer to Mechanical Drawings for louver size and schedule.

F. Blank-Off Plates:
   1. Aluminum sheet, 0.050 IN minimum thickness.
   2. Factory applied flat black painted finish.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install anchoring and bracing accessories as required.

C. Seal around perimeter on exterior and interior.
   1. See Section 07 92 00.

D. Install 0.040 IN aluminum flashing at sill to match louver.

END OF SECTION

DIVISION 09

FINISHES

SECTION 09 22 16
NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish labor, materials, tools, equipment, and services for Non-Structural Metal Framing in accordance with provisions of Contract Documents.

B. Completely coordinate with work of other trades.

1.2 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. Member of Certified Steel Stud Association (CSSA), Steel Stud Manufacturers Association (SSMA) or Steel Framing Industry Association (SFIA).

B. Referenced Standards:
   1. The American Iron and Steel Institute (AISI):
      a. AISI S220 North American Standard for Cold-Formed Steel Framing – Nonstructural Members.
   2. ASTM International (ASTM):
      a. ASTM C635 Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
      b. ASTM C645 Standard Specification for Nonstructural Steel Framing Members.
      c. ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
      d. ASTM C754 Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
      e. ASTM A1003 Standard Specification for Steel Sheet, Carbon, Metallic and Nonmetallic-Coated for Cold-Formed Framing Members.

C. Gypsum Association (GA):
   1. GA-216 Application and Finishing of Gypsum Panel Products.
   2. GA-234 Control Joints for Fire-Resistance Rated Systems.

1.3 SUBMITTALS

A. See Section 01 33 00 for requirements.

B. Product Data:
   1. Manufacturer's specifications for each type of material and accessory.
      a. Where fire resistance classification is indicated, submit copies of nationally recognized testing laboratory listings of products proposed for use.
   2. Where EQ coatings are used, submit copies of nationally recognized testing laboratory results showing conformance with ASTM A653 and AISI S220.
      a. Include data required to show specification compliance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Non-Structural Metal Framing:
   1. Base:
      a. ClarkDietrich Building Systems
   2. Optional:
      a. CEMCO Steel Framing and Metal Lath
      b. Custom Stud Inc.

c. Marino/WARE
d. MBA Metal Framing
e. MRI Steel Framing LLC.
f. Telling Industries
g. The Steel Network

B. Isolation Strip Material:
1. Base:
a. Reflectix, Inc.
2. Optional:
a. Saint-Gobain

C. Interlocking Grid Support Systems for Gypsum Board Ceilings:
1. Base:
a. USG Corporation
2. Optional:
a. Armstrong
b. Chicago Metallic

D. Other manufacturers desiring approval comply with Section 01 61 00.

2.2 DESIGN CRITERIA

A. Select steel studs in accordance with manufacturer's standard load tables and following design pressures and maximum deflections:

Performance Criteria		
Use Condition [2]	Design Pressure	Maximum Deflection
Wall enclosing stairs, elevator hoistways, and other vertical shafts	10 LBS/SF	L/240
Wall enclosing vestibules, ground floor lobbies, and similar spaces subject to intermittent exposure to exterior wind conditions	15 LBS/SF	L/240
Walls scheduled with Tile Backer Board, Moisture-Resistant, Impact-Resistant, or Abuse-Resistant Gypsum Wallboard	5 LBS/SF	L/360
Walls scheduled to receive Tile, lath and plaster, or veneer plaster. [1]		
Typical Interior Walls/Partitions (those not listed above)	5 LBS/SF	L/240
Interior Ceilings, Soffits and Bulkheads	5 LBS/SF	L/360

Footnotes
1. Limit deflection to L/360 where wall cladding on either face is any of the following: Ceramic Tile, Stone Tile, Porcelain Tile, Thin Brick, Lath & Plaster, Simulated Masonry, Adhered Stone, Veneer Plaster and similar brittle finishes which are prone to movement induced cracking.
2. Where elements meet multiple conditions; Use most stringent Deflection and Design Pressure values.

2.3 MATERIALS

A. Metal Studs and Floor Tracks:
1. C-shaped, roll formed studs and tracks conforming to ASTM C645.
2. Steel design standard: 33KSI.
3. Galvanized: G40 or G40EQ conforming to ASTM A653 and AISI S220.
4. Stud and track depths: As indicated by wall type.
5. Minimum flange width: 1-1/4 IN.
6. Minimum thickness: 30 MIL (20 GA), except as follows:
a. Increase member thickness to comply with performance criteria.
b. Decrease member thickness to minimum 18 MIL (25 GA) studs at following condition:

1) Where walls do not extend to overhead structural deck and supporting diagonal bracing or horizontal stiffeners are used.

7. In lieu of increased member thickness, design may employ diagonal braces above ceiling to reduce overall span.
   a. Coordinate locations with building services items.
   b. Do not employ studs with member thickness less than allowed by fire resistance rated assemblies.
8. High strength 50 KSI or 70 KSI studs shall comply with design criteria of equivalent thickness standard 33 KSI studs listed.
9. At walls designated STC 40 and above, use only studs with physical characteristics of studs used in documented STC testing.
10. Base product: ProSTUD Drywall Framing by ClarkDietrich.

B. Head of Wall Accessories:
   1. Configure to accommodate deflection of superstructure without inducing axial loading on partition wall.
   2. Maintain structural integrity, fire and smoke-resistance, and sound control as required by each wall.
   3. Slotted top deflection track:
      a. Deep leg, vertically slotted track.
      b. Cold-formed sheet steel; galvanized; G60.
      c. Thickness: 30 MIL (20 GA) minimum.
      d. Width: As required for studs sizes indicated.
      e. Depth: Minimum 2-1/2 IN down-standing legs with 1/4 IN wide by 1-1/2 IN high slots spaced 1 IN on center.
      f. Base product: MaxTrak by ClarkDietrich.
   4. Z-bars, cold formed channels and clips:
      a. Accommodate thickness of spray-applied fire-resistive materials.
   5. UL-listed fire resistant components tested for compliance with requirements indicated.
   6. Firestopping Materials:
      a. Sealants, sprays, intumescent strips and forming materials.
      b. Coordinate with sealants specified in Section 07 84 00 and Section 07 92 00.
      c. Intumescent applications:
         1) Factory or field applied.
      d. Base product: Blazeframe by ClarkDietrich.

C. Z-Bar Standoff Clips:
   1. 30 MIL (20 GA) galvanized steel.
   2. Provide Z-bars for attachment of top track to superstructure elements which are to be protected with sprayed fireproofing.
      a. Size: 2 IN x 2 IN x 2 IN.
   3. Length:
      a. As required to accommodate beam and deck fireproofing.
         1) At structural steel member: Length equal to flange width of structural steel member.
         2) At steel deck: Minimum length equal to partition width, or as required to span steel deck flutes.
      b. Extend length of Z-bar to accommodate partition offset that will not clear fireproofed steel beam.

D. Furring Channels:
   1. Hat shaped sections.
   2. Galvanized: G40 or certified equivalent.
   3. Sizes: 7/8 IN and 1-1/2 IN, as indicated.
   4. Minimum Thickness: 30 MIL (20 GA); Use heavier gauge as dictated by conditions.
   5. Base product: Furring Channel/ Hat Channel by ClarkDietrich.

E. Z-Furring:

1. Z-shaped sections, attached to structural parent wall.
2. Galvanized: G40 or certified equivalent.
3. Sizes: 1, 1-1/2, and 2 IN.
4. Thickness: 18 MIL (25 GA) minimum; Use heavier gauge as dictated by conditions.
5. XPS foam insulation: Specified in Section 07 21 00.
6. Base product: Z-Furring Channel by ClarkDietrich.

F. Accessory Items:
   1. Wire Ties:
      a. Minimum thickness: 43 MIL (18 GA) soft annealed, galvanized.
   2. Track Fasteners:
      a. Power driven type, to withstand minimum 190 LBS shear when driven.
   3. Backing
      a. General:
         1) See Drawings for applications of backing types listed and further details.
         2) Use heavier gauge as necessary for items to be supported.
         3) Comply with manufacturer's backing requirements if capacity exceeds types listed.
      b. Flat Plate (Type A):
         1) Flat, sheet metal stock per ASTM A1008.
         2) G40 galvanized or certified equivalent.
         3) Thickness: 50 MIL (18 GA) minimum.
      c. Metal Backing (Type B):
         1) C-shaped modified track runners.
         2) G40 galvanized or certified equivalent.
         3) Backing height: 6 IN minimum.
         4) Flange width: 1-1/4 IN minimum.
         5) Thickness: 30 MIL (20 GA) minimum.
         6) May be installed continuously across multiple stud spaces.
         7) Use where no other type of backing is designated.
      d. Metal Backing (Type C):
         1) C-shaped modified track runners.
         2) G40 galvanized or certified equivalent.
         3) Backing height: 8 IN minimum.
         4) Flange width: 1-1/4 IN minimum.
         5) Thickness: 54 MIL (16 GA) minimum.
         6) Install at single stud space with properly oriented studs.
      e. Hospital and Laboratory casework and wall mounted medical equipment without specific backing requirements:
         1) Type B backing as listed above with revised minimum thickness.
         2) Thickness: 54 MIL (16 GA) minimum.
            a) Use heavier gauge as necessary for items to be supported.

G. Support Systems for Gypsum Ceilings:
   1. Interlocking Grid Systems:
      a. ASTM C635, direct-hung system composed of T-Shaped framing members designed to carry load of screw-applied gypsum ceiling board.
      b. Tabs on Cross-Tees to interlock into slots in Main Runners where intersections occur.
      c. Base Product: Drywall Suspension System by USG Corporation.
   2. Track and Channel Systems:
      a. ASTM C645 roll-formed steel with G40 galvanized coating.
      b. Thickness: 30 MIL (20 GA) minimum; Use heavier gauge as dictated by conditions.
      c. Carrying channels:
         1) Size: 1-1/2 IN.
      d. Furring channels:
         1) Sizes: 7/8 IN and 1-1/2 IN, as indicated.
   3. Stud-Framed Ceiling/Soffit Systems:
      a. C-shaped studs or joists; roll-formed.

b. Galvanized: G40.
c. Frame member depth: 3-5/8 IN minimum, unless otherwise indicated.
1) Use wider stud sections if ceiling span and support requires.
d. Flange width: 1-1/4 IN minimum.
e. Stud thickness: 33 MIL minimum.

4. Tie Wire:
a. ASTM A641, Class 1 zinc coating, soft temper.
b. Diameter, single-strand: 62 MIL (14 GA) minimum.
c. Diameter, double-strand: 42 MIL (18 GA) minimum.

5. Wire Hangers:
a. ASTM A641, Class 1 zinc coating, soft temper.
b. Diameter: 97 mils (12 GA) minimum.

6. Anchors in Concrete:
a. Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 5 times that imposed by ceiling construction, as determined by testing per ASTM E488 or ASTM E1512 as applicable.
b. Acceptable types: Cast-in-place, post-installed expansion anchors and post-installed bonded anchors.
c. Material: Carbon-steel components zinc plated to comply with ASTM-B633, Class Fe/Zn 5 for Class SC 1 service condition.

7. Powder-Actuated Fasteners in Concrete:
a. Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E1190.
b. Comply with seismic design requirements where applicable.

8. Other items including suspension wire, tie wire, attachment devices: As specified and indicated.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine supporting structure and conditions under which system will be installed.

B. Correct conditions detrimental to proper installation.

C. Installation constitutes acceptance of responsibility for performance.

3.2 INSTALLATION - GENERAL

A. Layout and install metal framing accurate to dimensions indicated in drawings.

B. Installation Standard: ASTM C754, except comply with framing sizes and spacing indicated.
1. Gypsum Board Assemblies: Comply with additional requirements in ASTM C840 relative to framing installation.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, wall stops, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

F. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

G. Extend framing full height to structural supports.

1. Exception: Where partitions are indicated to terminate at, or just above, suspended ceilings.
2. Continue framing around ducts and similar items which penetrate partitions.

H. Position studs vertically engaging floor track and head of wall deflection track.
1. Align stud knockouts to facilitate running of wires and conduit.

I. Space studs maximum 16 IN on center.
1. Stud spacing at Shaftwall: 24 IN on center.

J. Provide additional studs at corners, partition intersections and terminations of partitions, and at each side of control joints.

K. Positively anchor studs to floor tracks with self-tapping pan head screws, or stud clinching tool per ASTM C754.

L. Anchor studs to deflection track with wafer head screws on both flanges of each stud.
1. Maintain deflection gap between top of stud and top of slotted track.
2. Install screws at centerline of slot and secure allowing vertical movement.

M. Anchor fire rated partitions as required by fire resistance design, and firestopping design.

N. Where partitions abut vertical structural elements, provide perimeter relief per Gypsum Association GA-600 Strain Relief System details.

O. Head-of-Wall:
1. Provide slotted top track for walls extended to structure.
2. Configure to resist lateral loads while accommodating deflection of overhead building superstructure without inducing axial loading on partition framing.
3. Secure deflection track to structure in accordance with industry standards and regulatory requirements.
4. Secure at corners and at ends.
5. Cut vertical studs 5/8 IN short to create a deflection gap when installed into top track.
a. Secure vertical studs to top track with framing screw at each stud, screwing through track slots for positive stud connection.
6. Secure Gypsum Wallboard to vertical studs; do not secure Gypsum Wallboard to top track directly.
7. Prepare wall for installation of seals, firestopping, or both:
a. Fire-rated Walls: Prepare for fire-resistive joint assemblies specified in Section 07 84 00.
b. Non-fire rated partitions including Smoke Partitions: Prepare for Acoustical Sealant specified in Section 07 92 00.

P. Furring Channels:
1. Attach furring channel systems directly to parent walls.
2. Install channels at maximum 16 IN OC.
3. Provide additional framing at openings, cutouts, corners, and control joints.
4. Space fasteners not more than 24 IN OC, staggered on opposite flanges of furring channels.

3.3 FRAMING AT OPENINGS

A. Control Joints (CJ):
1. Install additional stud, maximum 1/2 IN from jamb studs.
2. Do not fasten extra stud to track or jamb stud.
3. Refer to specification Section 09 29 00 for control joint locations.

B. Prefabricated headers, jambs, and sill framing systems option:
1. Proprietary opening framing systems may be used as an alternative to conventionally fabricated framing.
2. Pre-approved Products:
a. HDS Framing System by ClarkDietrich.
b. Quick Frame Rough Opening System by Marino/ Ware.

C. Door Openings:
   1. Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section for cripple studs at head and secure to jamb studs. Screw into web of jamb stud.
   2. Unless indicated otherwise, extend jamb studs through suspended ceilings and secure laterally to overhead structure.
   3. Jamb Studs:
      a. Minimum thickness of jamb studs: 30 MIL (20 GA) at openings.
      b. Install two studs at each jamb, toe-to-toe unless otherwise indicated.
         1) Securely attach first stud to frame.
         2) Fill cavity between studs with acoustic batt insulation where required by acoustical rating of wall.
         3) Join second stud to first stud on each face with 30 MIL (20 GA) screw attached steel straps at 42 IN on center maximum.
   4. Headers:
      a. Openings less than 4 FT wide:
         1) Cut-to-length section of floor runner above and below wall openings.
         2) Split flanges and bend webs at ends.
         3) Overlap and screw attach jamb studs to frames.
      b. Openings over 4 FT wide:
         1) Cut-to-length, horizontal box beam studs above and below wall openings.
         2) Design for actual span and loading.
      c. Incorporate miscellaneous steel members, specified in Section 05 50 00, and wood blocking, specified in Section 06 10 00, where indicated.
   5. Control Joints at head of jambs:
      a. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2 IN clearance from jamb stud to allow for installation of control joint in finished assembly.
      b. Gypsum Wallboard control joints as specified in Section 09 29 00.

D. Other Framed Openings:
   1. Frame openings other than door openings the same as required for door openings, unless otherwise indicated.
   2. Install framing below sills of openings to match framing required above door heads.
   3. Cripple Studs:
      a. Install cut-to-length intermediate vertical studs above and below openings.
      b. Spacing: As indicated for typical full-length studs.
   4. Incorporate miscellaneous steel members, specified in Section 05 50 00, and wood blocking, specified in Section 06 10 00, where indicated.

3.4 WALL BACKING AND BLOCKING

A. Metal Wall Backing: Provide in-wall metal wall backing reinforcement where following items are mounted to interior walls and interior face of exterior walls:
   1. Crash rails, chair rails, wall bumpers, and similar wall protection devices.
   2. Contractor or Owner furnished equipment indicated to be wall mounted.
   3. Toilet accessories that do not include proprietary backing devices.
   4. Toilet partitions and lockers.
   5. Markerboards, tackboards, and chalkboards.
   6. Other wall-mounted items where backing is indicated by details or specification.

B. Verify metal stud framing has been installed to support wall-mounted items specified in Section 05 50 00.

C. Wood Wall Blocking: Specified in Section 06 10 00.

D. Coordinate mounting height, location, and coverage with item to be supported.

E. Determine material width according to item to be supported.

F. Provide in-wall metal wall backing material to interior and exterior metal stud walls specified herein.

G. Exterior stud wall and components (including parapets) and connection to structure to be designed for wind loads per the design criteria listed in Section G3.1.C on Sheet 00S001.

H. Attachment: Minimum 2 - #10 sheet metal screws at each stud.

3.5 CEILING FRAMING

A. Install in compliance with manufacturer's recommendations.

B. Provide required items to support and trim out neatly, flush or recessed mechanical and electrical items.

C. Frame openings in ceiling support system to accommodate access panels and similar openings and penetrations.
   1. Completely frame openings with closed channel side of stud facing opening for support of recessed mechanical and electrical items.

3.6 CEILING SUPPORT SYSTEMS

A. Install suspension system components in sizes and spacing indicated on Drawings, but not less than required by referenced installation standards for assembly types and other assembly components indicated.

B. Isolate suspension systems from building structure where abutting or penetrated by building structure.

C. Suspend hangers from building structure as follows:
   1. Install hangers plumb and free from contact with insulation or other objects that are not part of supporting structural or suspension system.
      a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.
   2. Where width of ducts and other construction within ceiling plenum interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
      a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
   3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and secure fasteners appropriate for substrate.
   4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and secure fasteners appropriate for structure and hanger.
   5. Do not attach hangers to steel roof deck.
   6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
   7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
   8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Grid Suspension Systems:
   1. Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces.
   2. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
   3. Install suspension systems that are level to within 1/8 IN in 12 FT measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.
   4. Coordinate support requirements for in-ceiling devices with capacity of ceiling grid system.

END OF SECTION

SECTION 09 29 00
GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Gypsum board.
   2. Cement backer board.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 07 92 00 - Joint Sealants.
   4. Section 09 22 16 - Non-Structural Metal Framing.
   5. Section 09 91 10 - Architectural Painting.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
      b. C475/C475M, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
      c. C840, Standard Specification for Application and Finishing of Gypsum Board.
      d. C1002, Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
      e. C1047, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
      f. C1396/C1396M, Standard Specification for Gypsum Board.
      g. D3273, Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
   2. Gypsum Association (GA):
      a. GA-214, Recommended Levels of Gypsum Board Finish.
   3. Underwriters Laboratories, Inc. (UL):
      a. Building Materials Directory.
      b. Fire Resistance Directory.

1.3 DEFINITIONS

A. Wet Area:
   1. Toilet rooms, showers, laboratories, janitor closets, or similar areas.
   2. Areas within 5 FT of emergency showers, eye wash stations, service sinks, or mop sinks.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Drawings of unusual conditions.
      a. Control joint layout.
   3. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   4. Manufacturer's adhesive, joint treatment compound and tape recommendations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Gypsum board and accessories:
      a. American Gypsum.
      b. Georgia-Pacific Gypsum LLC.
      c. National Gypsum.
      d. USG Corporation.
   2. Cement board and accessories:
      a. James Hardie Building Products, Inc.
      b. National Gypsum.
      c. USG Corporation.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. General:
   1. Provide UL Listed materials in fire-resistant rated construction.
   2. Furnish in lengths as long as practicable.

B. Gypsum Board (GB):
   1. ASTM C1396/C1396M.
   2. Thickness: 5/8 IN unless noted otherwise.
   3. Edges: Tapered.
   4. Fire-rated board: Type X.

C. Cement Backer Board:
   1. ASTM C1325.
   2. Thickness:
      a. Wall board: 5/8 IN.
      b. Flooring underlayment: 1/4 IN.
   3. Water durable, mold resistant, non-combustible cement backer board for tile.
      a. Rot, warp and delaminate resistant.
      b. For use on walls or floors.
      c. See Specification Section 09 30 13 for ceramic tile.

2.3 ACCESSORIES

A. Trim:
   1. ASTM C1047.
   2. Galvanized: ASTM A653/A653M G-60, unless noted otherwise.
   3. Corner bead:
      a. Standard type with perforated flanges.
      b. ClarkDietrich "#103 Deluxe Corner Bead".
   4. Casing and trim bead:
      a. ClarkDietrich "#200-A Metal U-Trim.
   5. Control and expansion joints:
      a. ClarkDietrich "#093 Zinc Control Joint."

B. Fasteners:
   1. Gypsum boardandtile backer board:
      a. ASTM C1002.
      b. Self-drilling, corrosion-resistant bugle head screws.
         1) For fastening gypsum board to metal framing: Type S.
   2. Cement backer board:
      a. Self-drilling, corrosion resistant wafer head screws with strip-out prevention ribs.

b. Do not use drywall screws.

C. Adhesive: As recommended by board manufacturer.

D. Joint Tape:
1. ASTM C475/C475M.
2. Recommended by manufacturer for specified board type and location.

E. Joint Treatment Compound:
1. ASTM C475/C475M.
2. Recommended by manufacturer for specified board type and location.

F. Latex Modified Mortar:
1. See Specification Section 09 30 13.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
1. Verify that metal stud framing has been installed plumb, true, and in accordance with the Contract Documents.
2. Prior to application of gypsum board, ensure that all blocking, backing and bracing has been installed as necessary for the support of appurtenant items.
3. Install gypsum board in accordance with ASTM C840.
4. Install board in fire-rated construction in accordance with UL requirements.
   a. Self-adhesive applied fire rated tape is not acceptable for use on board joints in fire rated walls.
   b. Tape all joints using conventional fire rated joint tape and joint treatment compound.
5. Erect all board vertically with edges over supporting members.
   a. See Specification Section 09 22 16 non-structural metal framing.
6. Secure to each support or framing member with screws.
   a. Provide fasteners of sufficient length to penetrate framing member or stud not less than 3/8 IN.
7. Bring boards into contact, but do not force into place.
8. Fit neatly and carefully.
9. Stagger edge joints on opposite side of a partition so they occur on different framing members.
10. Hold board in firm contact with support while fasteners are being driven.
11. Proceed with attachment from center of board toward ends and edges.
12. Scribe board prior to cutting.
13. Where gypsum board abuts concrete, masonry, metal deck, exterior doors and windows, or other dissimilar material; provide 3/8 IN joint between edge of gypsum board and abutting material.
   a. Provide continuous casing bead trim on edge of board.
   b. Seal joint with sealant and backer rod.
   c. See Specification Section 07 92 00 for sealant.
14. Use water-resistant gypsum board (WRGB) in wet locations not scheduled to receive tile finish or abuse resistant panels (ARP).
15. Use Cement Backer Board in wet locations scheduled to receive tile finish.
   a. Install in accordance with ANSI A108.11 and manufacturer's recommendations.
   b. Use in areas where ceramictile is scheduled.

B. Installation:
1. Set fasteners between 3/8 and 1/2 IN from edges and 2 IN in from board corner.
   a. Space maximum of 12 IN on center at edges and in field of board.
   b. Where board butts at wall/ceiling juncture, hold fasteners back 6 IN from edges.
   c. Space fasteners closer if required by UL.

2. Install fasteners, in gypsum board, so that head rests in a slight dimple without cutting face paper or fracturing core or as recommended by board/panel manufacturer.

C. Control Joints:
   1. Install prefabricated control joints to provide following maximum unjointed lengths or areas:
      a. Partitions: 30 FT, maximum straight run, and at lock side of jamb from head of each door, borrow lite, or window opening to top of partition.
      b. Ceilings:
         1) 50 FT maximum in one direction,
         2) At change of direction or irregular shapes.
         3) Ceiling area: 2500 SQFT, maximum.
   2. Where control or expansion joints occur in fire or sound rated assemblies, install suitable backing material to maintain required rating.
   3. Where a partition or ceiling abuts a structural element or dissimilar wall or ceiling, install corner bead, casing bead or other trim as required.

D. Gypsum Board Finishing:
   1. Securely attach continuous corner beads to all external corners in accordance with manufacturer's recommendations.
   2. Provide the following minimum levels of gypsum board finish in accordance with GA-214.
      a. Areas exposed to view:
         1) Surfaces to receive vinyl wall covering: Level #4.
         2) Surfaces to receive painted finish: Level #5.
      b. Areas not exposed to view:
         1) Fire rated partitions: Level #2 unless a higher grade of finish is required by UL.
         2) Non-fire rated partitions: Level #2.
      c. Provide additional coats of joint compound as required to completely conceal joints, fasteners and accessories.
         1) Joint photographing will not be acceptable.
   3. Sand each coat to remove excess joint compound.
      a. Avoid roughing paper facing on board.
   4. Finish surface shall be smooth and free of tool marks and ridges.
   5. Prime gypsum board surfaces in accordance with Specification Section 09 91 10.
      a. After primer has been applied, inspect surfaces and repair and refinish all areas which show defects.
   6. Refer to ASTM C840 for additional finishing requirements.

E. Coated Fiber-faced Gypsum Board Finishing:
   1. Follow the manufacturer's published installation instructions.
   2. In showers or similar wet areas scheduled to receive a tile finish:
      a. Seal perimeter, joints and penetrations in accordance with manufacturer's instructions to provide a water-tight installation.
      b. Apply fiberglass mesh tape and finish with latex modified mortar per manufacturer's instructions.
      c. Cover fasteners with latex modified mortar.
   3. In wet areas scheduled to receive a painted finish:
      a. Apply paper joint tape with setting-type joint compound.
      b. Finish per the Gypsum Board Finishing paragraph in this Section.

END OF SECTION

SECTION 09 30 13
CERAMIC TILE (CT)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. See the DEFINITIONS Article, Ceramic Tile paragraph for types of tile included in this Specification Section.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 07 92 00 - Joint Sealants.
   4. Section 09 29 00 - Gypsum Board.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI):
      a. A108.1, Specification for the Installation of Ceramic Tile.
      b. A137.1, Specifications for Ceramic Tile.
   2. Tile Council of North America (TCNA):
      a. TCA Handbook for Ceramic, Glass, and Stone Tile Installation.

B. Qualifications:
   1. Installer must have minimum five years experience installing similar products with similar substrates.

C. Mock-Ups:
   1. Provide a sample wall and/or floor area minimum 4 x 4 FT each using specified tile, grout, special shapes and trim pieces.
      a. Sample area substrate shall be of same construction as actual project condition.
   2. Construct additional sample areas as required until accepted by Engineer.
   3. Sample area will constitute minimum acceptable standard of quality for actual construction.
   4. Sample area shall not be built into permanent construction.
   5. Remove sample when directed by Engineer.

1.3 DEFINITIONS

A. Installer or Applicator:
   1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
   2. Installer and applicator are synonymous.

1.4 SYSTEM DESCRIPTION

A. Unless noted otherwise on the Drawings, floor tile selection shall be made from complete range of available sizes within Class 3 or Class 4 durability rating.
   1. Tile colors, styles and profiles and associated trim pieces to be selected from manufacturer's complete line including premium and custom offerings.

B. Unless noted otherwise on the Drawings, wall tile selection shall be made from a complete range of available sizes from Color Group 3.
   1. Tile colors, styles and profiles and associated trim pieces to be selected from manufacturer's complete line including premium and custom offerings.

1.5 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   3. Certification of installer qualifications.
   4. Letter from grout and adhesive manufacturer stating that grout and tile adhesive being used is compatible with cement backer board specified in Specification Section 09 29 00.

B. Samples:
   1. Complete range of tile samples per the SYSTEM DESCRIPTION Article in this Specification Section for selection by Engineer.
      a. Tile trim may be contrasting color.
      b. Complete range of grout color samples.
   2. After selection of colors, types, patterns and sizes, and prior to ordering tile, provide minimum 16 x 16 IN sample palette or two full tiles if 12 x 12 IN (or larger) tile are specified, in color, pattern, blend and type for Engineer's final approval.
      a. Include selected grout color as part of sample.

C. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

D. Informational Submittals:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Ceramic tile:
      a. Daltile (DTC).
      b. American Olean (AOT).
      c. Esquire Interiors LLC (ESQ).
      d. Florida Tile, Inc. (FT).
      e. Metropolitan Ceramics (MC).
      f. Richetti (RICH).
      g. Summitville Tiles, Inc. (SUM).
      h. United States Ceramic Tile Co. (USCT).
   2. Adhesives, mortars, grouts and leveling compounds:
      a. Bonsal Co.
      b. Bostik by Arkema.
      c. H.B. Fuller Company (TEC).
      d. LATICRETE International, Inc.
      e. MAPEI, Inc.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. Adhesives for Setting Tile:
   1. Dry-set Portland cement mortars: ANSI A108.1.

2. Latex-Portland cement mortars: ANSI A108.1.
3. Assure adhesives are compatible with cement backer board.
4. Waterproofing:
    a. Trowel applied elastomeric compound.
    b. Acceptable to tile manufacturer.
    c. Compatible with backing material and setting adhesive.
    d. Mapei "PRP 315 IN.
    e. Fiber mesh reinforcing: As recommended by waterproofing manufacturer.

B. Grout: Portland cement-based material, containing quartz aggregate, colorfast pigments and Portland cement.

C. Sealant: One or two component, non-sag, polyurethane or silicone sealant, as specified in Specification Section 07 92 00.

D. Leveling Compounds: As recommended by tile manufacturer.

2.3 MANUFACTURED UNITS

A. Wall Tile:
1. Ceramic units conforming to ANSI A137.1.
2. 5/16 IN thick.
3. Size(s): As scheduled in PART 3.
4. Tile selections shall be made by the Engineer from Color Group 3and may include:
    a. Designer accents.
    b. Matt.
    c. Textured.
    d. Bright.
    e. Crystal.
    f. Satin.
    g. High gloss smooth glaze.
    h. Designer strips/rounded moldings.
    i. Granite look.
    j. Scored design.

B. Floor tile:
1. Provide and install a dynamic coefficient of friction (DCOF) of 0.42 as defined by Daltile.
    a. If other manufacturer is selected, provide similar DCOF.

C. Tile Base and Associated Trim:
1. Factory made trim shapes for all curbs, caps, corners, bullnose, bases, coves, beads, depressions, moldings, chair rails, etc.
    a. Provide as shown on drawings.

2.4 MAINTENANCE MATERIALS

A. Extra Material:
1. Furnish Owner with the following extra materials:
    a. 2 PCT of each different size, pattern, style and/or color of tile used including trim shapes with minimum of one full size tile of each for maintenance purposes.
    b. Enough extra grout mix of each different color and/or type to allow for full 2 PCT of tile to be replaced.

PART 3 - EXECUTION

3.1 PREPARATION

A. Locate expansion joints prior to product installation.

B. Verify that substrate is ready to accept tile installation.

1. Correct surface defects or conditions which may interfere with or prevent a satisfactory installation.

3.2 INSTALLATION

A. General:
   1. Install products in accordance with manufacturer's instructions and ANSI A108.1.
   2. Place tile in grid pattern as shown on Drawings.
   3. Align tile joints on adjoining walls/floors.
   4. Lay out and center tile in both directions in each space or on each wall area.
   5. Avoid use of tile less than 1/2 size.
   6. Adjust tile to minimize cutting.
   7. Provide uniform joint widths insofar as practicable.
      a. Provide joint widths as recommended by tile manufacturer.
   8. Provide leveling beds as required.
   9. Provide edging at exposed edges where there is a change of level.

B. Install expansion joints where indicated on Drawings:
   1. If not indicated on Drawings, place joints 12 - 16 FT OC or on column lines each way (whichever is smaller).
      a. Provide expansion joints in accordance with TCA Handbook.
   2. Install over construction or expansion joints in backing.
   3. Install where backing material changes.
   4. Install where floors abut vertical surface.
   5. Maintain nominal 1/4 IN wide joint at perimeter of tiled floor areas and fill with sealant.

C. Installation of Tile on Floors and WallsOver Waterproofing and Setting Adhesive:
   1. Provide waterproofing for all tile installed on:
      a. Floors in toilet rooms, and mechanical room.
         1) Extend up walls to height of base.
   2. Installation of Waterproofing Membrane:
      a. Prepare substrate in accordance with manufacturer’s published recommendations.
      b. Apply base membrane with flat trowel.
         1) Maximum thickness: 5/64 IN per coat or as recommended by manufacturer.
         2) Allow membrane to cure between coats in accordance with manufacturer’s instructions.
      c. Apply second coat with v-notch trowel and immediately flatten with flat trowel to a smooth, membrane, free of voids.
      d. Embed fiber mesh reinforcing into fresh membrane at all inside corners, vertical/horizontal intersections and where required for crack control.
         1) Do not bridge expansion joints with reinforcing or membrane.
      e. Apply additional coat (s) of membrane per manufacturer’s published instructions to completely encapsulate fiber mesh reinforcing
   3. After waterproofing has cured/dried in accordance with manufacturer's recommendations, install tile using setting adhesive in accordance with manufacturer's recommendations.

3.3 CLEANING

A. After installation, clean in accordance with manufacturer's instructions.

3.4 PROTECTION

A. Permit no traffic on floors for 72 HRS after grouting and protect installed tile work with minimum 0.125 IN thick non-staining covering during construction to prevent damage.

END OF SECTION

SECTION 09 51 00
ACOUSTICAL CEILINGS (ACT)

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish labor, materials, tools, equipment, and services for Acoustical Ceiling Systems (ACT) in accordance with provisions of Contract Documents.

B. This section only applies to the Scale Houses as provided by modular building manufacturer. See Section 13 34 33.

C. Completely coordinate with work of other trades.

1.2 QUALITY ASSURANCE

A. ASTM International (ASTM):
   1. ASTM A641/A641M Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
   2. ASTM B633Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
   3. ASTM C635/C635M Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panels Ceilings.
   4. ASTM C636/C636M Standard Specification for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
   5. ASTM E488/E488M Standard Test Methods for Strength of Anchors in Concrete Elements.
   6. ASTM E580/E580M Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions
   7. ASTM E1190 Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members

B. Site Classification and Seismic Design Categories as defined in the International Building Code.

1.3 SUBMITTALS

A. Product Data:
   1. Manufacturer’s specifications for each type of material and accessory.

B. Samples:
   1. Three samples of each type of tile listed in Drawing Finish Schedule.

C. Contract Closeout Information:
   1. Maintenance data.
      a. See Section 01 78 23.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Steel Suspension Systems:
   1. Base:
      a. Armstrong World Industries.
   2. Optional:
      a. USG Corporation
      b. Rockfon

B. Acoustical Ceiling Tile:
   1. Base:
      a. As noted for individual types in Drawings.

C. Other manufacturers desiring approval comply with Section 01 61 00.

2.2 MATERIALS

A. Acoustic Suspension Systems:
   1. Heavy duty systems, ASTM C635.
   2. Main runner jointing by spliced, interlocking ends, tab locks, pin locks, or other suitable connections.
   3. Cross runners interlocking with main runners.
   4. Include components and accessories necessary resist seismic loads and dead loads of items such as light fixtures and air diffusers.
   5. Hanger Wire:
      a. Pre-stretched, with a yield stress load of at least 5 times design load, but not less than 0.106 IN (12 GA) .
      b. Utilize continuous lengths, without kinks and splices.
      c. Galvanized Steel:
         1) Galvanized, soft annealed steel wire conforming to ASTM A641/A641m.
      d. Stainless Steel:
         1) Type 304, soft annealed steel wire conforming to ASTM A641/A641M.
         2) Use where aluminum ceiling grid is specified.
   6. Attachment Devices:
      a. Anchors in Concrete:
         1) Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 5 times that imposed by ceiling construction, as determined by testing per ASTM E488/A488M or ASTM E1512.
         2) Acceptable types: Cast-in-place, post-installed expansion anchors and post-installed bonded anchors.
         3) Material: Carbon-steel components zinc plated to comply with ASTM B633, Class Fe/Zn 5 for Class SC 1 service condition.
   7. Wall Moldings: In accordance with International Building Code.
      a. Description: 7/8 IN minimum horizontal leg for use with BERC-2 clip.
   8. Accessories
      a. Beam End Retaining Clip
         1) 2 IN, x 0.034IN thick.
         2) Hot dipped galvanized cold rolled steel per ASTM A568.
         3) Use to join main beam or cross tee to wall molding.
         4) Product: BERC2 by Armstrong.
   9. Suspension System Types:
      a. GR-1: Exposed grid, non-rated:
         1) Description: Galvanized, double web steel, main and cross runners.
         2) Face width: 15/16 IN .
         3) Base Product:
            a) Prelude XL, by Armstrong.
            b) Donn DX/DXL by USG.
            c) 1200 Series by Chicago Metallic.
         4) Finish on exposed surfaces: Smooth, flat white.
            a) 1200 Series by Chicago Metallic.
            b) Framing and suspension systems for Gypsum Board Ceilings:
               (1) Specified in Section 09 22 16.

B. Acoustical Ceiling Tile:
   1. Scheduled finishes to be factory applied.
   2. Class A incombustible units.
   3. Edges uniformly fabricated, true, square.
   4. Sizes as required to fit scheduled suspension system.
   5. Standard tile/panel size: See Reflected Ceiling Plan.

6. Sealants: VOC content No greater than 250 g/L.
    a. Sealants shall contain no carcinogen or reproductive toxicant components present at more than 1 PCT of total mass of the product as defined in the California Office of Environmental Health Hazard Assessment's (OEHHA) list entitled Chemicals Known to the State to Cause Cancer or the Reproductive Toxicity, Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65).
7. Wet Formed Mineral Fiber Ceiling Tile:
    a. Light reflectance: Not less than 0.75.
    b. Noise reduction coefficient: 0.50 – 0.65.
    c. Lay-in style: Minimum 5/8 IN thick.

C. Diffusers and Grilles:
1. See Division 23

D. Light Fixtures:
1. See Section 26 51 13.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify suitability of substrate to accept installation.

B. Examine installation site for irregularities having effect on quality and execution of work.

C. Consult other trades involved before start of ceiling work, to determine areas of potential interference

D. Do not start installation until interferences have been resolved.

E. Installation constitutes acceptance of responsibility for performance.

3.2 PREPARATION

A. Coordinate ceiling layout with sprinkler head spacing and work penetrating acoustical ceiling systems.

B. Tolerances:
1. Comply with ASTM C635/C635M Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
2. Deviation from level plane: 1/8 IN in 10 FT with no load applied maximum.
3. Bow: 1/32 IN in 2 FT maximum.
4. Camber: 1/32 IN in 2 FT maximum.
5. Twist: 1 degree in 2 FT maximum.

3.3 INSTALLATION

A. Suspension System:
1. Install suspension system in accordance with manufacturers' instructions.
2. Grid layout:
    a. See Reflected Ceiling Plans.
    b. Install grid based on electrical lighting fixture layout indicated in Electrical Drawings, unless otherwise indicated,
    c. Acoustical panel dimension at perimeter walls: Not less than 6 IN .
    d. In case of conflict notify Architect.
3. Install grid square with room and with grid or acoustical panel center lines coinciding with center lines of room, each direction.
4. Intersections between main tees and cross tees:
    a. Butt cut and notch as required.
5. Wall angles:

a. Install wall angles or moldings where ceilings meet walls, partitions, vertical elements, and other types of ceilings or ceiling fixtures.
    1) Secure angles to wall construction at stud locations.
        a) Maximum spacing from terminal ends: 3 IN.
        b) Draw fasteners tight against vertical surfaces.
    2) Level tolerance: not more than 1 IN 1000.
    3) Miter cut inside and outside corners.
    4) Install with leg supporting bottom flange of runners.

6. Hanger wires:
    a. Provide hangers and inserts necessary to support ceiling suspension systems and ceiling dead loads.
    b. Coordinate location and alignment with work of other trades.
    c. Install hanger wires plumb to main tees and cross tees.
        1) Do not suspend any part of suspension system from ducts, pipes, conduit, cable tray or equipment.
        2) Provide supplementary rough suspension system where necessary to support ceilings beneath pipes, ducts, equipment, cable trays.
        3) Splay hangers no greater than 30 DEG from vertical to avoid obstructions or other conditions that prevent plumb, vertical installation.
        4) Offset horizontal forces by bracing or counter-splaying.
    d. Space hangers to prevent eccentric deflection and rotation due to loads from items in or on ceiling
        1) Provide supplemental hangers to support lighting fixtures and within 6 IN from end of main runners and fixtures which exceed manufacturer's published load data.
        2) Do not bear runners on walls or partitions.
7. Main runners:
    a. Utilize wall angles to align and receive terminal ends of main tees without transferring load to wall angle.
    b. Space main tees as indicated to receive lay-in panels and fixtures.
    c. Support terminal ends of main tees by wires located within 6 IN from boundary walls.
8. Cross runners:
    a. Space cross tees as indicated to receive lay-in panels and fixtures.
        1) Install cross runners with positive interlock.
    b. Utilize wall angles to align and receive terminal ends of cross tees without transferring load to wall angle.
    c. Support terminal ends of cross tees by wires located within 6 IN from boundary walls.
9. Leave suspension system ready to accept installation of acoustic materials.

B. Lay-In Items:
1. Install acoustic materials in accordance with manufacturer's instructions.
2. Place lay-in panels, fixtures, diffusers, grilles, and similar items in manner not compromising suspension system performance.
3. Field cut materials to fit grid.
4. Tegular and similar tiles with articulated edges:
    a. Cut edges to match profile of factory edges and paint to match.
5. Ceiling paint:
    a. Touch-up minor surface scratches and blemishes.
    b. Cover field cut edges exposed to view.
    c. Armstrong SuperCoat Ceiling Panel Touch-up Paint.

3.4 CLEANING AND REPAIR

A. Perform cleaning of soiled units and replacement of defective or damaged units.

END OF SECTION

SECTION 09 65 00
VINYL COMPOSITION TILE FLOORING AND RESILIENT BASE

PART 1 - GENERAL

1.1 SUMMARY

A. This section applies to Scale Houses.

B. Section Includes:
   1. Vinyl composition tile (VCT).
   2. Resilient base (RB).

C. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. 07 26 00 Underslab Vapor Retarder

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. F710, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
      b. F1066, Standard Specification for Vinyl Composition Floor Tile.
      c. F1861, Standard Specification for Resilient Wall Base.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Recommendations on adhesives, primers and leveling and patching compounds.

B. Samples:
   1. Full range of colors and patterns for Engineer's color selection of each component specified.

C. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Vinyl composition tile (VCT):
      a. Armstrong Flooring, Inc.
      b. Azrock by Johnsonite.
      c. Congoleum.
      d. Mannington Commercial.
      e. Tarkett.
   2. Resilient base:
      a. Armstrong Flooring, Inc.
      b. Burke Flooring.

c. FLEXCO Corporation.
d. Johnsonite.
e. Roppe Corporation.
f. VPI Corporation.

3. Edging strips, reducers and joiners:
a. Burke Flooring.
b. FLEXCO Corporation.
c. Johnsonite.
d. Roppe Corporation.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MANUFACTURED UNITS

A. Vinyl Composition Tile (VCT):
1. 12 IN SQ x 1/8 IN.
2. ASTM F1066, Comp 1, Class 2.

B. Resilient Base (RB):
1. Rubber or vinyl, ASTM F1861.
a. Group 1, solid through-color.
b. Style B, coved.
c. 1/8 by 4 IN.
2. Factory-formed outside corners.
3. Continuous rolls, minimum 95 FT long.

C. Leveling compound as recommended by manufacturer compatible with adhesives.

D. Adhesives and primers as recommended by manufacturer.

E. Sheet Vinyl Accent Stripes: 1/8 x 1 IN plain color homogeneous vinyl with backing.

F. Edging Strips, Reducers and Joiners:
1. Thermoplastic vinyl.
a. ASTM E648, Class 1 Fire Rated.

2.3 MAINTENANCE MATERIALS

A. Extra Materials:
1. Furnish Owner the following extra material:
a. One carton of each type and color of vinyl composition tile.
b. Minimum 12 LF of resilient linoleum sheet flooring and enough welding rod to install all 12 LF of material.
c. Remaining portion of one partially used roll of resilient base material with a minimum of 10 LF of each height, color and type.
2. Package and label extra materials to protect material during storage.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare surfaces in accordance with manufacturer's recommendations and ASTM F710.

B. Acclimate tile to area in which it is to be installed for minimum 72 HRS at 68 DEGF prior to installation.
1. Provide manufacturer's recommended relative humidity levels.

C. Fill cracks, joints (except specified expansion joints), etc., in floors with a water-resistant noncrumbling patching and leveling compound.
1. Trowel level.
2. Verify moisture content in concrete substrate is within acceptable limits per the floor covering manufacturer.

a. Conduct one test for every 1000 SQFT of flooring per room or area in accordance with manufacturer's recommendation.
b. Provide necessary measures to dry out the substrate in accordance with flooring manufacturer's recommendations and retest until acceptable moisture levels are obtained.

D. Where tile flooring abuts other finish flooring materials and finished surfaces do not align, install and feather leveling compound for approximately 6 IN so that finished surfaces will align.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Floors to be free of all dust, paint, grease, oils, solvents, curing and hardening compounds, sealers and any other deleterious material which may affect the bonding of the adhesive used to install the floor coverings.

C. Ensure recommended minimum installation temperatures are maintained before, during and after installation as required by the manufacturer.

D. General:
1. Apply primer and adhesive as recommended by manufacturer.
2. Maintain minimum temperature of 68 DEGF for a minimum of 72 HRS prior to, during and after installation.

E. Vinyl Composition Tile:
1. Lay in pattern selected by Engineer.
2. Bond tile to floor, flush, tight, and in true alignment with adjacent tiles and with finished surface.
3. Fit neatly into breaks and recesses, against walls, around pipes, and other obstructions.
4. Install edging strips where tile edge is exposed or where flooring terminates.
5. Lay out tile to avoid less than one-half tile at permanent perimeter walls.
6. Perform any cutting or drilling of tile as required.
7. Install accent strips in all door openings directly under door when in closed position.
8. Roll entire floor.
9. Immediately after application and rolling, remove surplus adhesive.

F. Resilient Base:
1. Install base after wall material has thoroughly dried out.
2. Provide base at intersections of floor and all vertical surfaces in areas scheduled to receive base, where intersection is exposed to view.
3. Set base straight and true.
4. Fit into breaks and recesses.
5. Provide factory-formed outside corners; miter inside corners.
   a. Make joints tight.
   b. Where door frames are inset in opening, provide factory formed outside corner returned to frame; trim flush with face of frame.
6. Install with top level and bottom edge in firm contact with floor.

G. Edging Strips, Reducers and Joiners:
1. Provide edging, reducers and transitions as necessary for terminating flooring or transitioning to adjacent flooring materials.
   a. Profiles shall be ADA compliant.

3.3 CLEANING

A. Clean floors in accordance with manufacturer's recommendations.

B. Prior to final acceptance, wash, wax and buff floors.
1. After thorough cleaning, apply two coats of wax recommended by flooring manufacturer.
2. After each coat, buff floor.

3.4 PROTECTION

A. Protect with non-staining, non-sticking building paper as may be necessary to prevent dirt and damage.

B. Protect traffic areas with fiberboard or plywood laid over non-staining, non-sticking building paper.

END OF SECTION

SECTION 09 91 10
ARCHITECTURAL PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Surface Preparation.
   2. Field application of:
      a. Architectural Coatings.
      b. Special Coatings.
      c. Stains and varnishes.
      d. Any other coating, thinner, accelerator, inhibitor, etc., specified or required as part of a complete System specified in this Specification Section.
   3. Environmental controls for field application of coatings.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Division 03 - Concrete.
   4. Section 05 52 05 - Steel Railings.
   5. Section 08 11 00 - Metal Doors and Frames.
   6. Section 09 29 00 - Gypsum Board.
   7. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. D523, Standard Test Method for Specular Gloss.
      b. D4258, Standard Practice for Surface Cleaning Concrete for Coating.
      c. D4259, Standard Practice for Abrading Concrete.
      d. D4261, Standard Practice for Surface Cleaning Concrete Unit Masonry for Coating.
      e. D4262, Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
      f. D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
      g. F1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
      h. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
   2. National Fire Protection Association (NFPA):
      a. 101, Life Safety Code.
   3. Steel Door Institute/American National Standards Institute (SDI/ANSI):
      a. A250.10, Test Procedure and Acceptance Criteria For Prime Painted Steel Surfaces for Steel Doors and Frames.
   4. The Society for Protective Coatings (SSPC):
      a. SP 1, Solvent Cleaning.
      b. SP 2, Hand Tool Cleaning.
      c. SP 3, Power Tool Cleaning.
      d. SP 16, Brush-off Blast Cleaning of Non-Ferrous Metals.
   5. The Society for Protective Coatings/NACE International (SSPC/NACE):
      a. SP 6/NACE No. 3, Commercial Blast Cleaning.
      b. SP 7/NACE No. 4, Brush-off Blast Cleaning.
      c. SP 13/NACE No. 6, Surface Preparation of Concrete.
   6. United States Environmental Protection Agency (EPA).

B. Miscellaneous:
   1. Coating used in all corridors and stairways shall meet requirements of NFPA 101 and ASTM E84.

1.3 DEFINITIONS

A. Installer or Applicator:
   1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
   2. Installer and applicator are synonymous.

B. Approved Factory Finish: Finish on a product in compliance with the finish specified in the Specification Section where the product is specified.

C. Exposed Exterior Surface:
   1. Exterior surface which is exposed to view.
   2. Exterior surface which is exposed to weather but not necessarily exposed to view.

D. Finished Area:
   1. An area that is listed in or has finish called for on Room Finish Schedule.
   2. An area that is indicated on Drawings to be painted.

E. Gloss Range:
   1. Specular gloss measured in accordance with ASTM D523:
      a. Flat: Below 15, at 60 DEG.
      b. Eggshell: Between 20 and 35, at 60 DEG.
      c. Semi-gloss: Between 35 and 70, at 60 DEG.
      d. Gloss: More than 70, at 60-degrees.

F. Paint includes the following:
   1. Architectural paints (AP) include: Acrylic latex or alkyd enamel coatings.
   2. Special coatings (SC) include: Water-based pigmented resin particles suspended in acrylic latex solution.
   3. Stains and varnish include: Alkyd stain and polyurethane varnish.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's surface preparation instructions.
      c. Manufacturer's application instructions.

B. Samples:
   1. Manufacturer's full line of colors for Engineer's preliminary color selection.
   2. Gloss samples.
   3. After preliminary color selection by Engineer provide two (2) 8 by 10 IN samples of each final color and sheen selected.

C. Informational Submittals:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Test results.
   3. Applicator's daily records:
      a. Submit daily records at end of each week in which painting work is performed unless requested otherwise by Engineer's on-site representative.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver in original containers, labeled as follows:

1. Name or type number of material.
2. Manufacturer's name and item stock number.
3. Contents, by volume, of major constituents.
4. Warning labels.
5. VOC content.

B. Store materials in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 DEGF.

1.6 PROJECT CONDITIONS

A. Verify that atmosphere in area where painting is to take place is within paint manufacturer's acceptable temperature, humidity and sun exposure limits.
   1. Provide temporary heating, shade and/or dehumidification as required to bring area within acceptable limits.
      a. Provide temporary dehumidification equipment properly sized to maintain humidity levels required by paint manufacturer.
      b. Provide clean heat with heat exchanger type equipment sufficient in size to maintain temperature on a 24 HR basis.
         1) Vent exhaust gases to exterior environment.
         2) No exhaust gases shall be allowed to vent into the space being painted or any adjacent space.
   2. Do not apply coatings in snow, rain, fog or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide products from a single manufacturer to the greatest extent practicable.

B. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Architectural paints:
      a. Benjamin Moore & Co.
      b. PPG IdeaScapes.
      c. Pratt & Lambert.
      d. Sherwin-Williams.
      e. Tnemec, Inc.
   2. Special coatings:
      a. Master Coating Technologies, Inc. - Zolatone.
      b. Dryvit Systems, Inc.

C. No like, equivalent or "or-equal" item or substitution is permitted.

D. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. General:
   1. For unspecified materials such as thinner, provide manufacturer's recommended products.
   2. Unless noted otherwise, products listed are manufactured by the manufacturer listed below.
      a. Products of other manufacturers will be considered for use provided that the product:
         1) Is of the same generic formulation.
         2) Has comparable application requirements.
         3) Meets the same VOC levels or better.
         4) Provides the same finish and color options.
   3. Coatings shall comply with the VOC limits of EPA and the following:
      a. California Air Resources Board (CARB) Suggested Control Measure (SCM) for Architectural Coatings.
   4. Colors:

a. Colors and gloss will be selected from the manufacturer's complete offering, including special colors and premium offerings.

B. Architectural Paints:
1. Product List:

Generic Description	Product
Acrylic Primer	PPG Pure Performance 9-900
Acrylic Latex	PPG Pure Performance 9-100/9-300/9-500 Series
Acrylic Gloss	PPG Speedhide 6-8534 Series
Concrete Filler/Surfacer	Tnemec Series 215 and/or Series 218
CMU Block Filler	Tnemec Series 54 Masonry Filler
Dry-Fall Primer	Tnemec Series V115 Uni-Bond DF
Epoxy Barrier Coat	Tnemec Series 135 Chembuild
Fluoropolymer	Tnemec Series 1070V/1071V/1072V Fluoronar
HDP Acrylic	Tnemec Series 1028/1029 Enduratone
Organic Zinc Primer	Tnemec Series 94-H2O Hydro-Zinc
Polycarbamide	Tnemec Series 740/750 UVX
Waterborne Acrylate	Tnemec Series 156 Enviro-Crete

C. Special Coatings:
1. Product List:

Generic Description	Product
Special Coating Acrylic Primer	Zolatone SP203 Acrylic Basecoat.
Special Coating Stain Blocker	Zolatone SP222 Eco-Block.
Special Coating Base Coat	Zolatone Flex Base Coat.
Special Coating Finish Coat	Zolatone Flex Finish Coat.

D. Stains and Varnishes:
1. Product List:

Generic Description	Product
Sanding sealer	PPG Olympic 41061 Premium Interior Water Based Sanding Sealer
Alkyd Wood Stain	PPG Olympic 44500 Premium Interior Oil Based Wood Stain
Polyurethane Varnish	PPG Olympic 42786 Premium Interior Water Based Polyurethane Clear Satin

2.3 PAINT SYSTEMS

A. General:
1. Refer to Specification Section 09 96 00 for:
a. Items in corrosive or highly corrosive environments.
b. Items subject to immersion service.
c. Items subject to exterior exposure.
d. Any other locations where High Performance Industrial Coatings (HPIC) are required.

B. Schedule:

Substrate	Prime Coat[1]	Intermediate Coat(s)[1]	Finish Coat[1]
Concrete	Concrete Filler/Surfacer as necessary to fill all voids and depressions	100 to 200 SQFT/GAL Waterborne Acrylate	100 to 200 SQFT/GAL Waterborne Acrylate
Concrete Masonry	80 to 100 SQFT/GAL CMU Block Filler	100 to 200 SQFT/GAL Waterborne Acrylate	100 to 200 SQFT/GAL Waterborne Acrylate
Structural Steel and Miscellaneous Metals[3]	2.5 to 3.5 MIL Organic Zinc Primer	2.0 to 3.0 MIL HDP Acrylic[2]	2.0 to 3.0 MIL HDP Acrylic[2]
Galvanized Structural Steel and Miscellaneous Metals[3]	2.0 to 4.0 MIL Dry-Fall Acrylic	XX	2.0 to 3.0 MIL HDP Acrylic [2]
Galvanized Metal Deck	2.0 to 4.0 MIL Dry-Fall Acrylic	XX	2.0 to 4.0 MIL Dry-Fall Acrylic
Factory Primed Metal Deck	XX	2.0 to 4.0 MIL Dry-Fall Acrylic	2.0 to 4.0 MIL Dry-Fall Acrylic
Galvanized Steel Railings	4.0 to 6.0 MIL Epoxy Barrier Coat	2.5 to 3.5 MIL Polycarbamide Gloss	2.5 to 3.5 MIL Polycarbamide Gloss
Steel Railings	4.0 to 6.0 MIL Epoxy Barrier Coat	2.0 to 3.0 MIL HDP Acrylic Gloss	2.0 to 3.0 MIL HDP Acrylic Gloss
Exposed wood indicated to be painted	300 to 400 SQFT/GAL Acrylic Primer	300 to 400 SQFT/GAL Acrylic Gloss	300 to 400 SQFT/GAL Acrylic Gloss
Exposed wood indicated to be stained	400 to 500 SQFT/GAL Sanding Sealer	Two coats at 400 to 500 SQFT/GAL Alkyd Wood Stain	Two coats at 400 to 500 SQFT/GAL Polyurethane Varnish
Hollow Metal - Interior	4.0 to 5.0 MIL DFT Epoxy Barrier Coat	2.0 to 3.0 MIL HDP Acrylic[2]	2.0 to 3.0 MIL HDP Acrylic[2]
Hollow Metal - Exterior	4.0 to 5.0 MIL DFT Epoxy Barrier Coat	2.5 to 3.5 MIL Polycarbamide[2]	2.5 to 3.5 MIL Polycarbamide[2]
Sectional Overhead Doors	4.0 to 5.0 MIL DFT Epoxy Barrier Coat	XX	2.0 to 3.0 MIL DFT Fluoropolymer[2]
Gypsum Board scheduled to receive "AP"	300 to 400 SQFT/GAL Acrylic Primer	300 to 400 SQFT/GAL Acrylic Latex [2]	300 to 400 SQFT/GAL Acrylic Latex [2]
Gypsum Board scheduled to receive "SC"	250 to 350 SQFT/GAL Special Coating Acrylic Primer	250 to 300 SQFT/GAL Special Coating Base Coat	125 to 150 SQFTGAL Special Coating Finish Coat

1. Application rates (SF/GAL) shown are for unthinned materials.
2. Sheen as scheduled or selected.

PART 3 - EXECUTION

3.1 ITEMS TO BE PAINTED

A. Exterior surfaces, including but not limited to:
   1. Concrete:
      a. Where indicated on Drawings.
   2. Structural steel:
      a. Columns, beams and bracing.
      b. Field welded connections of factory painted structural steel.
      c. Exposed metal decking.
      d. Pre-engineered metal building frames, girts, purlins and bracing that do not come with a factory finish
   3. Steel railings.
   4. Galvanized steel railings.
   5. Miscellaneous ferrous metal surfaces:
      a. Items specifically noted on Drawings to be painted.
   6. Miscellaneous galvanized steel surfaces:
      a. Pipe Bollards.
      b. Embed Plates.
      c. Loose lintels.
      d. Steel components of concrete lintels.
      e. Items specifically noted on Drawings to be painted.
   7. Doors and frames:
      a. Hollow metal doors and frames.
      b. Hollow metal window frames.

B. Interior Areas:
   1. Refer to Room Finish Schedule on Drawings.
      a. If space is scheduled to be painted, paint all appurtenant surfaces within the space unless specifically noted otherwise.
      b. Provide coating manufacturer's recommended bonding primer.
      c. Appurtenant surfaces include but are not limited to:
         1) Columns, beams, bracing and similar components.
         2) Underside of roof or floor decks above.
         3) Conduit, boxes, covers and supports.
         4) Ductwork, duct insulation and duct supports.
         5) Piping, pipe insulation and jacketing.
         6) Miscellaneous ferrous metal surfaces.
   2. Concrete walls and columns.
   3. Concrete masonry.
   4. Doors and frames:
      a. Hollow metal doors and frames
      b. Hollow metal window frames.
      c. Four-fold industrial doors.
      d. Sectional overhead doors.

3.2 ITEMS NOT TO BE PAINTED

A. General: Do not paint items listed in this Article, unless noted otherwise.

B. Items with Approved Factory Finish: These items may require repair of damaged painted areas or painting of welded connections.

C. Electrical equipment.

D. Moving parts of mechanical and electrical units where painting would interfere with the operation of the unit.

E. Code labels, equipment identification or rating plates and similar labels, tagging and identification.

F. Contact surfaces of friction-type structural connections.

G. Stainless steel surfaces.

H. Aluminum Surfaces Except:
   1. Where specifically shown in the Contract Documents.
   2. Where in contact with concrete.
   3. Where in contact with dissimilar metals.
   4. Appurtenant surfaces as described in the ITEMS TO BE PAINTED article.

I. Fiberglass Surfaces Except:
   1. Fiberglass piping where specifically noted to be painted.
   2. Piping supports where specifically noted to be painted.
   3. Appurtenant surfaces as described in the ITEMS TO BE PAINTED article.

J. Galvanized steel items, unless specifically noted to be painted.
   1. Provide intumescent paint where indicated.

K. Architectural finishes:
   1. Exterior concrete indicated to receive another finish.
   2. Fiberglass fabrications.
   3. Anodized aluminum.
   4. PVDF coated metals.
   5. Factory finished doors and frames.
   6. Aluminum windows, curtainwall and storefront framing systems.
   7. Finish hardware.
   8. Glass and glazing.
   9. Ceramic, porcelain, quarry tile or natural stone.
   10. Building specialties.
   11. Louvers.
   12. Countertops.
   13. Pipe insulation and jacketing.
   14. Standing seam metal roof, fascia, trim, soffit and accessories.

3.3 EXAMINATION

A. Concrete:
   1. Test pH of surface to be painted in accordance with ASTM D4262.
      a. If surface pH is not within paint manufacturer's required acceptable range, use methods acceptable to paint manufacturer as required to bring pH within acceptable range.
      b. Retest pH until acceptable results are obtained.
   2. Verify that moisture content of surface to be painted is within paint manufacturer's recommended acceptable limits.
      a. Test surface to be coated in accordance with ASTM D4263 to determine the presence of moisture.
         1) If moisture is detected, test moisture content of surface to be coated in accordance with ASTM F1869.
         2) Provide remedial measures as necessary to bring moisture content within paint manufacturer’s recommended acceptable limits.
         3) Retest surface until acceptable results are obtained.

B. Concrete Unit Masonry:
   1. Test pH of surface to be painted in accordance with ASTM D4262.
      a. If surface pH is not within paint manufacturer's required acceptable range, use methods acceptable to paint manufacturer as required to bring pH within acceptable limits.
      b. Retest pH until acceptable results are obtained.

2. Verify that moisture content of surface to be painted is within paint manufacturer's recommended acceptable limits.
    a. Test surface to be coated in accordance with ASTM D4263 to determine the presence of moisture.
        1) If moisture is detected, test moisture content of surface to be coated in accordance with ASTM F1869.
        2) Provide remedial measures as necessary to bring moisture content within paint manufacturer's recommended acceptable limits.
        3) Retest surface until acceptable results are obtained.

3.4 PREPARATION

A. General:
1. Prepare surfaces to be painted in accordance with paint manufacturer's instructions and this Specification Section unless noted otherwise in this Specification Section.
    a. Where discrepancy between paint manufacturer's instructions and this Specification Section exists, the more stringent preparation shall be provided unless approved otherwise, in writing, by the Engineer.
2. Remove all dust, grease, oil, compounds, dirt and other foreign matter which would prevent bonding of paint to surface.
3. Adhere to manufacturer's recoat time surface preparation requirements.
    a. Surfaces that have exceeded paint manufacturer's published recoat time and/or have exhibited surface chalking shall be prepared prior to additional paint in accordance with manufacturer's published recommendations.

B. Protection:
1. Protect surrounding surfaces not to be coated.
2. Remove and protect hardware, accessories, plates, fixtures, finished work, and similar items; or provide ample in-place protection.
3. Protect code labels, equipment identification or rating plates and similar labels, tagging and identification.

C. Prepare and paint before assembly all surfaces which are inaccessible after assembly.

D. Existing Surfaces:
1. Wherever existing work is cut, patched or modified; repair and repaint to match new work.
2. Where a wall or ceiling is disturbed and patched, paint entire wall or ceiling.

E. Wood:
1. Sandpaper smooth, remove dust.
2. Opaque Finishes:
    a. Seal all knots, pitch and resinous sapwood after prime coat has dried.
    b. Putty holes and imperfections; sand smooth.
3. Transparent Finishes:
    a. Treat wood with compatible wash-coat prior to stain application.
    b. Putty holes and imperfections to match wood color; sand smooth.

F. Ferrous Metal:
1. Complete fabrication, welding or burning before beginning surface preparation.
    a. Chip or grind off flux, spatter, slag or other laminations left from welding.
    b. Remove mill scale.
    c. Grind smooth rough welds and other sharp projections.
2. Solvent clean in accordance with SSPC SP 1 to remove all dust, grease, oil, compounds, dirt and other foreign matter.
3. Exterior exposure:
    a. Commercial blast clean in accordance with SSPC SP 6/NACE No. 3.
4. Interior exposure:
    a. Hand tool cleaning in accordance with SSPC SP 2 and/or power tool cleaning in accordance with SSPC SP 3.

G. Hollow Metal:
   1. Solvent clean in accordance with SSPC SP 1 to remove all dust, grease, oil, compounds, dirt and other foreign matter.
   2. Lightly sand primed surfaces with fine grit sandpaper as recommended by hollow metal manufacturer.

H. Galvanized Steel and Non-ferrous Metals:
   1. Solvent clean to remove all dust, grease, oil, compounds, dirt and other foreign matter.
   2. Brush-off blast in accordance with SSPC SP 16 or hand tool cleaning in accordance with SSPC SP 2 to remove surface contaminants.

I. Gypsum Wallboard:
   1. Repair minor irregularities left by finishers.
   2. Avoid raising nap of paper face on gypsum wallboard.
   3. Verify moisture content is less than 8 PCT before painting.
   4. After application of prime coat and between subsequent coats, inspect surface and repair holes, dents, irregularities or other defects as necessary to provide a smooth, uniform finish.

J. Concrete:
   1. Cure for minimum of 28 days.
   2. Clean in accordance with ASTM D4258.
      a. Remove all soil, grease, oil, or other surface contaminants.
   3. Grind fins and protrusions in accordance with ASTM D4259, flush to plane of wall.
   4. Abrasive blast in accordance with ASTM D4259 and SSPC SP13/NACE No. 6.
      a. Remove all laitance, efflorescence, scabbing and other foreign matter.
      b. Provide minimum concrete surface profile CSP 3 per ICRI 310.2.
   5. Test pH and moisture content in accordance with EXAMINATION article in this specification section.
   6. Repair tie holes, voids, bugholes or other surface defects as necessary to provide smooth, uniform surface.

K. Concrete Unit Masonry:
   1. Cure for minimum of 28 days.
   2. Remove all mortar spatters and protrusions.
   3. Clean in accordance with ASTM D4261.
      a. Remove all soil, grease, oil, efflorescence.
   4. Test pH and moisture content in accordance with EXAMINATION article in this specification section.

3.5 APPLICATION

A. General:
   1. Thin, mix and apply paints in accordance with manufacturer's installation instructions.
      a. Where discrepancy exists between manufacturer’s instructions and this Specification Section, the more stringent requirement shall apply.
      b. When materials have been thinned, adjust application rates as necessary to achieve film coverage indicated in Part 2 for unthinned materials.
      c. Backroll spray applied paints.
   2. Temperature and weather conditions:
      a. Do not paint surfaces when surface temperature is below 50 DEGF unless product has been formulated specifically for low temperature application and application is approved in writing by Engineer and paint manufacturer's authorized representative.
      b. Avoid painting surfaces exposed to hot sun.
      c. Do not paint on damp surfaces.
   3. Apply materials under adequate illumination.
   4. Evenly spread to provide full, smooth coverage.
      a. All paint systems are "to cover."
         1) When color or undercoats show through, apply additional coats until paint film is of uniform finish and color.

b. Finished paint system shall be uniform and without voids, bugholes, holidays, laps, brush marks, roller marks, runs, sags or other imperfections.

5. If so directed by Engineer, do not apply consecutive coats until Engineer has had an opportunity to observe and approve previous coats.
6. Work each application of material into corners, crevices, joints, and other difficult to work areas.
7. When painting rough surfaces, hand brush and backroll paint to work into all recesses.
8. Smooth out runs or sags immediately, or remove and recoat entire surface.
9. Allow preceding coats to dry before recoating.
   a. Recoat within time limits specified by paint manufacturer.
   b. If recoat time limits have expired re-prepare surface in accordance with paint manufacturer's printed recommendations.
10. Allow coated surfaces to cure prior to allowing traffic or other work to proceed.
11. Finish colors not otherwise indicated shall be selected by Engineer from paint manufacturer's complete offering.

B. Fillers, surfacers or patching compounds:
   1. Provide fillers, surfacers or patching compounds in accordance with manufacturer's recommendations and as specified herein as necessary to provide a smooth, defect free substrate.

C. Prime Coat Application:
   1. Prime all surfaces indicated to be painted.
      a. Apply prime coat in accordance with paint manufacturer's written instructions and as written in this Specification Section.
   2. Ensure field-applied paints are compatible with factory-applied paints or existing coatings.
      a. Employ services of coating manufacturer's qualified technical representative.
         1) Certify through material data sheets.
         2) Perform test patch.
      b. If field-applied coating is found to be not compatible, require the coating manufacturer's technical representative to recommend, in writing, product to be used as barrier coat, thickness to be applied, surface preparation and method of application.
      c. At Contractor's option, coatings may be removed, surface re-prepared, and new coating applied using appropriate paint system listed in the MATERIALS Article, Paint Systems paragraph of this Specification Section.
         1) All damage to surface as result of coating removal shall be repaired to original condition or better by Contractor at no additional cost to Owner.
   3. Special coatings prime coat application:
      a. Prime new gypsum board surfaces using sealer as recommended by manufacturer.
         1) Apply at rate per manufacturer's recommendation.
      b. Prime and fill new concrete and masonry using sealer coat as recommended by manufacturer followed by modified epoxy filler as specified.
      c. Prime filled concrete and masonry surfaces with primer at rates and as recommended by manufacturer.
   4. Back prime all wood scheduled to be painted, prior to installation.
   5. Touch up damaged primer coats prior to applying finish coats.
      a. Restore primed surface equal to surface before damage.

D. Finish Coat Application:
   1. Apply finish coats in accordance with paint manufacturer's written instructions and in accordance with this Specification Section.
   2. Touch up damaged finish coats using same application method and same material specified for finish coat.
      a. Prepare damaged area in accordance with the PREPARATION Article of this Specification Section.
   3. Hollow metal frames and doors:
      a. Finish coats shall be spray applied only.

b. Finish edges same as faces of doors.

4. Varnish:
   a. Apply first coat of varnish: Gloss.
      1) Allow to dry a minimum of 48 HRS.
   b. Apply second and third coats of varnish: Satin.
      1) Allow a minimum of 48 HRS between each coat.
   c. Lightly sand between coats as required and remove dust.

3.6 FIELD QUALITY CONTROL

A. Application Deficiencies:
   1. Surfaces showing runs, laps, brush marks, telegraphing of surface imperfections or other defects will not be accepted.
   2. Surfaces showing evidence of fading, chalking, blistering, delamination or other defects due to improper surface preparation, environmental controls or application will not be accepted.

B. Provide protection for painted surfaces.
   1. Surfaces showing soiling, staining, streaking, chipping, scratches, or other defects will not be accepted.

C. Maintain Daily Records:
   1. Record the following information during application of each coat of paint applied:
      a. Date, starting time, end time, and all breaks taken by painters.
      b. For exterior painting:
         1) Sky condition.
         2) Wind speed and direction.
      c. Air temperature.
      d. Relative humidity.
      e. Moisture content and surface temperature of substrate prior to each coat.
      f. Provisions utilized to maintain work area within manufacturer's recommended application parameters including temporary heating, ventilation, cooling, dehumidification and provisions utilized to mitigate wind blown dust and debris from contaminating the wet paint film.
      g. Record environmental conditions, substrate moisture content and surface temperature information not less than once every four (4) hours during application.
         1) Record hourly when temperatures are below 50 DEGF or above 100 DEGF.
   2. Record the following information daily for the paint manufacturer's recommended curing period:
      a. Date and start time of cure period for each item or area.
      b. For exterior painting:
         1) Sky conditions.
         2) Wind speed and direction.
      c. Record environmental conditions not less than once every 12 HRS.
         1) Record once every 4 HRS when ambient temperature is below 35 DEGF.
      d. Provisions utilized to protect each item or area and to maintain areas within manufacturer's recommended curing parameters.
   3. Format for daily record to be computer generated.

D. Measure surface temperature of items to be painted with surface temperature gage specifically designed for such.

E. Measure substrate humidity with humidity gage specifically designed for such.

F. Provide wet paint signs.

3.7 CLEANING

A. Clean paint spattered surfaces.
   1. Use care not to damage finished surfaces.

B. Remove masking, adhesive residue or other foreign materials.

C. Upon completion of painting, replace hardware, accessories, plates, fixtures, and similar items.

D. Remove surplus materials, scaffolding, and debris.

END OF SECTION

SECTION 09 96 00
HIGH PERFORMANCE INDUSTRIAL COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. High performance industrial coatings (HPIC).
   2. Any other coating, thinner, accelerator, inhibitor, etc., specified or required as part of a complete System specified in this Specification Section.
   3. Minimum surface preparation requirements.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 01 61 03 - Equipment - Basic Requirements.
   4. Section 09 91 10 - Architectural Painting.
   5. Division 23 - Heating, Ventilating, and Air-Conditioning (HVAC).
   6. Division 26 - Electrical.
   7. Division 40 - Process Interconnections.
   8. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. B499, Standard Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals.
      b. D3359, Standard Test Methods for Rating Adhesion by Tape Test.
      c. D4258, Standard Practice for Surface Cleaning Concrete for Coating.
      d. D4259, Standard Practice for Abrading Concrete.
      e. D4261, Standard Practice for Surface Cleaning Concrete Masonry Units for Coating.
      f. D4262, Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
      g. D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
      h. D4414, Standard Practice for Measurement of Wet Film Thickness by Notch Gages.
      i. D4541, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
      j. D6132, Standard Test Method for Nondestructive Measurement of Dry Film Thickness of Applied Organic Coatings Using an Ultrasonic Gage.
      k. D6677, Standard Test Method for Evaluating Adhesion by Knife.
      l. D7091, Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals.
      m. D7234, Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.
      n. E337, Standard Test Method for Measuring Humidity with a Psychrometer (the Measurement of Wet- and Dry-Bulb Temperatures).
      o. F1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
      p. F2170, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
   2. Environmental Protection Agency (EPA).
   3. International Concrete Repair Institute (ICRI):

a. 310.2, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

4. NACE International (NACE).
5. National Association of Pipe Fabricators (NAPF):
   a. 500-03, Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings:
      1) 500-03-04, Abrasive Blast Cleaning for Ductile Iron Pipe.
      2) 500-03-05, Abrasive Blast Cleaning for Cast Ductile Iron Fittings.
6. NSF International (NSF).
   a. 61, Drinking Water System Components - Health Effects.
7. The Society for Protective Coatings (SSPC):
   a. PA 2, Procedure for Determining Conformance to Dry Coating Thickness Requirements.
   b. SP 1, Solvent Cleaning.
   c. SP 2, Hand Tool Cleaning.
   d. SP 3, Power Tool Cleaning.
   e. SP 16, Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals.
8. The Society for Protective Coatings/ NACE International (SSPC/ NACE):
   a. SP 5/ NACE No. 1, White Metal Blast Cleaning
   b. SP 6/ NACE No. 3, Commercial Blast Cleaning.
   c. SP 7/ NACE No. 4, Brush-off Blast Cleaning.
   d. SP 10/ NACE No. 2, Near-White Blast Cleaning.
   e. SP 13/ NACE No. 6, Surface Preparation of Concrete.

B. Qualifications:
   1. Coating manufacturer's technical representative shall be a NACE Certified Coatings Inspector, Level 3 minimum.
   2. Applicators shall have minimum of 10 years of experience in application of similar products on similar project.
      a. Provide references for minimum of three different projects completed in last five years with similar scope of work.
      b. Include name and address of project, size of project in value (coating) and contact person.
   3. NACE inspector shall be NACE Certified Coatings Inspector Level 3 minimum and shall have minimum of five years of experience of conducting inspections and tests as indicated in this Specification Section.

C. Miscellaneous:
   1. Furnish coating through one manufacturer unless noted otherwise.

D. Deviation from specified MIL thickness or product type is not allowed without written authorization of Engineer.

E. Material shall not be thinned unless approved, in writing, by coating manufacturer's technical representative.

1.3 DEFINITIONS

A. Applicator:
   1. Applicator is the person actually installing or applying the product in the field, at the Project site, or at an approved shop facility.

B. Approved Factory Finish: Finish on a product in compliance with the finish specified in the Specification Section where the product is specified or in Specification Section 01 61 03.

C. Appurtenant Surface: Accessory or auxiliary surface attached to or adjacent to a surface indicated to be coated.

D. Corrosive Environment:

1. Immersion in or subject to:
    a. Condensation, spillage or splash of a corrosive material such as water, wastewater or chemical solution.
    b. Exposure to corrosive caustic or acidic agent, chemicals, chemical fumes, chemical mixture, or solutions.
    c. For purposes of this Specification Section, corrosive environments include:
        a) Tipping Room
        b) Tunnel

E. Outdoor Atmosphere or Surface: Outdoor atmosphere or surface exposed to weather and/or direct sunlight.

F. Finished Area: A room or area that is listed in or has finish called for on Room Finish Schedule or is indicated on Drawings to be coated.

G. Holiday:
1. A void, crack, thin spot, foreign inclusion, or contamination in the coating that significantly lowers the dielectric strength of the coating.
2. May also be identified as a discontinuity or pinhole.

H. HPIC: High performance industrial coatings.
1. Epoxies, urethanes, vinyl ester, waterborne vinyl acrylic emulsions, acrylates, silicones, alkyds, acrylic emulsions and any other coating listed as a HPIC.

I. Interior Atmosphere or Surface: Indoor atmosphere or surface not exposed to weather and/or direct sunlight.

J. Immersion Service:
1. Any surface immersed in water or some other liquid.
2. Surface of any pipe, valve, or any other component of the piping system subject to frequent wetting.
3. Surfaces within two feet above high water level in water bearing structures.

K. Piping System: Pipe, valves, fittings and accessories.

L. Surface Hidden from View:
1. Within pipe chases.
2. Between top side of ceilings and underside of floor or roof structures above.

M. Vapor Space: Interior space within tankage, closed structures, or similar elements that is above the low liquid line and subject to the accumulation of fumes, vapor and/or condensation.

1.4 SUBMITTALS

A. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

B. Certifications:
1. Applicator experience qualifications.
    a. No submittal information will be reviewed until Engineer has received and approved applicator qualifications.
2. NACE inspector certification.
3. NACE inspector experience qualifications.
4. Certification that High Performance Coating Systems proposed for use have been reviewed and approved by a NACE Certified Coatings Inspector employed by the coating manufacturer.
    a. Submittals not including this certification will be returned without review.

C. Shop Drawings:
1. Product technical data including:
    a. Acknowledgement that products submitted meet requirements of standards referenced.
    b. Manufacturer's surface preparation instructions.

c. Manufacturer's application instructions.
    1) Manufacturer's standard details, including but not limited to penetrations, transitions, and terminations for:
        a) High-build coatings on concrete.
        b) Secondary containment coatings.
        c) Other special conditions as applicable.
d. If products being used are manufactured by Company other than listed in the MATERIALS Article of this Specification Section, provide complete individual data sheet comparison of proposed products with specified products including:
    1) Application procedure.
    2) Coverage rates.
    3) Certification that product is designed for intended use and is equal or superior to specified product.
e. Contractor's written plan of action for containing airborne particles created by blasting operation and location of disposal of spent contaminated blasting media.
f. Coating manufacturer's recommendation on abrasive blasting.
g. Coating manufacturer's technical representative's written statement attesting that applicator has been instructed on proper preparation, mixing and application procedures for coatings specified.
h. Manufacturer's recommendation for universal barrier coat.
i. Manufacturer's recommendation for providing temporary or supplemental heat or dehumidification or other environmental control measures.

2. Manufacturer's statement regarding applicator instruction on product use.

D. Samples:
1. Manufacturer's full line of colors for Engineer's preliminary color selection.
2. After preliminary color selection by Engineer provide two, 3 x 5 IN samples of each final color selected.

E. Informational Submittals:
1. Approval of application equipment.
2. Applicator's daily records:
    a. Submit daily records at end of each week in which coating work is performed unless requested otherwise by Engineer's on-site representative.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver in original containers, labeled as follows:
1. Name or type number of material.
2. Manufacturer's name and item stock number.
3. Contents, by volume, of major constituents.
4. Warning labels.
5. VOC content.

B. Store materials in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 DEGF.

1.6 PROJECT CONDITIONS

A. Pre-application Conference:
1. Prior to commencement of surface preparation or coating application, the Contractor shall convene a pre-application conference with all affected parties, including but not limited to: the applicator, coating manufacturer's technical representative, Owner's representative, and Engineer's representative(s).
2. The meeting shall discuss all aspects of the Project including but not limited to:
    a. Schedule.
    b. Material storage and handling.
    c. Examination of surfaces to be coated.
    d. Protection of surfaces not to be coated.

e. Surface preparation.
f. Coating application:
    1) Environmental conditions for application of coatings.
    2) Temporary environmental controls.
g. Field quality control requirements:
    1) Manufacturer's technical representative responsibilities.
    2) Contractor performed testing.
        a) Instrumentation requirements.
        b) Frequency of testing.
        c) Record keeping.
    3) NACE inspector performed testing.

B. Verify that atmosphere in area where coating is to take place is within coating manufacturer's acceptable temperature, humidity and sun exposure limits.
    1. Provide temporary heating, shade and/or dehumidification as required to bring area within acceptable limits.
        a. Provide temporary dehumidification equipment properly sized to maintain humidity levels required by coating manufacturer.
        b. Provide clean heat with heat exchanger type equipment sufficient in size to maintain temperature on a 24 HR basis.
            1) Vent exhaust gases to outdoor environment.
            2) No exhaust gases shall be allowed to vent into the space being coated or any adjacent space.
    2. Do not apply coatings in snow, rain, fog or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
    1. High Performance Industrial Coatings:
        a. Carboline Protective Coatings.
        b. PPG.
        c. The Sherwin-Williams Company.
        d. Tnemec.
        e. AkzoNobel.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

C. "Or-Equal" Submittals:
    1. Materials by other manufacturers are acceptable provided that they are established as being compatible with and of equal quality to the coatings of the manufacturers listed.
    2. Provide satisfactory documentation from the proposed "or-equal" manufacturer that proposed materials meets or exceeds the following:
        a. Is of the same generic resin.
        b. Requires comparable surface preparation.
        c. Has comparable application requirements.
        d. Meets the same VOC levels or better.
        e. Provides the same finish and color options.
        f. Is suitable for the intended service.
        g. Resistance to abrasion and physical damage.
        h. Resistance to chemical attack.
        i. Resistance to UV exposure.
        j. Ability to recoat in future.
        k. Dry film thickness per coat.

1) Where manufacturer's product data sheet indicates a minimum MIL thickness per coat that is greater than specified herein, MIL thickness for entire coating system shall be increased proportionately.

l. Minimum and Maximum time between coats.
m. Compatibility with other coatings.
n. Temperature limitations in service and during application.
o. Type and quality of recommended undercoats and topcoats.
p. Ease of application.
q. Ease of repairing damaged areas.
r. Stability of colors.

3. The cost of all testing and analyzing of the proposed substitute materials shall be borne by the CONTRACTOR.

2.2 MATERIALS

A. Coatings used for interior finishes shall meet the requirements of the building code.

B. Coatings shall comply with the VOC limits of EPA and:
1. California Air Resources Board (CARB) Suggested Control Measure (SCM) for Architectural Coatings.

C. For unspecified materials such as thinner, provide manufacturer's recommended products.

D. High Performance Industrial Coatings:

COATING CODE	GENERIC DESCRIPTION	MANUFACTURER	
		TNEMEC	SHERWIN WILLIAMS
AAE	Acrylic/Acrylate Emulsion	Series 180 WB Tneme-Crete	Cement Plex 875
AREL	Abrasion-Resistant Epoxy Lining	Series 435 Perma-Glaze	Duraplate 5900
CRM	Cementitious Repair Mortar	Series 217 MortarCrete	Cemtec Silatec MSM
CRU	Corrosion Resistant Urethane	Series 290 CRU	Polylon HP
DFA	Dry-fall Acrylic	Series 115 Uni-Bond DF	DFA Dry Fall Acrylic
EBF	Epoxy Block Filler	Series 1254 Epoxoblock WB	Kem Cati Coat HS
ESF	Epoxy Surfacer/Filler	Series 215 Surfacing Epoxy	Steel Seam FT 910
EMM	Epoxy Modified Cementitious Mortar	Series 218 MortarClad	Duraplate 2300
EF	Epoxy Flooring	Series 237 Power-Tread	GP3746
GFRE	Glass Flake Reinforced Epoxy	Series 142	Sher-Glass FF
HREM	H2S-Resistant Epoxy Mortar	Series 434 Perma-Shield H_2S	Duraplate 5900 Mortar
HU	Hybrid Urethane	Series 740 UVX	Acrolon Ultra
MIO	MIO Polyurethane	Series 1 Omnithane	Corothane 1 MIO

COATING CODE	GENERIC DESCRIPTION	MANUFACTURER	
		TNEMEC	SHERWIN WILLIAMS
MPE	Multi-Purpose Epoxy	Series N69 Hi-Build Epoxoline II	Macropoxy 646
MTEP	Moisture-Tolerant Epoxy Primer	Series 201 Epoxoprime	Corobond 100
SCE	Secondary Containment Epoxy	Series 237SC Chembloc	Cor Cote HP
SCEP	Secondary Containment Epoxy Primer	Series 206SC Chembloc	GP3552
STEP	Surface-Tolerant Epoxy Primer	Series 135 Chembuild	Macropoxy 646
UHSE	Ultra-High Solids Epoxy (NSF 61)	Series 22 Epoxoline	Duraplate UHS
VEP	Vinyl Ester Primer	Series 251SC Chembloc	Corobond Vinyl Ester Primer
VESC	Vinyl Ester Secondary Containment	Series 252SC Chembloc	Cor Cote VEN FF
ZRU	Zinc-Rich Urethane	Series 94-H_20 Hydro-Zinc	Corothane 1 Galvapak

E. High Temperature Coatings:

COATING CODE	GENERIC DESCRIPTION	MANUFACTURER		
		PPG	TNEMEC	SHERWIN WILLIAMS
HTZRP	High Temperature Zinc Rich Primer	Dimetcote 9 Series	Series 1505 Endura-Heat ZR	Zinc Clad II Plus

2.3 COATING SYSTEMS:

A. The following tables indicate coating systems by material and environment, unless a specific application is indicated.

Environment/ Application	Surface Preparation	Prime Coat	Intermediate Coats	Finish Coat
Ferrous Metals (Structural & Miscellaneous Metals)				
Interior atmospheric	SSPC-SP 6/ NACE No. 3	3.0 to 4.0 MIL MPE	3.0 to 4.0 MIL MPE	3.0 to 4.0 MIL MPE
Interior atmospheric (corrosive environment)	SSPC-SP 10/ NACE No. 2, min. 2 MIL anchor profile	2.5 to 3.5 MIL ZRU	3.0 to 4.0 MIL MPE	3.0 to 4.0 MIL MPE
Outdoor atmospheric	SSPC-SP 6/ NACE No. 3	2.5 to 3.5 MIL ZRU	3.0 to 5.0 MIL MPE	2.5 to 3.5 MIL HU
Hollow Metal Doors	SSPC-SP 3	2.5 to 3.5 MIL STEP		2.5 to 3.5 MIL HU

Environment/ Application	Surface Preparation	Prime Coat	Intermediate Coats	Finish Coat
Bar Joists Interior atmospheric	SSPC SP-3 SSPC Rust Grade Condition C			2.0 TO 3.5 MIL DFA
Bar Joists (corrosive environment)	SSPC SP-3 SSPC Rust Grade Condition C	2.5 to 3.5 MIL MIO		3.0 to 4.0 MIL MPE
Factory Primed Metal Deck Interior atmospheric	SSPC SP-3 SSPC Rust Grade Condition C			2.0 TO 3.5 MIL DFA
Factory Primed Metal Deck (corrosive environment)	SSPC SP-3 SSPC Rust Grade Condition C	4.0 to 6.0 MIL STEP		2.0 to 3.0 MIL MPE
Galvanized Steel				
Interior atmospheric	SSPC-SP 16	4.0 to 6.0 MIL STEP		2.0 to 3.0 MIL MPE
Bar Joists (corrosive environment)	SSPC-SP 16	2.5 to 3.5 MIL MIO		3.0 to 4.0 MIL MPE
Metal Deck (corrosive environment)	SSPC-SP 16	4.0 to 6.0 MIL STEP		2.0 to 3.0 MIL MPE
Outdoor atmospheric	SSPC-SP 16	4.0 to 6.0 MIL STEP		2.5 to 3.5 MIL HU
Field cut pipe threads	SSPC-SP 3	4.0 to 6.0 MIL STEP	Coat per exposure above	Coat per exposure above
Non Ferrous Metals, including piping				
Dissimilar Materials Protection	SSPC-SP 2	4.5 to 5.5 MIL MPE		
Interior atmospheric	SSPC-SP 2	3.0 to 4.0 MIL MPE		3.0 to 4.0 MIL MPE
Outdoor atmospheric	SSPC-SP 2	4.0 to 6.0 MIL MPE		2.5 to 3.5 MIL HU
Ferrous Piping				
Interior atmospheric	SSPC-SP 6/ NACE No. 3	2.5 to 3.5 MIL ZRU	3.0 to 4.0 MIL MPE	3.0 to 4.0 MIL MPE
Outdoor atmospheric	SSPC-SP 10/ NACE No. 2	2.5 to 3.5 MIL ZRU	3.0 to 4.0 MIL MPE	2.5 to 3.5 MIL HU
Ductile Iron Piping				
Interior atmospheric	Pipe: NAPF 500-03-04 Fittings: NAPF 500-03-05	3.0 to 4.0 MIL MPE	3.0 to 4.0 MIL MPE	3.0 to 4.0 MIL MPE

Environment/ Application	Surface Preparation	Prime Coat	Intermediate Coats	Finish Coat
Outdoor atmospheric	Pipe: NAPF 500-03-04 Fittings: NAPF 500-03-05	3.0 to 4.0 MIL MPE	3.0 to 4.0 MIL MPE	2.5 to 3.5 MIL HU
Cast Iron Piping				
Interior atmospheric	SSPC-SP 1	4.0 to 6.0 MIL STEP	2.0 to 3.0 MIL MPE	2.0 to 3.0 MIL MPE
Outdoor atmospheric	SSPC-SP 1	4.0 to 6.0 MIL STEP	2.0 to 3.0 MIL MPE	2.5 to 3.5 MIL HU
PVC Piping				
Interior atmospheric	Hand Sanding/ SSPC-SP 1	3.0 to 4.0 MIL MPE		3.0 to 4.0 MIL MPE
Outdoor atmospheric	Hand Sanding/ SSPC-SP 1	3.0 to 4.0 MIL MPE		2.5 to 3.5 MIL HU

Environment/ Application	Surface Preparation	Filler/Surfacer	Prime Coat	Intermediate Coat(s)	Finish Coat
Concrete*					
Walls, and appurtenant surfaces Interior atmospheric	SSPC-SP 13/ NACE No. 6 ICRI CSP 5	ESF and/or EMM as necessary to fill holes and depressions	100 to 150 SQFT/GAL MPE		100 to 150 SQFT/GAL MPE
Interior Safety Striping	SSPC-SP 13/ NACE No. 6 ICRI CSP 3	ESF and/or EMM as necessary to fill holes and depressions			6.0 to 8.0 MIL EF Pigmented
Outdoor atmospheric Corrosive Environment	SSPC-SP 13/ NACE No. 6 ICRI CSP 5	ESF and/or EMM as necessary to fill holes and depressions	150 to 175 SQFT/GAL AAE		150 to 175 SQFT/GAL AAE

* For repair of deteriorated existing concrete, provide additional surface preparation as specified in PREPARATION article in this Specification Section.

PART 3 - EXECUTION

3.1 ITEMS TO BE COATED

A. Outdoor Surfaces, including but not limited to:
   1. Piping, valves, fittings, hydrants and supports:
      a. As scheduled in Specification Section 40 05 00.
   2. Pumps and motors.
   3. Ferrous metal tankage.
   4. Ferrous metal process equipment.
      a. Clarifier mechanisms.

b. Equipment bridges.
c. Gates and operators.

5. Structural steel:
   a. Columns, beams and bracing.
   b. Field welded connections of factory coated structural steel.
   c. Exposed metal decking.
   d. Pre-engineered metal building frames, girts, purlins and bracing.
6. Miscellaneous ferrous metal surfaces:
   a. Items specifically noted on Drawings to be coated.
7. Miscellaneous galvanized steel surfaces:
   a. Pipe Bollards.
   b. Embed Plates.
   c. Loose lintels.
   d. Steel components of concrete lintels.
   e. Items specifically noted on Drawings to be coated.
8. Doors and frames:
   a. Hollow metal doors and frames
9. Appurtenant surfaces attached to or adjacent to a surface indicated to be coated:
   a. Conduit, boxes, covers and supports.

B. Interior Areas:
1. Refer to Room Finish Schedule on Drawings.
   a. If space is scheduled to be coated, coat all appurtenant surfaces within the space unless specifically noted otherwise. Appurtenant surfaces include but are not limited to:
      1) Columns.
      2) Equipment pads.
      3) Equipment supports.
      4) Underside of roof or floor decks above:
         a) Including semi-exposed or concealed from view unless noted otherwise.
      5) Conduit, boxes, covers and supports.
      6) Miscellaneous ferrous metal surfaces.
2. Concrete:
3. Piping, valves, fittings, hydrants and supports:
   a. Do not coat piping scheduled to be insulated.
4. Pumps and motors.
5. Ferrous metal tankage.
6. Ferrous metal process equipment.
   a. Clarifier mechanisms.
   b. Equipment bridges.
   c. Gates and operators.
   d. Items specifically noted on Drawings to be coated.
7. Miscellaneous galvanized steel surfaces:
   a. Pipe Bollards.
   b. Embed Plates.
   c. Railings.
   d. Loose lintels.
   e. Steel components of concrete lintels.
   f. Seismic angles at masonry partitions.
   g. Items specifically noted on Drawings to be coated.
8. Safety Striping:
   a. Equipment Pads: Coat vertical face and return 3 IN onto horizontal surface of pad.
   b. Pipe supports, columns, piers and similar vertical elements: Coat embedded galvanized steel armoring angles3 IN each face of corners, up to 48 IN above finished floor.
   c. As shown on Drawings.

3.2 ITEMS NOT TO BE COATED

A. General: Do not coat items listed in this Article, unless noted otherwise.

B. Items with Approved Factory Finish: These items may require repair of damaged coated areas or coating of welded connections.

C. Electrical Equipment.

D. Moving parts of mechanical and electrical units where coating would interfere with the operation of the unit.

E. Code labels, equipment identification or rating plates and similar labels, tagging and identification.

F. Contact surfaces of friction-type structural connections.

G. Stainless Steel Surfaces, except:
   1. Dissimilar metals in immersion service.
   2. Piping where specifically noted to be coated.
   3. Banding as required to identify piping.

H. Aluminum Surfaces, except:
   1. Where specifically shown in the Contract Documents.
   2. Where in contact with concrete.
   3. Where in contact with dissimilar metals.
   4. Appurtenant surfaces as described in the ITEMS TO BE COATED article.

I. Fiberglass Surfaces, except:
   1. Fiberglass piping where specifically noted to be coated.
   2. Piping supports where specifically noted to be coated.
   3. Appurtenant surfaces as described in the ITEMS TO BE COATED article.

J. Mechanical piping scheduled to be insulated.

K. Interior of Pipe, Ductwork, and Conduits.
   1. See Division 23 for ductwork.
   2. See Division 40 for pipe linings.

L. Galvanized Steel Items, unless specifically noted to be coated.

M. Architectural Finishes:
   1. Outdoor concrete indicated to receive another finish.
   2. Plastic laminate.
   3. Solid surface material.
   4. Standing and running trim.
   5. Fiberglass fabrications.
   6. Anodized aluminum.
   7. PVDF coated metals.
   8. Factory finished doors and frames.
   9. Aluminum windows, curtainwall and storefront framing systems.
   10. Finish hardware.
   11. Glass and glazing.
   12. Ceramic, porcelain, quarry tile or natural stone.
   13. Acoustical materials.
   14. Building specialties.
   15. Louvers.
   16. Casework and countertops.
   17. Pipe insulation and jacketing.
   18. Standing seam metal roof, fascia, trim, soffit and accessories.

3.3 EXAMINATION

A. Concrete:
   1. Test pH of surface to be coated in accordance with ASTM D4262.
      a. If surface pH is not within coating manufacturer's required acceptable range, use methods acceptable to coating manufacturer as required to bring pH within acceptable range.
      b. Retest pH until acceptable results are obtained.
   2. Verify that moisture content of surface to be coated is within coating manufacturer's recommended acceptable limits.
      a. Test surface to be coated in accordance with ASTM D4263 to determine the presence of moisture.
         1) If moisture is detected, test moisture content of surface to be coated in accordance with ASTM F1869 or ASTM F2170.
         2) Provide remedial measures as necessary to bring moisture content within coating manufacturer’s recommended acceptable limits.
         3) Retest surface until acceptable results are obtained.

3.4 PREPARATION

A. General:
   1. Prepare surfaces to be coated in accordance with coating manufacturer's instructions and this Specification Section unless noted otherwise in this Specification Section.
      a. Where discrepancy between coating manufacturer's instructions and this Specification Section exists, the more stringent surface preparation shall be provided unless approved otherwise, in writing, by the Engineer.
   2. Remove all dust, grease, oil, compounds, dirt and other foreign matter which would prevent bonding of coating to surface.
   3. Adhere to manufacturer's recoat time surface preparation requirements.
      a. Surfaces that have exceeded coating manufacturer's published recoat time and/or have exhibited surface chalking shall be prepared prior to additional coating in accordance with manufacturer's published recommendations.
         1) Minimum SSPC-SP 7/ NACE No. 4 unless otherwise approved by Engineer.

B. Protection:
   1. Protect surrounding surfaces not to be coated.
   2. Remove and protect hardware, accessories, plates, fixtures, finished work, and similar items; or provide ample in-place protection.
   3. Protect code labels, equipment identification or rating plates and similar labels, tagging and identification.

C. Prepare and coat before assembly all surfaces which are inaccessible after assembly.

D. Ferrous Metal:
   1. Prepare ductile iron pipe in accordance with pipe manufacturer's recommendations and NAPF.
      a. All piping, pumps, valves, fittings and any other component used in the water piping system that requires preparation for coating shall be prepared in accordance with requirements for immersion service.
      b. Prepare all areas requiring patch coating in accordance with recommendations of manufacturer and NAPF.
      c. Remove bituminous coating per piping manufacturer, coating manufacturer and NAPF recommendations.
         1) The most stringent recommendations shall apply.
   2. Complete fabrication, welding or burning before beginning surface preparation.
      a. Chip or grind off flux, spatter, slag or other laminations left from welding.
      b. Remove mill scale.
      c. Grind smooth rough welds and other sharp projections.
   3. Solvent clean in accordance with SSPC-SP 1.

4. Restore surface of field welds and adjacent areas to original surface preparation.

E. Galvanized Steel and Non-ferrous Metals:
   1. Solvent clean in accordance with SSPC-SP 1 followed by brush-off blast clean in accordance with SSPC-SP 16 to remove zinc oxide and other foreign contaminants.
      a. Provide uniform 1 MIL profile surface.

F. Hollow Metal Doors and Frames:
   1. Verify factory-applied prime coat is in accordance with ANSI/SDI A250.10.
   2. Prepare as indicated in COATING SYSTEMS Article.

G. Concrete:
   1. Cure for minimum of 28 days.
   2. Concrete surfaces shall be cleaned in accordance with ASTM D4258.
   3. Abrasive blast concrete surfaces in accordance with ASTM D4259 and SSPC-SP 13/ NACE No. 6.
      a. Provide profile per ICRI 301.2 as listed in MATERIALS article of this Specification Section.
   4. Test pH and moisture content in accordance with EXAMINATION article in this Specification Section.

H. Preparation by Abrasive Blasting:
   1. Schedule the abrasive blasting operation so blasted surfaces will not be wet after blasting and before coating.
   2. Provide compressed air for blasting that is free of water and oil.
      a. Provide accessible separators and traps.
   3. Protect nameplates, valve stems, rotating equipment, motors and other items that may be damaged from blasting.
   4. All abrasive-blasted ferrous metal surfaces shall be inspected immediately prior to application of coatings.
      a. Inspection shall be performed to determine cleanliness and profile depth of blasted surfaces and to certify that surface has been prepared in accordance with these Specifications.
      b. Surface preparation shall be approved in writing by NACE coatings inspector.
   5. Perform additional blasting and cleaning as required to achieve surface preparation required.
      a. Re-blast surfaces not meeting requirements of these Specifications.
      b. Prior to coating, re-blast surfaces allowed to set overnight and surfaces that show rust bloom.
      c. Surfaces allowed to set overnight or surfaces which show rust bloom prior to coating shall be re-inspected prior to coating application.
   6. Profile depth of blasted surface: Not less than 1 MIL or greater than 2 MILS unless required otherwise by coating manufacturer.
   7. Ensure abrasive blasting operation does not result in embedment of abrasive particles in coating.
   8. Confine blast abrasives to area being blasted.
      a. Provide shields of polyethylene sheeting or other such barriers to confine blast material.
      b. Plug pipes, holes, or openings before blasting and keep plugged until blast operation is complete and residue is removed.
   9. Abrasive blasting media may be recovered, cleaned and reused providing Contractor submits, for Engineer's review, a comprehensive recovery plan outlining all procedures and equipment proposed in reclamation process.
   10. Properly dispose of blasting material contaminated with debris from blasting operation.

I. All Plastic Surfaces:
   1. Sand using 80-100 grit sandpaper to scarify surfaces.

3.5 APPLICATION

A. General:

1. Thin, mix and apply coatings by brush, roller, or spray in accordance with manufacturer's installation instructions.
    a. Application equipment must be inspected and approved in writing by coating manufacturer.
    b. Hollow metal shall be spray applied only.
2. Temperature and weather conditions:
    a. Do not coat surfaces when surface temperature is below 50 DEGF unless product has been formulated specifically for low temperature application and application is approved in writing by Engineer and coating manufacturer's technical representative.
    b. Avoid coating surfaces exposed to hot sun.
    c. Do not coat damp surfaces.
    d. Apply coating to concrete or masonry surfaces in descending temperatures, in accordance with coating manufacturer's application instructions.
3. Apply materials under adequate illumination.
4. Provide complete coverage to MIL thickness specified.
    a. Thickness specified is dry MIL thickness.
5. Evenly spread to provide full, smooth coverage.
    a. All coating systems are "to cover."
        1) In situations of discrepancy between manufacturer's square footage coverage rates and MIL thickness, MIL thickness requirements govern.
    b. When color or undercoats show through, apply additional coats until coating is of uniform finish and color.
    c. Finished coating system shall be uniform and without voids, bugholes, holidays, laps, brush marks, roller marks, runs, sags or other imperfections.
6. If so directed by Engineer, do not apply consecutive coats until Engineer has had an opportunity to observe and approve previous coats.
7. Work each application of material into corners, crevices, joints, and other difficult to work areas.
8. Provide coating manufacturer’s recommended details at all terminations, penetrations, embedments, cracks, joints and changes in substrate direction.
9. Avoid degradation and contamination of blasted surfaces and avoid inter-coat contamination.
    a. Clean contaminated surfaces before applying next coat.
    b. Intercoat surface cleanliness shall be inspected and approved by the Engineer prior to application of each coat.
    c. NACE coatings inspector shall inspect and approve surface of each preceding coat prior to application of each succeeding coating.
10. Smooth out runs or sags immediately, or remove and recoat entire surface.
11. Allow preceding coats to dry before recoating.
    a. Recoat within time limits specified by coating manufacturer.
    b. If recoat time limits have expired re-prepare surface in accordance with coating manufacturer's printed recommendations.
12. Allow coated surfaces to cure prior to allowing traffic or other work to proceed.
13. Coat all aluminum in contact with dissimilar materials.
14. When coating rough surfaces which cannot be backrolled sufficiently, hand brush coating to work into all recesses provided that the maximum DFT is not exceeded.
15. Backroll surfaces if coatings are spray applied.

B. Employ services of coating manufacturer's technical representative to ensure that field-applied coatings are compatible with factory-applied or existing coatings.
    1. Certify through material data sheets.
    2. Perform test patch.
        a. Prepare existing coating surface to receive specified coating system.
        b. Apply coating to a minimum 1 SQFT area and allow to cure in accordance with manufacturer's recommendations.
        c. Evaluate adhesion to existing coating:

1) Concrete or Masonry substrates: ASTM D4541.
2) All other substrates: ASTM D6677 and ASTM D3359 (X-cut method).

3. If field-applied coating is found to be not compatible, require the coating manufacturer's technical representative to recommend, in writing, product to be used as barrier coat, thickness to be applied, surface preparation and method of application.
   a. Perform test patch as described above.
4. At Contractor's option, coatings may be removed, surface re-prepared, and new coating applied using appropriate coating system listed in the MATERIALS Article, Coating Systems paragraph of this Specification Section.
   a. All damage to surface as result of coating removal shall be repaired to original condition or better by Contractor at no additional cost to Owner.

C. Prime Coat Application:
1. Apply structural steel and miscellaneous steel prime coat in the factory.
   a. Finish coats shall be applied in the field.
   b. Prime coat referred to here is prime coat as indicated in this Specification.
      1) Prime coating applied in factory (shop) as part of Fabricator's standard rust inhibiting and protection coating is not acceptable as replacement for specified prime coating.
   c. Application of all factory-applied coatings(s) on structural steel and miscellaneous steel, steel moment frames, and steel joists shall be continually observed and certified by NACE coatings inspector.
2. Prime all surfaces indicated to be coated.
   a. Apply prime coat in accordance with coating manufacturer's written instructions and as written in this Specification Section.
      1) If coatings are removed and surface is re-prepared by Contractor, NACE coatings inspector shall inspect and approve surface in writing prior to recoating and shall provide continuous observation and certification of new coating.
3. Prime ferrous metals embedded in concrete to minimum of 1 IN below exposed surfaces.
4. Apply zinc-rich primers while under continuous agitation.
5. Brush or spray bolts, welds, edges and difficult access areas with primer prior to primer application over entire surface.
6. Touch up damaged primer coats prior to applying finish coats.
   a. Restore primed surface equal to surface before damage.
7. All surfaces of steel lintels and steel components of concrete lintels used in wall construction shall be completely coated with both prime and finish coats prior to placing in wall.

D. Finish Coat Application:
1. Apply finish coats in accordance with coating manufacturer's written instructions and in accordance with this Specification Section; manufacturer instructions take precedent over these Specifications.
2. Touch up damaged finish coats using same application method and same material specified for finish coat.
   a. Prepare damaged area in accordance with the PREPARATION Article of this Specification Section.

3.6 COLOR CODING

A. Color code piping in accordance with the SCHEDULE Article of this Specification Section.

3.7 FIELD QUALITY CONTROL

A. Application Deficiencies:
1. Surfaces showing runs, laps, brush marks, telegraphing of surface imperfections or other defects will not be accepted.
2. Surfaces showing evidence of fading, chalking, blistering, delamination or other defects due to improper surface preparation, environmental controls or application will not be accepted.

a. Epoxy surfaces showing evidence of chalking or amine blush shall be prepared and recoated as follows:
    1) Solvent clean surfaces in accordance with SSPC-SP1 and abrasive blast in accordance with SSPC-SP7/ NACE No. 4.
    2) Recoat with intermediate and finish coats in accordance with coating system specified herein.

B. Provide protection for coated surfaces.
1. Surfaces showing soiling, staining, streaking, chipping, scratches, or other defects will not be accepted.

C. Contractor Performed Testing:
1. Provide ongoing testing and inspection, including but not limited to the following:
    a. Measurement and recording of environmental conditions as specified herein.
    b. Measurement and recording of substrate conditions as specified herein.
    c. Thickness Testing:
        1) Wet film thickness during application in accordance with ASTM D4414.
        2) Dry Film Thickness (DFT) in accordance with SSPC-PA 2.
        3) Engineer may measure coating thickness at any time during project to assure conformance with these Specifications.
    d. Bond Strength:
        1) Bond strength testing will be required by the Engineer where there is reason to suspect the integrity of the coating system.
        2) Measure bond strength of the coating in accordance with:
            a) Steel substrate: ASTM D4541.
            b) Concrete substrate ASTM D7234.
        3) The number of test sites and locations to be tested shall be determined by the Engineer after application of coating. The Contractor will apply the dollies, perform the tests and repair the coating in the presence of the Engineer.
            a) For each test that fails, two additional tests shall be performed in the adjacent area.
            b) Further bond tests may be performed to determine the extent of potentially deficient bonded areas at no additional cost to the Owner.
        4) Repairs shall be made by applicator in strict accordance with manufacturer's recommendations. Any coated areas that do not pass the bond strength tests shall be removed and replaced at the expense of the Contractor.

D. NACE inspection:
1. The Owner reserves the right to retain a NACE Level 3 coating inspector to perform observation, inspection and testing as deemed necessary to document the quality of the Work.
    a. All work shall be done to the satisfaction of the Owner's inspector.
    b. Any portion of the coating that does not satisfactorily pass the inspection and testing requirements shall be repaired or replaced by the Contractor at no additional cost to the Owner.
    c. Additional testing and/or inspection may be done at the discretion of the Owner.
        1) The Contractor will provide all equipment, materials, and labor to perform the testing.
2. Inspection, testing or observation by the Owner's inspector shall not relieve the Contractor of responsibility for surface preparation, inspection or quality control specified herein.

E. Instrumentation:
1. Provide instrumentation as necessary to measure and record atmospheric and substrate conditions, including but not limited to:
    a. Dry Film Thickness Gauge:
        1) Ultrasonic: ASTM D6132.
        2) Magnetic: ASTM B499.
    b. Wet Film Thickness Gauge: ASTM D4414.

c. Sling Psychrometer: ASTM E337.
d. Surface Temperature Gauge.
e. Anemometer.
f. Moisture Meter.
g. Adhesion test apparatus:
1) Steel: ASTM D4541.
2) Concrete: ASTM D7234.

F. Maintain Daily Records:
1. Record the following information during application:
a. Date, starting time, end time, and all breaks taken by applicators.
b. Air temperature.
c. Relative humidity.
d. Dew point.
e. Moisture content and pH level of concrete or masonry substrates prior to coating.
f. Surface temperature of substrate.
g. Provisions utilized to maintain work area within manufacturer's recommended application parameters including temporary heating, ventilation, cooling, dehumidification and provisions utilized to mitigate wind-blown dust and debris from contaminating the wet coating.
h. For outdoor coating, also record:
1) Sky condition.
2) Wind speed and direction.
i. Record environmental conditions, substrate moisture content and surface temperature information not less than once every 4 HRS during application.
1) Record hourly when temperatures are below 50 DEGF or above 100 DEGF.
2. Record the following information daily for the coating manufacturer's recommended curing period:
a. Date and start time of cure period for each item or area.
b. For outdoor coating, also record:
1) Sky conditions.
2) Wind speed and direction.
3) Air temperature.
a) Dry Bulb.
b) Wet Bulb.
4) Relative humidity.
5) Dew point.
6) Surface temperatures.
c. Record environmental conditions not less than once every 4 HRS.
1) Record hourly when temperatures are below 50 DEGF or above 100 DEGF.
d. Provisions utilized to protect each item or area and to maintain areas within manufacturer's recommended curing parameters.
3. Format for daily record to be computer generated.

G. Provide wet paint signs.

3.8 CLEANING

A. Clean coating spattered surfaces.
1. Use care not to damage finished surfaces.

B. Upon completion of coating, replace hardware, accessories, plates, fixtures, and similar items.

C. Remove surplus materials, scaffolding, and debris.

3.9 COLOR SCHEDULE

A. Pipe Bollards: Safety Yellow.

B. Piping:

1. Refer to Specification Section 10 14 00 for the piping system and banding material and refer to this Specification Section and this Schedule for the banding colors.

END OF SECTION

DIVISION 10

SPECIALTIES

SECTION 10 14 00
IDENTIFICATION DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Tag, tape and stenciling systems for equipment, piping, valves, pumps, ductwork and similar items.
   2. Hazard and safety signs.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. A13.1, Scheme for the Identification of Piping Systems.
   2. The International Society of Automation (ISA).
   3. National Electrical Manufacturers Association/American National Standards Institute (NEMA/ANSI):
      a. Z535.1, Safety Color Code.
      b. Z535.2, Environmental and Facility Safety Signs.
      c. Z535.3, Criteria for Safety Symbols.
      d. Z535.4, Product Safety Signs and Labels.
   4. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
      b. 704, Standard System for the Identification of Hazards of Materials for Emergency Response.
   5. Occupational Safety and Health Administration (OSHA):
      a. 29 CFR 1910.145, Specification for Accident Prevention Signs and Tags.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Catalog information for all identification systems.
      b. Acknowledgement that products submitted meet requirements of standards referenced.
   3. Identification register, listing all items in PART 3 of this Specification Section to be identified, type of identification system to be used, lettering, location and color.
   4. Schedule of Hazard and Safety Signage indicating text and graphics.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. W.H. Brady Co.
   2. Panduit.
   3. Seton.
   4. National Band and Tag Co.

5. Carlton Industries, Inc.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MANUFACTURED UNITS

A. Type A1 - Round Metal Tags:
   1. Materials:
      a. Aluminum or stainless steel.
      b. Stainless steel shall be used in corrosive environments.
   2. Size:
      a. Diameter: 1-1/2 IN minimum.
      b. Thickness: 0.035 IN (20 GA) minimum.
   3. Fabrication:
      a. 3/16 IN minimum mounting hole.
      b. Legend: Stamped and filled with black coloring.
   4. Color: Natural.

B. Type A2 - Rectangle Metal Tags:
   1. Materials: Stainless steel.
   2. Size:
      a. 3-1/2 IN x 1-1/2 IN minimum.
      b. Thickness: 0.036 IN (20 GA) minimum.
   3. Fabrication:
      a. 3/16 IN minimum mounting hole.
      b. Legend: Stamped and filled with black coloring.
   4. Color: Natural.

C. Type A3 - Metal Tape Tags:
   1. Materials: Aluminum or stainless steel.
   2. Size:
      a. Width 1/2 IN minimum.
      b. Length as required by text.
   3. Fabrication:
      a. 3/16 IN minimum mounting hole.
      b. Legend: Embossed.
   4. Color: Natural.

D. Type B2 - Nonmetallic Signs:
   1. Materials: Fiberglass reinforced or durable plastic.
   2. Size:
      a. Surface: As required by text.
      b. Thickness: 60 MILS minimum.
   3. Fabrication:
      a. Rounded corners.
      b. Drilled holes in corners with grommets.
      c. Legend: Preprinted, permanently embedded and fade resistant for a 10 year minimum outdoor durability.
   4. Color:
      a. Background: Manufacturer standard or as specified.
      b. Lettering: Black.
   5. Standards for OSHA signs: NEMA/ANSI Z535.1, NEMA/ANSI Z535.2, NEMA/ANSI Z535.3, NEMA/ANSI Z535.4, OSHA 29 CFR 1910.145.

E. Type C - Laminated Name Plates:
   1. Materials: Phenolic or DR (high impact) acrylic.
   2. Size:
      a. Surface: As required by text.
      b. Thickness: 1/16 IN.

3. Fabrication:
    a. Outdoor rated and UV resistant when installed outdoors.
    b. Two layers laminated.
    c. Legend: Engraved through top lamination into bottom lamination.
    d. Two drilled side holes, for screw mounting.
4. Color: Black top surface, white core, unless otherwise indicated.

F. Type D - Self-Adhesive Tape Tags and Signs:
1. Materials: Vinyl tape or vinyl cloth.
2. Size:
    a. Surface: As required by text.
    b. Thickness: 5 MILS minimum.
3. Fabrication:
    a. Indoor/Outdoor grade.
    b. Weather and UV resistant inks.
    c. Permanent adhesive.
    d. Legend: Preprinted.
    e. Wire markers to be self-laminating.
4. Color: White with black lettering or as specified.
5. Standards for OSHA signs: NEMA/ANSI Z535.1, NEMA/ANSI Z535.2, NEMA/ANSI Z535.3, NEMA/ANSI Z535.4, OSHA 29 CFR 1910.145.

G. Type E - Heat Shrinkable Tape Tags:
1. Materials: Polyolefin.
2. Size: As required by text.
3. Fabrication:
    a. Legend: Preprinted.
4. Color: White background, black printing.

H. Type F - Underground Warning Tape:
1. Materials: Polyethylene.
2. Size:
    a. 6 IN wide (minimum).
    b. Thickness: 3.5 MILS.
3. Fabrication:
    a. Legend: Preprinted and permanently imbedded.
    b. Message continuous printed.
    c. Tensile strength: 1750 PSI.
4. Color: As specified.

I. Type G - Stenciling System:
1. Materials:
    a. Exterior type stenciling enamel.
    b. Either brushing grade or pressurized spray can form and grade.
2. Size: As required.
3. Fabrication:
    a. Legend: As required.
4. Color: Black or white for best contrast.

J. Underground Tracer Wire:
1. Materials:
    a. Wire:
        1) 12 GA AWG.
        2) Solid.
    b. Wire nuts: Waterproof type.
    c. Split bolts: Brass.

2.3 ACCESSORIES

A. Fasteners:
   1. Bead chain: #6 brass, aluminum or stainless steel.
   2. Plastic strap: Nylon, urethane or polypropylene.
   3. Screws: Self-tapping, stainless steel.
   4. Adhesive, solvent activated.

2.4 MAINTENANCE MATERIALS

A. Where stenciled markers are provided, clean and retain stencils after completion and include in extra stock, along with required stock of paints and applicators.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Install identification devices at specified locations.

B. All identification devices to be printed by mechanical process, hand printing is not acceptable.

C. Attach tags to equipment with sufficient surface or body area with solvent activated adhesive applied to back of each tag.

D. Attach tags with 1/8 IN round or flat head screws to equipment without sufficient surface or body area, or porous surfaces.
   1. Where attachment with screws should not or cannot penetrate substrate, attach with plastic strap.

E. Single items of equipment enclosed in a housing or compartment to be tagged on outside of housing.
   1. Several items of equipment mounted in housing to be individually tagged inside the compartment.

F. Tracer Wire:
   1. Attach to pipe at a maximum of 10 FT intervals with tape or tie-wraps.
   2. Continuous pass from each valve box and above grade at each structure.
   3. Coil enough wire at each valve box to extend wire a foot above the ground surface.
   4. 1,000 FT maximum spacing between valve boxes.
   5. If split bolts are used for splicing, wrap with electrical tape.
   6. If wire nuts are used for splicing, knot wire at each splice point leaving 6 IN of wire for splicing.
   7. Use continuous strand of wire between valve box where possible.
      a. Continuous length shall be no shorter than 100 FT.

3.2 SCHEDULES

A. Process Systems:
   1. General:
      a. Provide arrows and markers on piping.
         1) At 20 FT maximum centers along continuous lines.
         2) At changes in direction (route) or obstructions.
         3) At valves, risers, "T" joints, machinery or equipment.
         4) Where pipes pass through floors, walls, ceilings, cladding assemblies and like obstructions provide markers on both sides.
      b. Position markers on both sides of pipe with arrow markers pointing in flow direction.
         1) If flow is in both directions use double headed arrow markers.
      c. Apply tapes and stenciling in uniform manner parallel to piping.
   2. Trenches with piping:
      a. Tag type: Type F - Underground Warning Tape
      b. Location: Halfway between top of piping and finished grade.

c. Letter height: 1-1/4 IN minimum.
d. Potable water:
1) Color: Blue with black letters.
2) Legend:
a) First line: "CAUTION CAUTION CAUTION"
b) Second line: "BURIED WATER LINE BELOW"
e. Storm and sanitary sewer lines:
1) Color: Green with black letters.
2) Legend:
a) First line: "CAUTION CAUTION CAUTION"
b) Second line: "BURIED SEWER LINE BELOW"

3. Yard valves, buried, with valve box and concrete pad:
a. Tag type: Type A2 - Rectangle Metal Tags.
b. Fastener: 3/16 IN x 7/8 IN plastic screw anchor with 1 IN #6 stainless steel pan head screw.
c. Legend:
1) Letter height: 1/4 IN minimum.
2) Valve designation as indicated on the Drawings (e.g., "V-xxx").
d. Fastener:
1) Type A1: Chain of the same material.
2) Type B1: Stainless steel chain.
e. Color: Per ASME A13.1 corresponding to the piping system.
f. Legend:
1) Letter height: 1/4 IN minimum.
2) Valve designation as indicated on the Drawings (e.g., "V-xxx").

4. Piping systems:
a. Refer to Section 22 05 53 for identification of plumbing piping.
b. Tag type:
1) Outdoor locations: Type G - Stenciling System.
2) Indoor locations:
a) Type D - Self-Adhesive Tape Tags and Signs.
b) Type G - Stenciling System.
c. Fastener: Self.
d. Color: Per ASME A13.1.
e. Legend:
1) Letter height: Manufacturers standard for the pipe diameter.
2) Mark piping in accordance with ASME A13.1.
3) Use piping designation as indicated on the Drawings.
4) Arrow: Single arrow.

5. Equipment that starts automatically:
a. Tag type:
1) Type B2 - Nonmetallic Signs.
2) Type D - Self-Adhesive Tape Tags and Signs.
b. Fastener:
1) Type B2 - Screw or adhesive.
2) Type D - Self.
c. Size: 5 IN x 7 IN
d. Location: pumps, motors, scales, readout displays, etc.
e. Legend:
1) OSHA Warning Sign.
2) Description of Warning: "THIS MACHINE STARTS AUTOMATICALLY".

B. Instrumentation Systems:
1. Instrumentation Equipment (e.g., flow control valves, primary elements, etc.):
a. Tag type:
1) Outdoor locations: Type B1 - Square Nonmetallic Tags.

2) Indoor noncorrosive:
a) Type A1 - Round Metal Tags.
b) Type B1 - Square Nonmetallic Tags.
3) Indoor corrosive:
a) Stainless steel Type A1 - Round Metal Tags.
b) Type B1 - Square Nonmetallic Tags.
b. Fastener:
1) Type A1: Chain of the same material.
2) Type B1: Stainless steel chain.
c. Legend:
1) Letter height: 1/4 IN minimum.
2) Equipment ISA designation as indicated on the Drawings (e.g., “FIT-xxx”).
2. Enclosure for instrumentation and control equipment, (e.g., PLC control panels, etc.):
a. Tag type: Type C - Phenolic Name Plates.
b. Fastener: Screws.
c. Legend:
1) Letter height: 1/2 IN minimum.
2) Equipment name (e.g., "PLC CONTROL PANEL PCP-xxx").
3. Components inside equipment enclosure, (e.g., PLC’s, control relays, contactors, and timers):
a. Tag type: Type D - Self-Adhesive Tape Tags.
b. Fastener: Self.
c. Legend:
1) Letter height: 3/16 IN minimum.
2) Description or function of component (e.g., "PLC-xxx” or “CR-xxx").
4. Through enclosure door mounted components (e.g., selector switches, controller digital displays, etc.):
a. Tag type: Type C - Phenolic Name Plates.
b. Fastener: Screws.
c. Legend:
1) Letter height: 1/4 IN minimum.
2) Component ISA tag number as indicated on the Drawings (e.g., “HS-xxx”).

C. HVAC Systems:
1. General:
a. Provide arrows and markers on ducts.
1) At 20 FT maximum centers along continuous lines.
2) At changes in direction (route) or obstructions.
3) At dampers, risers, branches, machinery or equipment.
4) Where ducts pass through floors, walls, ceilings, cladding assemblies and like obstructions provide markers on both sides.
b. Position markers on both sides of duct with arrow markers pointing in flow direction.
1) If flow is in both directions use double headed arrow markers.
c. Apply tapes and stenciling in uniform manner parallel to ducts.
2. HVAC Equipment (e.g., unit heaters, exhaust fans, air handlers, etc.):
a. Tag type:
1) Type B2 - Nonmetallic Signs.
2) Type C - Phenolic Name Plates.
b. Fastener: Screws.
c. Legend:
1) Letter height: 1 IN minimum.
2) Equipment designation as indicated on the Drawings (e.g., "EF-xxx").
3. Ductwork:
a. Tag type:
1) Type D - Self-Adhesive Tape Tags and Signs.
2) Type G - Stenciling System.

b. Fastener: Self.
c. Legend:
1) Letter height: 1 IN minimum.
2) Description of ductwork, (e.g., “AIR SUPPLY”).
3) Arrows: Single arrow.

4. Enclosure for instrumentation and control equipment, (e.g., fan control panels, etc.):
a. Tag type: Type C - Phenolic Name Plates.
b. Fastener: Screws.
c. Legend:
1) Letter height: 1/2 IN minimum.
2) Equipment designation as indicated on the Drawings (e.g., "FAN CONTROL PANEL FCP-xxx").

5. Wall mounted thermostats:
a. Tag type: Type D - Self-Adhesive Tape Tags and Signs.
b. Fastener: Self.
c. Legend:
1) Letter height: 3/16 IN minimum.
2) Description of equipment controlled (e.g., "UH-xxx" or AHU-xxx").

6. Components inside equipment enclosure, (e.g., controller’s, control relays, contactors, and timers):
a. Tag type: Type D - Self-Adhesive Tape Tags and Signs.
b. Fastener: Self.
c. Legend:
1) Letter height: 3/16 IN minimum.
2) Description or function of component (e.g., "CR-xxx").

7. Through enclosure door mounted equipment (e.g., selector switches, controller digital displays, etc.):
a. Tag type: Type C - Phenolic Name Plates.
b. Fastener: Screws.
c. Legend:
1) Letter height: 1/4 IN minimum.
2) Component tag number as indicated on the Drawings or as defined by contractor (e.g., “HS-xxx”).

D. Electrical Systems:
1. Trenches with ductbanks, direct-buried conduit, or direct-buried wire and cable.
a. Tag type: Type F - Underground Warning Tape.
b. Letter height: 1-1/4 IN minimum.
c. Location:
1) Where trench is 12 IN or more below finished grade: In trench 6 IN below finished grade.
2) Where trench is less than 12 IN below finished grade: In trench 3 IN below finished grade.
d. Electrical power (e.g., low and medium voltage):
1) Color: Red with black letters.
2) Legend:
a) First line: “CAUTION CAUTION CAUTION”.
b) Second line: “BURIED ELECTRIC LINE BELOW”.
e. Communications (e.g., telephone, instrumentation, LAN, SCADA):
1) Color: Orange with black letters.
2) Legend:
a) First line: “CAUTION CAUTION CAUTION”.
b) Second line: “BURIED COMMUNICATION LINE BELOW”.

2. Switchgear, switchboards and motor control centers:
a. Tag type: Type C - Phenolic Name Plates.
b. Fastener: Screws.

c. Main equipment legend:
    1) Letter height:
        a) First line: 1 IN minimum.
        b) Subsequent lines: 3/8 IN minimum.
    2) First line: Equipment name (e.g., "MAIN SWITCHBOARD MSBxxx").
    3) Second line:
        a) Source of power (e.g., "FED FROM MCCxxx LOCATED IN ROOM xxx").
        b) Include the building name or number if the source is in another building.
    4) Third line: System voltage and phase (e.g., “480/277 V, 3PH”).
    5) Fourth line: Date installed (e.g., “INSTALLED JULY 20xx”).
d. Main and feeder device legend:
    1) Letter height: 3/8 IN minimum.
    2) Description of load (e.g., “MAIN DISCONNECT”, "PUMP Pxxx" or "PANELBOARD HPxxx").

3. Panelboards and transformers:
    a. Tag type: Type C - Phenolic Name Plates.
    b. Fastener: Screws.
    c. Legend:
        1) Letter height:
            a) First line: 3/8 IN minimum.
            b) Subsequent lines: 3/16 IN minimum.
        2) First line: Equipment name (e.g., "PANELBOARD LPxxx" or "TRANSFORMER Txxx").
        3) Second line (panelboards only): System voltage and phase (e.g., “208/120V, 3PH”).
        4) Third line:
            a) Source of power (e.g., "FED FROM MCCxxx LOCATED IN ROOM xxx").
            b) Include the building name or number if the source is in another building.
        5) Fourth line: Date installed (e.g., “INSTALLED JULY 20xx”).
4. Safety switches, separately mounted circuit breakers and motor starters, VFD’s, etc.:
    a. Tag type: Type C - Phenolic Name Plates.
    b. Fastener: Screws.
    c. Legend:
        1) Letter height: 1/4 IN minimum.
        2) First line: Description of load equipment is connected to (e.g., "PUMP Pxxx").
        3) Second line:
            a) Source of power (e.g., "FED FROM MCCxxx LOCATED IN ROOM xxx").
            b) The source of power room number is only required when there are multiple electrical rooms, if the source is in another building, the building name or number shall be used.
5. Enclosure for instrumentation and control equipment, (e.g., lighting control panels, etc.):
    a. Tag type: Type C - Phenolic Name Plates.
    b. Fastener: Screws.
    c. Legend:
        1) Letter height: 1/2 IN minimum.
        2) Equipment name (e.g., "LIGHTING CONTROL PANEL LCPxxx").
6. Components inside equipment enclosures (e.g., circuit breakers, fuses, control power transformers, control relays, contactors, timers, etc.):
    a. Tag type: Type D - Self-Adhesive Tape Tags and Signs.
    b. Fastener: Self.
    c. Legend:
        1) Letter height: 3/16 IN minimum.
        2) Description or function of component (e.g., "M-xxx”, “CR-xxx” or “TR-xxx").
7. Through enclosure door mounted equipment (e.g., selector switches, controller digital displays, etc.):
    a. Tag type: Type C - Phenolic Name Plates.

b. Fastener: Screws.
c. Legend:
    1) Letter height: 1/4 IN minimum.
    2) Component tag number as indicated on the Drawings or as defined by contractor (e.g., “HS-xxx”).

8. Conductors in control panels and in pull or junction boxes where multiple circuits exist.
    a. Tag type: Type D - Self-Adhesive Tape Tags.
    b. Fastener: Self.
    c. Tag conductor at both ends.
    d. Legend:
        1) Letter height: 1/8 IN minimum.
        2) Circuit number or wire number as scheduled on the Drawings or as furnished with the equipment.
9. Conductors in handholes and manholes.
    a. Tag type: Type A3 - Metal Tape Tags.
    b. Fastener: Nylon strap.
    c. Tag conductor at both ends.
    d. Legend:
        1) Letter height: 1/8 IN minimum.
        2) Circuit number or wire number as scheduled on the Drawings.
10. Grounding conductors associated with grounding electrode system in accordance with the following:
    a. Tag type: Type D - Self-Adhesive Tape Tags.
    b. Fastener: Self.
    c. Legend:
        1) Letter height: 1/8 IN minimum.
        2) Function of conductor (e.g., "MAIN BONDING JUMPER", "TO GROUND RING", "TO MAIN WATER PIPE").
11. Flash protection for switchboards, panelboards, industrial control panels and motor control centers:
    a. Tag type: Type D - Self-Adhesive Tape Signs.
    b. Fastener: Self.
    c. Legend: Per NFPA 70.
12. Entrances to electrical rooms:
    a. Tag type: Type B2 - Nonmetallic Signs.
    b. Fastener: Screw or adhesive.
    c. Size: 5 IN x 7 IN.
    d. Location: Each door to room.
    e. Legend:
        1) OSHA Danger Sign.
        2) Description of Danger: “HIGH VOLTAGE, AUTHORIZED PERSONNEL ONLY”.
13. Equipment where more than one voltage source is present:
    a. Tag type:
        1) Type B2 - Nonmetallic Signs.
        2) Type D - Self-Adhesive Tape Signs.
    b. Fastener:
        1) Screw or adhesive.
        2) Self.
    c. Size: 1-3/4 IN x 2-1/2 IN.
    d. Location: Exterior face of enclosure or cubical.
    e. Legend:
        1) OSHA Danger Sign.
        2) Description of Danger: “MULTIPLE VOLTAGE SOURCES”.

END OF SECTION

SECTION 10 14 23
SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Room identification signs.
      a. Fire and/or smoke barrier identification signs.
   2. Aluminum letters.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 10 14 00 - Identification Devices.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Americans with Disabilities Act (ADA):
      a. Accessibility Guidelines for Buildings and Facilities (ADAAG) as expressed in the 2019 California Building Code Chapter 11B.
   2. ASTM International (ASTM):
      a. B26, Standard Specification for Aluminum-Alloy Sand Castings.

1.3 DEFINITIONS

A. Authority Having Jurisdiction (AHJ): Building official, fire chief, fire marshal or other individual having statutory authority.

B. Wet and/or Corrosive Areas: For the purposes of this Specification Section, the following rooms or areas are considered wet and/or corrosive:
   1. Tipping Floor
   2. Mechanical Room
   3. Fire Riser Room
   4. Men’s Toilet
   5. Women’s Toilet
   6. Tunnel

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Color charts for Engineer's color selection.
         1) Color selection shall be made from manufacturer's complete color line including all premium and special colors.
   3. Schedule of all signs indicating text and graphics.
   4. Layout drawings of all signage showing size, letter style, text, border, finish, and installation detail.
      a. Provide drawings for:
         1) Room, exit, and stair identification signs.
         2) Aluminum letters.

B. Samples:

1. Roomidentification signs.
2. Aluminum letters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Roomidentification signs:
      a. ASE - Architectural Signs and Engraving.
      b. ASI Signage Innovations.
      c. Best Sign Systems.
      d. Mohawk Sign Systems.
      e. Nelson-Harkins.
      f. Southwell Co.
      g. Stamprite Supersine Identification Specialists.
   2. Aluminum letters:
      a. A R K Ramos Manufacturing Co., Inc.
      b. ASI Signage Innovations.
      c. Leeds Architectural Letters.
      d. Metal Arts.
      e. Metallic Arts.
      f. The Southwell Co.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. RoomIdentification Signs:
   1. Interior:
      a. Dry, non-corrosive areas: Melamine plastic suitable for raised lettering and Braille.
      b. Wet and/or corrosive areas: Aluminum or fiberglass suitable for raised lettering and Braille.
   2. Exterior: Aluminum or fiberglass suitable for raised lettering and Braille.

B. Aluminum Letters:
   1. Cast aluminum ASTM B26.
   2. For machine cut letters, provide aluminum of appropriate alloy and hardness.

2.3 FABRICATION

A. Room Identification Signs:
   1. General:
      a. Raised text, border and graphics.
         1) Minimum 1/32 IN height.
         2) Provide international graphic symbology for all toilet, locker and shower rooms or combinations thereof, and for unisex toilet rooms and stairs.
         3) Provide handicap symbol on all signs for rooms meeting handicap requirements.
      b. Grade 2 Braille.
      c. Finish: Eggshell.
         1) Color: To be selected.
      d. Text:
         1) Typeface: Sans Serif.
         2) Size: Minimum 3/4 IN high.
      e. Text as indicated in the SCHEDULES Article in PART 3 of this Specification Section.
      f. Exterior signs shall be rated for exterior use.

B. Hazard Communication Signage (NFPA and OSHA signage): See Specification Section 10 14 00.

C. Aluminum Letters:
   1. Mount with appropriate backing and weather resistance at location determined by Owner.
   2. General:
      a. Cast aluminum, machine cut or laser cut aluminum.
      b. Finish: Baked enamel
      c. Color: To be determined by Owner.
      d. Mounting:
         1) 1 IN projected.
         2) Provide stainless steel mounting studs.
      e. Text: As indicated in the SCHEDULES Article in PART 3.
   3. Letters:
      a. Owner shall determine exact number of letters (and numerals if any)at submittal, up to 50 characters at time of submittal.
      b. Owner shall determine text at time of submittal.
      c. Typeface: Match existing facility signage.
      d. Size:
         1) Height: 8 IN.
         2) Stroke: 1/2 IN minimum.
      e. Depth: 3/8 IN.
   4. Provide true angles, crisp corners and straight edges with no burrs or pitting in the surface.

D. Site Signs:

2.4 MAINTENANCE MATERIALS

A. Where stenciled markers are provided, clean and retain stencils after completion and include in extra stock, along with required stock of paints and applicators.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Room Identification Signs:
   1. Install signs using foam tape for interior signs and stainless steel screws (minimum of two) for exterior signs.
      a. Stainless steel screws shall be painted to match sign color.
   2. Mounting Locations:
      a. Tactile characters on signs shall be located 48 IN minimum above the finished floor or ground surface, measured from the baseline of the lowest tactile character and 60 IN maximum above the finish floor or ground surface, measured from the baseline of the highest tactile character.
      b. Where a tactile sign is provided at a door, the sign shall be located alongside the door at the latch side. Where a tactile sign is provided at double doors with one active leaf, the sign shall be located on the inactive leaf. Where a tactile sign is provided at double doors with two active leafs, the sign shall be located to the right side of the right hand door. Where there is no wall space at the latch side of a single door or at the right side of double doors, signs shall be located on the nearest adjacent wall.
      c. Signs containing tactile characters shall be located so that a clear floor space of 18 IN minimum by 18 IN minimum, centered on the tactile characters, is provided beyond the arc of any door swing between the closed position and 45 degree open position.
   3. Interior and exterior signs identifying permanent rooms and spaces shall comply with Chapter 11-B of the California Building Code (aka ADA).

B. Aluminum Letters:
   1. Install letters where instructed by Owner.

2. Mount to walls with 1 IN projection in accordance with manufacturer's instructions.

3.2 SCHEDULES

A. Room and Exit Identification Signs:
   1. Door 100A
      a. Push side: No sign.
      b. Pull side:”"MECHANICAL ROOM”
   2. Door 101A
      a. Push side: No sign.
      b. Pull side: “FIRE RISER ROOM”
   3. Door 102A
      a. Push side: No sign.
      b. Pull side: “ELECTRICAL ROOM”.
   4. Door 103A
      a. Push side: No sign.
      b. Pull side:”"MEN”
      c. International ADA symbol for men’s restroom.(triangle)
   5. Door 104A
      a. Push side: No sign.
      b. Pull side:”"WOMEN”
      c. International ADA symbol for women’s restroom (circle).
   6. Door 105A
      a. Push side: “EXIT”
      b. Pull side:”"TIPPING FLOOR”
   7. Door 105B
      a. Push side: No sign.
      b. Pull side: “FIRE DEPARTMENT ACCESS”
   8. Door 105C
      a. Push side: No sign.
      b. Pull side: “FIRE DEPARTMENT ACCESS”.
   9. Door 106A
      a. Push side: No sign.
      b. Pull side:”"SCALE HOUSE”
   10. Door 107A
      a. Push side: No sign
      b. Pull side: “SCALE HOUSE”.

B. Aluminum Letters:
   1. Place as directed by OWNER.
   2. Provide a 72 character allowance.
   3. Provide backing reinforcement to PEMB Transfer Station exterior wall and metal stud framed exterior wall at Scale Houses.
      a. 300 lb point load resistance minimum.

END OF SECTION

SECTION 10 28 13
TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Toilet accessories.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Americans with Disabilities Act (ADA):
      a. Accessibility Guidelines for Buildings and Facilities (ADAAG) as expressed in California Building Code Chapter 11B, 2019 edition
   2. ASTM International (ASTM):
      a. A269/A269M, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
      b. A480/A480M, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Manufacturer's recommendation on fasteners.
   3. Schedule of items being provided for each room. Reference rooms using room number designated on Drawings.
   4. Catalog cut sheet of each item proposed.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original packaging.

B. Store materials in a dry, conditioned location, until ready for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Product numbers scheduled are manufactured by Bobrick.

B. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. American Specialties, Inc.
   2. Bobrick Washroom Equipment, Inc.

3. Bradley.

C. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. Toilet Accessories:
   1. General: ASTM A480/A480M, stainless steel.
   2. Grab bars: ASTM A269/A269M, stainless steel.

B. Anchoring Devices:
   1. Stainless steel.

2.3 FABRICATION

A. Toilet Accessories:
   1. General:
      a. Satin finish.
      b. Items shall meet design requirements of ADA.
   2. Grab bars:
      a. Concealed mounting.
      b. 3 IN DIA flange.
      c. 1-1/2 IN OD.
      d. Peened finish on gripping surface.

B. Anchoring Devices:
   1. Designed to withstand minimum concentrated load of 250 LB applied at any point on grab bar.

PART 3 - EXECUTION

3.1 PREPARATION

3.2 INSTALLATION

A. Install in accordance with manufacturer's instruction and in accordance with ADA.

B. Install in locations indicated on Drawings.

C. Mount all items using manufacturer's recommended anchorage devices for the substrate to which the accessory is to be mounted.

3.3 SCHEDULE

A. See Drawings for locations.

B. Model numbers indicated are Bobrick, unless noted otherwise.
   1. TA-1: NOT USED
   2. TA-2: Toilet Tissue Dispenser (double non-controlled) - B-2740.
   3. TA-3: NOT USED.
   4. TA-4: NOT USED.
   5. TA-5: NOT USED
   6. TA-6: Paper Towel Dispenser - B-262. X2
   7. TA-7: Waste Receptacle - B-279. X2
   8. TA-8: Liquid Soap Dispenser - B-2112.X2
   9. TA-9: Mop and Broom Rack - B-223 x 36 IN. X1
   10. TA-10: NOT USED.
   11. TA-11: NOT USED.
   12. TA-12: Mirror - B-290 x size indicated on Drawings. X2
   13. TA-13: NOT USED.
   14. TA-14: Metal Shelf - B-295 x 24 IN. X2
   15. TA-15: NOT USED.

16. TA-16:.NOT USED.
17. TA-17: NOT USED.
18. TA-18: Grab Bar - B-6806.99 x length indicated on Drawings. X4
19. TA-19: NOT USED.
20. TA-20: NOT USED.
21. TA-21: NOT USED.

END OF SECTION

SECTION 10 44 33
FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Portable fire extinguishers.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 05 50 00 - Metal Fabrications.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Americans with Disabilities Act (ADA):
      a. 2019 California Building Code Chapter 11-B. in lieu of 2010 ADA Standard for Accessible Design.
   2. National Fire Protection Association (NFPA):
      a. 10, Standard for Portable Fire Extinguishers.
   3. Underwriters Laboratories, Inc. (UL):
      a. 8, Water Based Agent Fire Extinguishers.
      b. 154, Carbon Dioxide Fire Extinguishers.
      c. 299, Dry Chemical Fire Extinguishers.
      d. 626, Water Fire Extinguishers.
      e. 711, Rating and Fire Testing of Fire Extinguishers.
      f. 2129, Halocarbon Clean Agent Fire Extinguishers.

1.3 DEFINITIONS

A. Authority Having Jurisdiction (AHJ): Building official, fire chief, fire marshal or other individual having statutory authority.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Ratings and classification of extinguishers.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver and install filled and charged extinguishers just prior to building occupancy.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Fire extinguishers:
      a. Amerex Corporation.
      b. Ansul – Tyco Fire Protection Products.

c. Badger Fire Protection.
d. United Technologies - Kidde.
e. Buckeye Fire Equipment.

2. Fire extinguisher signs:
   a. Seton.
   b. Compliance Signs.
   c. Safety Sign.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MANUFACTURED UNITS

A. Fire Extinguisher (FEXT):
1. Steel bodied, all metal top (head) and valves.
2. Multi-purpose dry chemical extinguisher with hose and nozzle.
3. Provide one listed 10 LB. 4A-60BC extinguisher for each fire extinguisher location (FEXT) indicated on Drawings.
4. Finish: Red with epoxy finish coat.

B. Wall Brackets:
1. Bracket type to fit specified extinguisher.
2. Furnish bracket for each extinguisher not in cabinet.
3. Bracket to be finished in red or black enamel.

C. Fire Extinguisher Signage:
1. Single faced: SETON #21999.
2. Double faced: SETON #22001.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions and NFPA 10.
1. Install units with extinguisher top not over 48 IN above floor.
2. Install wall brackets to concrete or masonry substrate with self-tapping concrete anchors.
   a. See Specification Section 03 15 19.

B. Fire extinguisher locations shown on Drawings are approximate locations.
1. Verify all extinguisher mounting locations with the AHJ.

C. Provide "FIRE EXTINGUISHER" sign for each extinguisher location.
1. Provide single or double faced sign to provide optimum visibility for extinguisher location.

END OF SECTION

DIVISION 12

FURNISHINGS

SECTION 12 21 13
HORIZONTAL ALUMINUM BLINDS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish labor, materials, tools, equipment, and services for Horizontal Aluminum Blinds, as indicated, in accordance with provisions of Contract Documents.

B. Completely coordinate with the window configuration of modular building. See Section 13 34 33.

1.2 QUALITY ASSURANCE

A. Single Source Responsibility:
   1. Provide Horizontal Aluminum Blind units from a single manufacturer for entire project.

B. Installer Qualifications:
   1. Qualified to install specified products by prior experience, demonstrated performance and acceptance of requirements of manufacturer, subsidiary, or licensed agent.
   2. Responsible for an acceptable installation.

C. Flame-resistant materials: Comply with the following:
   1. NFPA 701.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Including mounting details specific to the modular building manufacturer configuration.
   2. Including sill detail showing how the blind suspends above the sill at closed position.

B. Product Data:
   1. Manufacturer's descriptive literature indicating materials, finishes, construction and installation instructions and verifying that product meets requirements specified.

C. Samples:
   1. Manufacturer's Color Selector for Architect selection from entire line of available colors.

D. Contract Closeout Information:
   1. Maintenance Data.
      a. See Section 01 78 23.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Horizontal Aluminum Blinds:
   1. Base:
      a. Hunter Douglas Contract.
   2. Optional:
      a. Levolor Contract.
      b. Bali Window Treatments.

B. Other manufacturers desiring approval comply with Section 01 61 00.

2.2 MATERIALS

A. General:
   1. Nominal 1 IN blind system adjustable blinds with headrail, slats, bottom rail, lift cord, tilter, hardware and installation brackets:

2. Capability of spanning at least 12 FT wide and 12 FT tall.
    a. Design so there is no visible sag after continued use.
3. Provide with tilt function on left, Lift cord on right.
4. Base Product: CE-series by Hunter Douglas Contract.
5. Base Product: CE80 by Hunter Douglas Contract.

B. Slats:
1. Minimum Thickness: 1 IN wide x 0.008 IN thick.
2. Material: Heat-treated and spring tempered aluminum alloy 6011.
3. Eased corners and manufacturing burrs removed.
4. Un-perforated.
5. Maximum Slat Spacing:
    a. Not more than 20mm, nominal 15.2 slats/FT, to tight closure and light control.
6. Finish:
    a. Manufacturer's standard baked-on finish.
    b. Color selected by Architect.

C. Slat Support:
1. Braided ladder tapes of 100 PCT polyester yarn.
2. Assure proper control and adequate overlap of slats.
3. Distance between end ladder and end of slats not over 6 IN.
4. Color: Coordinated with slat.

D. Headrail:
1. U-shaped profile with rolled edges.
2. Material/thickness: Corrosion resistant steel / 0.024 IN thick.
3. Overall size, maximum: 1 x 1-1/2 IN.
4. End caps: 0.030 IN steel end lock with adjustable tab for centering blinds.
5. Internally fit with components required for specified performance and designed for smooth, quiet, trouble-free operation.
6. Headrail Finish: Standard baked-on polyester and matching color of slats.
7. Provide plastic grommets to protect cords and slat supports through bottom of headrail with round edges to prevent wear and discoloration.

E. Bottom Rail:
1. Material: Steel with corrosion-resistant finish formed with double-lock seam into closed oval shape for optimum beam and torsional strength.
2. End Caps: Color-coordinated engineered polymer caps.
    a. Hold down bracket pins molded on end caps.
3. Tape buttons: Color-coordinated engineered polymer tape buttons securing the ladder and cord.
4. Bottom Rail Finish: to be standard baked-on polyester color coordinated to slats.

F. Lifting Mechanism:
1. Low friction.
2. Material: Steel with corrosion-resistant finish.
3. Crash-proof cord locks automatically upon release of cord.
4. Lift cord:
    a. 2-ply polyester cord filler in braided polyester jacket lift cords, cord equalizers, cord lock adapter, and Break-Thru safety tassel.
    b. Provide ring pull with 4 IN cord, where no intermediate locking is specified.
5. Operation:
    a. Slats may be fully raised and lowered.
    b. Blinds may be locked in full-open, full-closed, and any intermediate position.
6. Provide bottom rail hold down brackets.

G. Tilting Mechanism:
1. Permanently lubricated die-cast worm and gear type tilter gear mechanism in fully enclosed housing with clutch action to protect ladder tapes from over rotation of tilt rod.

2. Tilt Rod: Solid steel, corrosion-resistant, 1/4 IN, in cross section; support weight of blind on tilt rod.
3. Tilt Range: Slats may be tilted to any position.

H. Tilt Control Wand:
1. Tubular shaped 7/16 IN diameter, ribbed, extruded clear plastic rod.
2. Detachable without tools.

I. Mounting Hardware:
1. Manufacturer's standard 0.042 IN steel box brackets with baked-on polyester finish to match headrail.
2. Provide additional intermediate support brackets for blinds over 60 IN wide.
3. Maximum spacing for intermediate support brackets: Not to exceed 48 IN OC.
4. Provide specialized bracket types for conditions indicated.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine substrates and conditions under which materials are to be installed.

B. Correct unsatisfactory conditions.

C. Installer to inspect site and verify mounting surfaces are adequate for installation.
1. Verify installation conditions and field measurements.

D. Furnish installation drawings and requirements to other interfacing trades.
1. Include dimensions, assembly and installation methods.

E. Installation constitutes acceptance of responsibility for performance.

3.2 INSTALLATION

A. Install blinds in accordance with manufacturer's instructions and reviewed shop drawings.

B. Provide adequate clearance to enable unencumbered operation of shade and hardware.

C. Position units plumb and true.

D. Anchor securely in place with proper clips, brackets and bolts for mounting.

E. Isolate metal parts from concrete and mortar to prevent galvanic action.

3.3 CLEANING

A. Clean installed items of dirt and finger marks.

B. Leave work area clean and free of debris.

3.4 DEMONSTRATION

A. Demonstrate operation method and instruct owner's personnel in the proper operation and maintenance of the blinds.

3.5 SCHEDULE

A. Install Horizontal Louver Blinds on all exterior windows in scale houses except for pass through window.

END OF SECTION

DIVISION 13

SPECIAL CONSTRUCTION

SECTION 13 34 19
METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Complete metal building system including but not limited to:
      a. Design.
      b. Materials.
      c. Fabrication.
      d. Shipment.
      e. Erection.
      f. Components as specified.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 03 15 19 - Anchorage to Concrete.
   4. Section 07 92 00 - Joint Sealants.
   5. Section 09 96 00 - High Performance Industrial Coatings.

C. Buildings listed below are included in the metal building system contractor scope. Locations for buildings on-site can be found on civil drawings.
   1. Main Transfer Station Building.
   2. Fire Riser/Mechanical/Electrical/Restroom Building.
   3. Scale House Canopies.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Architectural Manufacturers Association (AAMA):
      a. 621, Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates.
   2. ASTM International (ASTM):
      a. A36/A36M, Standard Specification for Carbon Structural Steel.
      b. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
      c. A563, Standard Specification for Carbon and Alloy Steel Nuts.
      d. A792/A792M, Standard Specification for Steel Sheet, 55 PCT Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
      e. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
      f. C653, Standard Guide for Determination of the Thermal Resistance of Low-Density Blanket-Type Mineral Fiber Insulation.
      g. C665, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
      h. C991, Standard Specification for Flexible Fibrous Glass Insulation for Metal Buildings.
      i. C1136, Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
      j. D2244, Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.
      k. D4214, Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films.

l. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
m. E96/E96M, Standard Test Methods for Water Vapor Transmission of Materials.
n. E1592, Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
o. F436, Standard Specification for Hardened Steel Washers.
p. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
q. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
r. F3125, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

3. American Welding Society (AWS):
   a. D1.1/D1.1M, Structural Welding Code - Steel.
   b. D1.3/D1.3M, Structural Welding Code - Sheet Steel.
4. FM Global (FM).
   a. FMRC Standard 4471, Approval Standard for Class 1 Roofs for Hail Damage Resistance, Combustibility, and Wind Uplift Resistance.
5. International Accreditation Service (IAS):
   a. AC472, Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems.
6. Metal Building Manufacturer's Association (MBMA):
   a. Low Rise Building Systems Manual.
7. Research Council on Structural Connections (RCSC):
   a. Specification for Structural Joints Using High-Strength Bolts.
8. The Society for Protective Coatings/NACE International (SSPC/NACE).
   a. SP 6/NACE No. 3, Commercial Blast Cleaning.
9. Underwriters Laboratories, Inc. (UL):
   a. Building Materials Directory.

B. Qualifications:
1. Manufacturer's qualifications:
   a. Manufacturer must be member in good standing of the MBMA.
   b. Manufacturer must be currently approved by IAS Accreditation Committed under the Inspection Programs for Manufacturers of Metal Buildings Systems IAS AC472 to assure compliance with fabrication Special Inspections as required by the building code.
2. Erector qualifications:
   a. Erector (installer) must be approved in writing by metal building manufacturer.
   b. Erector must have minimum of 10 years current experience in erection of similar structures.
3. Manufacturer's Structural Engineer: Registered in the State where project is located.

1.3 DEFINITIONS

A. Code: The word "code" refers to the building code.

B. Installer, Erector or Applicator:
1. Installer, erector or applicator is the person actually installing, erecting or applying the product in the field at the Project site.
2. Installer, erector and applicator are synonymous.

C. PVDF: Polyvinylidene fluoride.
1. Nomenclature as listed in Bibliography of the MBMA Low Rise Building Systems Manual.

1.4 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

2. Product technical data including:
    a. Acknowledgement that products submitted meet requirements of standards referenced.
    b. Manufacturer's technical reference manual containing all of the manufacturer's standard construction details and specifications.
        1) Manufacturer's erection manual containing all details and methods for installation of building frame, roof system, wall system, and accessories.
        2) Edit to mark out items not used for this installation.
3. Design and fabrication drawings:
    a. Erection drawings minimum scale: 1/8 IN = 1 FT-0 IN.
    b. Details and sections minimum scale: 1-1/2 IN = 1 FT-0 IN.
    c. List of all design loads and combination of loads.
    d. Size and location of each component of the building.
        1) Include clearance under structural framing members, both horizontal and vertical.
        2) Include cross-section of components.
    e. Fasteners and details of fasteners connecting each component of the building.
    f. Size, location and details of anchor bolts, base plates, and all other components fastened to the foundation.
        1) Size anchor bolts and base plates assuming 3000 PSI concrete.
    g. Details of wall panels, roof panels, finishes, flashings, closures, closure strips, trim, gutters, downspouts, sealant, and all other miscellaneous components.

B. Samples:
1. Metal color and finish samples of roof and wall panels, roof trim, wall trim, and interior liner panel colors for Engineer's selection.
2. Color chart is not acceptable.

C. Contract Closeout Information:
1. Operation and Maintenance Data:
    a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

D. Informational Submittals:
1. Manufacturer's and Erector's Qualifications.
2. Manufacturer's approval of erector.
3. Manufacturer's Certificate of Accreditation per IAS AC472.
4. Structural calculations stamped and signed by a professional Structural Engineer licensed in the State where Project is located.
    a. Include list of design loads and loads transmitted to foundation through columns or walls and location where loads occur.
    b. Submit calculations for information only.
5. Certificate of compliance by fabricator that steel was fabricated in accordance with the approved construction documents.

1.5 WARRANTY

A. Manufacturer's standard warranty.

B. Manufacturer's standard warranty for factory applied PVDF coating system against blistering, chipping, cracking, peeling, or color fading of wall and roof panels.

C. Metal building system manufacturer shall provide a written weathertightness warranty for a maximum of 25 years against leaks in roof panels, arising out of or caused by ordinary wear and tear under normal weather and atmospheric conditions.
1. Warranty shall be signed by both the metal roof system manufacturer and the metal roof system installer.
2. Maximum liability of warranty shall be no less than $0.70/SQFT of roof area.

D. Metal building system manufacturer shall provide a written warranty for 20 years against perforation of metal roof and wall panels due to corrosion under normal weather and atmospheric conditions.

1. Warranty shall be signed by metal roof system manufacturer.
2. Acrylic Coated Galvalume: Product will not rupture, fail structurally, or perforate within period of 20 years due to normal atmospheric corrosion.

E. Metal building system manufacturer shall provide a paint film written warranty for 25 years against cracking, peeling, chalking, and fading of exterior coating on painted roof and wall panels.
1. Warranty shall be signed by metal building system or roof system manufacturer and state that the coating contains 70 PCT "Kynar 500 IN or "Hynar 5000 IN resin.
2. Failure of adhesion, peeling, checking, or cracking for 25 years.
3. Color fading in excess of 5 Hunter units per ASTM D2244 for 25 years.
4. Chalking in excess of No. 8 rating per ASTM D4214 for 25 years.

F. Provide written notice of any exceptions taken to warranties.
1. Any exceptions may be grounds for not accepting the manufacturer, at the discretion of the Owner or Engineer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Metal building systems:
   a. Butler Manufacturing.
   b. NCI Building Systems.
   c. Nucor Building Systems.
   d. Star Building Systems.
2. Insulation:
   a. Fiberglass batt or blanket:
      1) Certainteed.
      2) Johns Mansville.
      3) Owens-Corning Fiberglass Corp.
      4) United States Gypsum Company (USG).
   b. Rigid extruded polystyrene board:
      1) Dow Building Solutions.
      2) Owens Corning.
      3) VC Industries.
      4) Johns Mansville.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 SYSTEM DESCRIPTION

A. Tipping floor of the building shall be non-insulated type with vertical walls and gable type roof.
1. Provide partial height wall liner panels and no ceiling liner panel.
2. Provide cross bracing in the side walls perpendicular to the rigid frame.
3. Buildings with flush girts must have cast-in-place anchor bolts, due to minimum edge distance requirements for alternate anchor types.

B. Mechanical Wing of the building shall be insulated type with vertical walls and flat type roof.
1. Finish as shown in the drawings.
2. Provide cross bracing within walls. Do not put bracing outside of the plane of the wall.
3. Buildings with flush girts must have cast-in-place anchor bolts, due to minimum edge distance requirements for alternate anchor types

C. End-Wall Framing: Manufacturer's standard, for buildings not required to be expandable, consisting of load-bearing end-wall and corner columns and rafters.

D. End-Wall Framing: Engineer end walls to be expandable. Provide primary frame, capable of supporting full-bay design loads, and end-wall columns.

2.3 BUILDING DESIGN CRITERIA

A. Critical Dimensions:
   1. Building Size:
      a. As indicated on the Drawings.
   2. Roof slope:
      a. As indicated on the Drawings.
   3. Horizontal Plan Dimensions:
      a. Measure to interior face of girts / outside face of rigid frame.
   4. Eave Height:
      a. Measure from top of finished floor to intersection of insides of roof and sidewall sheets.
   5. Clear height between finished floor and bottom of roof steel: indicated on the drawings.

B. Building Foundation:
   1. All footings, foundations, anchor bolts and piers have been designed based on assumed loadings and reactions.
      a. Member sizes and geometry may vary depending on the building being supplied.
      b. Do not construct these members until Engineer has verified design with approved Shop Drawings of metal building being supplied.
      c. Design all column base plates as pinned connections. Fixed base plates are not permitted.
   2. Building dimension changes in either horizontal or vertical direction resulting in either 5 PCT change of envelope volume or lighting height or spacing shall be addressed by incorporating any necessary changes to mechanical or electrical systems or any other building component impacted, at no additional cost to Owner.
      a. Design changes must be approved by Engineer prior to constructing changed item or system.
      b. Does not apply to structural member sizes.
   3. Contractor is responsible for incorporating any necessary changes to foundations, mechanical, or electrical systems or to any other building component.
      a. Design changes must be approved by Engineer prior to constructing changed item or system.
   4. Itemize modifications in a separate attachment to the bid form and include all modifications in the bid price.
   5. Completed building to be free of excessive noise from wind induced vibrations under ordinary weather conditions to be encountered at location of erection, and meet all specified design requirements listed below.

C. Lateral Seismic Resisting System
   1. As indicated on sheet 00S001.

D. Roof Live Loads:
   1. Roof panels:
      a. Per building code.
      b. 20 PSF uniformly distributed live load.
      c. 300 LB concentrated (point) live load (over a 1 x 1 FT area) located at center of maximum roofing (panel) span.
      d. The most severe condition governs.
   2. Roof framing members:
      a. Per building code.
   3. The above loads are in addition to other applicable equipment loads and shall be applied to the horizontal projection of the roof.

E. Snow Loads:
   1. Design structure for snow loading as set forth in the building code.
      a. Project site conditions are as follows:

1) Basic ground snow: 40 PSF.
2) Importance factor: 1.0.
3) Snow exposure coefficient: 0.9.

2. Design roof panels, secondary support members and primary framing where appropriate for a snow load drifting accumulation as specified in the building code.

F. Wind Loads:
1. Design structure for wind loading as set forth in the building code.
a. Project site conditions are as follows:
1) Basic wind speed: 94 MPH.
2) Site exposure: Class C.
3) Enclosure type: Enclosed/Partially open, the most stringent one.

G. Seismic (Earthquake) Loads:
1. Design structure for seismic forces as set forth in the building code.
a. Project site conditions are as follows:
1) Importance factor: 1.00.
2) Spectral response acceleration (Ss): 0.522.
3) Spectral response acceleration (S1): 0.23.
4) Site class: C.
5) Spectral response coefficient (Sds): 0.45.
6) Spectral response coefficient (Sd1): 0.23.
7) Seismic design category: D.

H. Auxiliary Loads:
1. Consider other superimposed loads as part of the design requirements and combine with the normal design (dead, live, seismic and wind) loads as prescribed hereafter and on drawings.
a. Static loads:
1) 100 PSF for stairs and landings.
2. Contractor to coordinate and verify magnitude and location of auxiliary loads before fabrication.

I. Combination of Loads:
1. The combining of dead, live, wind, seismic and auxiliary loads for design purposes as set forth in the building code, unless otherwise specified.
2. Horizontal sway deflection of building due to combination of required design loads:
a. 3 IN.
3. Deflection of purlins and secondary members not to exceed L/180 of its span when supporting applicable vertical live, dead, and auxiliary loads.
4. Wind beams supporting masonry walls: Do not deflect more than L/240 of its span when resisting applicable loads.
5. Lintel beams supporting brick/masonry: Do not deflect more than the lesser of L/600 of span or 0.3 IN.

2.4 MATERIALS

A. Steel:
1. Structural Shapes and Plate:
a. All W-shapes and WT-shapes: ASTM A992/A992M.
b. All other plates, bars and rolled shapes: ASTM A36/A36M.
c. Unless noted otherwise on Drawings.
2. Miscellaneous Metals:
a. Insulation support: Structural Steel Grade 50 per ASTM C653.

B. Bolts, Nuts and Washers, High Strength:
1. Bolts: ASTM F3125, Grade A325.
2. Nuts: ASTM A563.
3. Washers (hardened): ASTM F436.
4. Galvanized, ASTM A153/A153M.

5. Provide two washers with all bolts.

C. Bolts and Nuts:
   1. ASTM A307, Grade A.
   2. Galvanized, ASTM A153/A153M.

D. Anchor Bolts:
   1. ASTM A307, ASTM A36/A36M, galvanized steel.
   2. Embedment details to be developed by Engineer upon receipt of anchor bolt and loading information for approved Shop Drawings from building manufacturer.

E. Fasteners:
   1. Roof and wall panels: 300 series stainless steel, ASTM F593.
   2. Miscellaneous fasteners: Corrosion resistant.

F. Any structural member to be hot-dipped galvanized shall be minimum 12 GA thickness.

G. Roof and Fascia Panels:
   1. General:
      a. Galvalume per ASTM A792/A792M.
         1) Painted surfaces: AZ50.
         2) Unpainted surfaces: AZ55.
      b. Apply clear acrylic film for additional protection.
         1) Apply to both sides of panels.
   2. Wall Panels:
      a. General:
      b. Galvalume per ASTM A792/A792M.
         1) Painted surfaces: AZ50.
         2) Unpainted surfaces: AZ55.
      c. Apply clear acrylic film for additional protection.
         1) Apply to both sides of panels.
   3. Wall and Roof Liner Panels and Soffit Panels:
      a. Galvalume: ASTM A792/A792M, Grade 50B.

H. Perimeter Trim, Panel Closures, Flashing and Counterflashing:
   1. Same material and factory applied finish to match roof and wall panels.

I. Insulation:
   1. Blanket or Batt:
      a. Glass or other inorganic fibers and resinous binders formed into flexible blankets or semi-rigid sheets.
         1) Unfaced: ASTM C665, Type I.
         2) Nonreflective membrane: ASTM C665, Type II.
         3) Reflective membrane: ASTM C665, Type III.
   2. Rigid Foam Board:
      a. Extruded polystyrene, ASTM C578, Type X.

J. Vapor Retarder: ASTM C665.

K. Translucent Panels: ASTM D3841, Grade 1 (weather resistant).

L. Gutters and Downspouts:
   1. Same material and factory applied finish to match roof panels.

M. Grout: See Division 03.

N. Closures: Neoprene.

O. Calking and Sealants:
   1. See Specification Section 07 92 00.

2.5 FABRICATION

A. General:
   1. Fabricate building structure, roof and wall panels, accessories and trim in accordance with requirements of AISC and MBMA.
   2. Provide all necessary clips, flashing angles, caps, channels, closures, bases and any other miscellaneous trim required for complete water and airtight installation.
      a. Provide an inside closure at the base of all corrugated panels and an outside closure at the top of all corrugated panels in addition to all other closure strips required.
         1) Form closure strips to fit the corrugation of the metal panels and securely support in place.
         2) Closure strips shall fit between corrugated panels and trim or flashing as required to completely separate the interior of the building from the exterior.
      b. Provide flashing at all intersections of wall panels and roof panels, and above all openings in wall and roof panels, in addition to all other flashing required.
         1) Form flashing:
         2) To completely contain water on the outside of the building.
            a) To be watertight and securely fastened in place.
      c. Provide sealant at all edges where metal panel trim or flashing is adjacent to the foundation of the building in addition to all other sealant required.
   3. At door and window and louver openings, provide additional framing and fasteners as required to structurally replace the wall panel and/or framing displaced.
   4. Fabricate and prepare material for shipment knocked down.
   5. Factory punch frame to receive all fasteners.
   6. Finishes:
      a. Clean ferrous surfaces of oil, grease, loose rust, loose mill scale, and other foreign substances.
         1) Clean all primary and secondary structural steel members, not noted as being galvanized, in accordance with SSPC SP 6/NACE No. 3.
      b. All structural components shall have primer paint coats applied in the shop and finish coats applied in the shop.
         1) Shop paint, prime and finish coats, all surfaces which will be inaccessible after erection.
         2) Paint in accordance with Specification Section 09 96 00.
         3) Paint surfaces of all components not exposed to view.
         4) Manufacturer's standard shop applied primer is not acceptable as substitute for primer specified.
      c. Wall and roof panels:
         1) Exterior surface:
            a) Thermosetting fluoropolymer resin enamel.
               (1) Minimum 70 PCT "KYNAR" resin.
            b) Meet requirements of AAMA 621.
            c) FM Class 1 rated.
            d) Exposed screw heads shall match color of panel.
         2) Interior surface:
            a) Galvalume with no additional coating.

B. Structural Steel Design:
   1. Structural Mill Sections or Welded-up Plate Sections: Design in accordance with AISC Specification for Structural Steel Buildings.
   2. Cold-Formed Steel Structural Members: Design in accordance with AISI North American Specification for the Design of Cold-Formed Steel Structural Members.
   3. Structural System: Design in accordance with specified building code (Refer to Design Loads and Building Codes).

C. Primary Framing:
   1. Painted Steel.

2. Rigid Frames:
    a. Frames: Welded-up plate section columns and roof beams, complete with necessary splice plates for bolted field assembly.
    b. Base Plates, Cap Plates, Compression Splice Plates, and Stiffener Plates: Factory welded into place and connection holes factory fabricated.
    c. Columns and Roof Beams: Fabricated complete with holes in webs and flanges for attachment of secondary structural members and bracing.
    d. Bolts for Field Assembly of Frame Members: High-strength bolts.
3. Endwall Structural Members:
    a. Cold-formed channel members designed in accordance with AISI North American Specification for the Design of Cold-Formed Steel Structural Members or welded-up plate sections designed in accordance with AISC Specification for Structural Steel Buildings.
    b. Endwall corner posts, endwall roof beams, and endwall posts as required by design criteria.
    c. Splice Plates and Base Clips: Shop fabricated complete with bolt connection holes.
    d. Base Plates, Cap Plates, Compression Splice Plates, and Stiffener Plates: Factory welded into place and connection holes shop fabricated.
    e. Beams and Posts: Factory fabricated complete with holes for attachment of secondary structural members.
4. Intermediate Frames:
    a. Substituted for end-wall roof beams, when specified.
    b. Factory fabricate necessary endwall posts and holes for connection to intermediate frame used in endwall.

D. Secondary Structural Members:
1. Wall Purlins (Girts):
    a. By-passing column purlins.
2. Purlins:
    a. Purlins:
        1) Zee-shaped, precision-roll-formed, acrylic-coated G30 galvanized steel in different gauges to meet specified loading conditions.
        2) Zee sections to be design by manufacturer.
    b. Eave Members:
        1) Eave Struts:
            a) Cee-shapped precision-roll-formed, acrylic-coated G30 galvanized steel in different gauges to meet specified loading conditions.
            b) Factory punched cee sections to be design by manufacturer.
        2) Girts:
            a) Zee or Cee shaped, precision-roll-formed, acrylic-coated G30 galvanized steel in different gauges to meet specified loading conditions.
            b) Zee or cee sections to be design by manufacturer.
        3) Outer Flange of Girts: Factory-punched holes for panel connections.
    c. Bracing:
        1) Locate bracing as indicated on the Drawings.
        2) Diagonal Bracing:
            a) Hot-rolled rods of sizes sections to be design by manufacturer.
            b) Attach to columns and roof beams.
            c) Optional fixed-base wind posts or pinned-base portal frames may be substituted for wall rod bracing on buildings as required.
        3) Flange Braces and Purlin Braces: Cold formed and installed as indicated on the Drawings.

E. Welding:
1. Welding Procedures, Operator Qualifications, and Welding Quality Standards:
    a. AWS D1.1.
    b. AWS D1.3.

2. Welding inspection, other than visual inspection as defined by AWS D1.1, paragraph 6.9, shall be identified and negotiated before bidding.
3. Certification of Welder Qualification: Supply when requested.

F. Framed Openings:
1. Walls:
a. Provide all necessary subframing, including connections, to support wall openings for doors, windows, louvers, pipe or duct penetrations, etc.
1) Material gage to be determined by metal building manufacturer for size of opening.
b. Size and location of opening as shown on the Drawings.
c. Jamb, lintel and girts:
1) Steel:
a) Factory applied prime coat per Section 09 96 00.
2) Metal building manufacturer responsible for providing correct size opening for penetration scheduled, shown or specified.
d. Provide trim to cover all exposed areas of opening frames to matchwith the wall panels.
2. Roofs:
a. Provide all necessary roof subframing to support roof mounted equipment and to frame roof penetrations.
1) Material gage to be determined by metal building manufacturer for size of equipment or opening.
b. Location of roof mounted equipment and/or roof or wall opening as shown on the Drawings.
c. Purlins, angles, clips:
1) Steel:
a) Factory applied prime coat per Section 09 96 00.
2) Metal building manufacturer responsible for providing correct size of opening for penetration scheduled, shown or specified.

G. Painting of Structural Steel Framing System:
1. General:
a. Structural Steel: Prime paint as temporary protection against ordinary atmospheric conditions.
b. Perform subsequent finish painting, if required, in field as specified in the painting section.
c. Before painting, clean steel of loose rust, loose mill scale, dirt, and other foreign materials.
2. Primary Frames:
a. Clean steel in accordance with SSPC SP 2.
b. Factory cover steel with 1 coat of gray water-reducible alkyd primer paint formulated to equal or exceed performance requirements SSPC-Paint 15.
c. Minimum Coating Thickness: 1.0 MIL.
3. Secondary Structural Members – Roll-Formed:
a. Hot-dipped zinc coating, ASTM A653, G30; followed by 1 coat of clear acrylic finish.
b. Acrylic-Coated G30 Galvanized Steel: Equal or exceed performance requirements of SSPC Paint-15.

2.6 ROOF PANEL SYSTEM

A. Metal Roof Panel System 3 (Bulterib II):
1. Design Performance:
a. Design roof panels to support a 200 LB load distributed evenly over a 2 FT square area centered between purlins, without exceeding a panel deflection-to-span ratio of 1/180 IN a 2-span condition.
b. See “Roof System Performance Requirements” section below for additional requirements.
2. Materials:
a. Steel.

b. Thickness: 24 Gauge.
c. Finish: Factory applied color coating.
1) PVDF Coating.

3. Factory roll-formed panel.
4. Standing seam interlocking rib configuration.
5. Machined seaming.
6. Use panels of maximum possible lengths to minimize end laps.
7. Extend eave panels beyond structural line of sidewalls.
8. Factory punch panels at panel end to match factory-punched holes in eave structural member.
9. Panel End Splices: Factory punched and factory notched.
10. Panel End Laps: Locate directly over, but not fastened to, a supporting secondary roof structural member and be staggered, to avoid 4-panel lap-splice condition.
11. End Laps: Floating. Allows roof panels to expand and contract with roof panel temperature changes.
12. Self-Drilling Fasteners: Not permitted.
13. Fasteners per manufactures standard recommendations.
14. Ridge Assembly:
    a. One-piece, factory formed to match roof slope.
    b. Ridge Panel Cross Section: Match roof panels.
    c. Ridge Panel Splices: Occur over first purlin on either side of building center.
    d. Design ridge assembly to allow roof panels to move lengthwise with expansion and contraction as roof panel temperature changes.
    e. Factory punch parts for correct field assembly.
    f. Install panel closures and interior reinforcing straps to seal panel ends at ridge.
    g. Do not expose attachment fasteners on weather side.
    h. Use lock seam plug to seal lock seam portion of panel.
    i. High-Tensile Steel Ridge Cover: Span from panel closure to panel closure and flex as roof system expands and contracts.
15. Provision for Expansion and Contraction:
    a. Provision for Thermal Expansion Movement of Roof Panels:
        1) Provide for thermal expansion and contraction without detrimental effects on roof panels, with plus or minus 100 DEGF temperature difference between interior structural framework of building and of roof panels.
        2) Slotted Holes: Permit thermal movement of panels without detrimental effect on roof panels.
16. Roof panels based on: Butler Manufacturing.
    a. Profile: Butlerib II.
    b. Panel width: 36 IN minimum.
    c. Panel depth: 2 IN minimum.
    d. Panel corrugations:
        1) Majors: Four per panel at12 IN on centers, 1-1/2 IN high x 2-7/8 IN wide tapering, nominal.
        2) Minors (in flat portion): Two per panel flat zone, 1 IN wide, 1/8 IN high, spaced 4 IN OC, between major corrugations.
    e. Panel length:
        1) Sufficient to cover entire length of any unbroken roof slope up to 40 FT.
        2) When cut panels are required provide a 20 FT minimum panel length.
        3) Provide 6 IN end laps at each panel.
    f. Panel Side Laps:
        1) Overlap one major corrugation.
        2) One of the Outboard Corrugations: Formed as overlapping corrugation.
        3) Other Outboard Corrugation:
            a) Formed as underneath corrugation.
            b) Full corrugation to provide bearing support to side lap.
            c) Formed with continuous-length sealant groove.

17. Color:
    a. To be selected from manufacturer's full range of primary and secondary colors.
18. Accessories:
    a. Provide all necessary trim accessories to provide a weathertight building.

B. Roof System Performance Requirements:
1. Design roof paneling system for a minimum roof slope of 1/2 IN in 12 IN.
    a. Refer to Drawing for project required roof slope.
2. Design roof paneling system to support design live, snow, and wind loads
3. Endwall Trim and Roof Transition Flashings: Allow roof panels to move relative to wall panels and/or parapets as roof expands and contracts with temperature changes.
4. UL Wind Uplift Classification Rating, UL 580: Class 90.
5. Structural Performance Under Uniform Static Air Pressure Difference: Test roof system in accordance with ASTM E1592.

C. Provision for Expansion and Contraction:
1. Clips with movable tab.
2. Stainless Steel Tabs: Factory centered on roof clip when installed to ensure full movement in either direction.
3. Maximum Force of 8 LBS: Required to initiate tab movement.
4. Each clip to accommodate a minimum of 1-1/4 IN movement in either direction.
5. Provide for thermal expansion and contraction without detrimental effects on roof panels, with plus or minus 100 DEGF temperature difference between interior structural framework of building and of roof panels.

D. Thermal Blocking:
1. Insulate purlins to eliminate "thermal short circuits" between purlins and roof panels.
2. Minimize heat loss (thermal short circuit) caused by compression of blanket insulation between structural members and roof panels by use of thermal block at each purlin location.

2.7 METAL WALL AND FASCIA PANELS SYSTEM

A. Metal Wall and Fascia Panels:
1. Material:
    a. Steel.
    b. Thickness: 24 Gauge.
    c. Finish: Factory applied color coating.
        1) PVDF Coating.
        2) Smooth finish.
2. Length sufficient to cover entire height of any unbroken wall up to 40 FT.
3. Roll-form panels with alternating box corrugations.
4. Interlocking panels
5. Provide thermal blocking at connection to purlins or structural system.
6. Concealed fasteners.
7. Wall panels based on: Butler Manufacturing.
8. Profile: eStylwall II – Fluted, 4 IN wide flutes.
9. Panel width: 16 IN nominal.
10. Panel depth: 2 IN nominal.
11. Color:
    a. To be selected from manufacturers full range of primary and secondary colors.
12. Accessories:
    a. Provide all necessary trim accessories to provide a weathertight building.

B. Metal Wall and Fascia Panels:
    a. Steel.
    b. Thickness: 24 Gauge.
    c. Finish: Factory applied color coating.
        1) PVDF Coating.
        2) Smooth finish.

2. Length sufficient to cover entire height of any unbroken wall up to 40 FT.
3. Roll-form panels with alternating box corrugations.
4. Interlocking panels
5. Provide thermal blocking at connection to purlins or structural system.
6. Exposed fasteners.
7. Wall panels based on: Butler Manufacturing.
8. Profile: eStylwall II – Fluted, 4 IN wide flutes.
9. Panel width: 16 IN nominal.
10. Panel depth: 2 IN nominal.
11. Color:
    a. To be selected from manufacturer's full range of primary and secondary colors.
12. Accessories:
    a. Provide all necessary trim accessories to provide a weathertight building.

2.8 FINISHES

A. PVDF Finish:
1. Substrate Preparation:
    a. G90 Hot-Dipped Galvanized Steel or AZ50 Galvalume.
        1) Factory-controlled chemical-conversion treatment.
2. Clean ferrous surfaces of oil, grease, loose rust, loose mill scale, and other foreign substances.
    a. Clean all primary and secondary structural steel members, not noted as being galvanized, in accordance with SSPC SP 6/NACE No. 3.
3. All structural components shall have primer paint coats applied in the shop and finish coats applied in the shop.
    a. Shop paint, prime and finish coats, all surfaces which will be inaccessible after erection.
    b. Paint in accordance with Section 09 96 00.
    c. Paint surfaces of all components not exposed to view.
    d. Manufacturer's standard shop applied primer is not acceptable as substitute for primer specified.
4. Paint with exterior finish system, full-strength, fluoropolymer (PVDF) coating.
5. Exterior Panel surface (exposed side):
    a. Minimum 70 PCT "Kynar 500 IN or "Hynar 5000 IN resin.
    b. Meet requirements of AAMA 621.
    c. FM Class 1 rated.
    d. Exposed screw heads shall match color of panel.
6. Interior surface (unexposed side):
    a. Manufacturer's standard shop applied polyester coating.

B. Panel and Accessories Finishes:
1. PVDF Coating Warranty: Metal building system manufacturer shall warrant coating for 25 years for the following.
    a. Not to peel, crack, or chip.
    b. Chalking: Not to exceed ASTM D 4214, #8 rating.
    c. Fading: Not more than five color-difference units, ASTM D2244.
2. Meet requirements of AAMA 621.

C. Provide this finish system for the following products but not limited too:
1. Contact the Engineer for finishes not identified clearly or covered.
2. Roof panels and accessories.
3. Wall panels and accessories.
4. Liner panels and accessories.
5. Gable and Eave Trim and accessories.
6. Flashing and accessories.
7. Soffit panels and accessories.
8. Gutters, downspouts and accessories.

2.9 BUILDING INSULATION SYSTEMS

A. General Batt Insulation:
   1. Provide wall insulation for complete building envelope with factory laminated fabric liner.
   2. Formaldehyde free insulation.
   3. Provide standard roll widths best suited for the project.
   4. Glass or other inorganic fibers and resinous binders formed into flexible blankets or semi-rigid sheets with vinyl or aluminum foil vapor retarder.
   5. Unfaced Fiberglass Insulation:
      a. For use in walls and roofs.
      b. Comply with NAIMA 202-96-REV 2000.
      c. Flame Spread Index less than 25 when tested in accordance with ASTM E84, NFPA 255 and UL 723.
      d. Smoke Developed Index less than 50 when tested in accordance with ASTM E84, NFPA 255 and UL 723.
      e. Contain a minimum of 60 PCT recycled glass content.
      f. GREENGUARD Indoor Air Quality Certified®.
      g. GREENGUARD Gold Certified.
      h. Wall Insulation:
         1) Nominal Thickness:
            a) 6 IN (R-19).

      i. Basis of Design: Owens Corning Eco Touch Certified R Metal Building Insulation or equal.

B. Fabric Liner Facing / Vapor Retarder:
   1. For wall and roof application.
   2. Adhered to batt insulation.
   3. Fabric liner facing/vapor retarder composed of woven high-density polyethylene coated on both sides with polyethylene.
   4. Facing material of vinyl film and metalized substrate laminated to glass fiber scrim reinforcement (VRP) rolled out over top of liner panels.
   5. Polypropylene Film Thickness: 0.0015 IN.
   6. Metallized Polyester Film Thickness: 0.0005 IN.
   7. Bursting Strength: 100 PSI per ASTM D774.
   8. Tensile Strength: 35 LBS/IN width per ASTM C1136.
   9. Perm Rating: Less than 0.02 per ASTM E 96 Procedure A.
   10. Flame Spread Index: Less than 25 per ASTM E84.
   11. Smoke Developed Index: Less than 50 per ASTM E84.
   12. Light Reflectance: 85 PCT per ASTM C523 for White and Silver.
   13. Light Reflectance: not applicable for Black.
   14. Color:
      a. White.
      b. Black.
      c. Silver.
   15. Liner Panel, Sidelaps, and Endlaps: Seal with sealant to prevent vapor transmission between sheets.
   16. Foam Closure: Use at terminating ends of liner panels to seal corrugations of panels.
   17. Basis of Design: Lamtec Corp, WMP-VR-R Plus or equal.
   18. Basis of Design: Lamtec Corp, R-3035 HD or equal.

C. Insulation Support Systems:
   1. Contractor Option for either Metal Banding or Fabric Web system unless noted otherwise.
   2. Metal Banding System:
      a. Coated steel.
      b. 1 IN wide.
      c. Exposed color to match vapor retarder.

d. Basis of Design: Owens Corning, Optiliner.

3. Fabric Web System:
   a. 1,000 denier polyester yarn interwoven on nominal 1/2 IN-square grid coated with fire-retardant, UV-stabilized, PVC-based binder.
   b. Polypropylene tape bindings on all edges.
   c. Furnish in building bay lengths by building widths.
   d. Physical Properties:
      1) Tensile Strength (pounds/yarn):
         a) Machine Direction: 15 LBS.
         b) Cross Direction: 15 LBS.
      2) Ends per Inch:
         a) Machine Direction: 2.5.
         b) Cross Direction: 2.0.
      3) Weight: 0.28 to 0.32 OZ/SQFT.
      4) Fasteners and Attachment Hardware:
         a) Connections to Eave Members: Steel strapping and self-drilling screws.
         b) Mesh-to-Insulation Support System Edge Connections: Plastic cable ties.
      5) UL Fire-Hazard Classification Ratings, UL 723:
         a) Flame Spread: 15.
         b) Smoke Developed: 400.
   e. Basis of Design: Butler Manufacturing, Sky-web I.

D. Rigid Polyisocyanurate Board Insulation:
   1. ASTM C1289, Type 1, Class II.
   2. CFC and HCFC free.
   3. Ozone depletion potential: 0.
   4. Compressive strength: ASTM D1621, 25 PSI minimum.
   5. Density: 2 PCF nominal.
   6. Vapor transmission: 0.03 perm-IN maximum.
   7. Water absorption: 0.3 PCT maximum.
   8. Thermal conductivity (k-Value at 75 DEGF): 0.14.
   9. Reflective foil facer both sides.
   10. Minimum thickness as noted on Drawings.
   11. Provide insulation designed for intended use.
   12. Fire resistance: ASTM E84.
      a. Flame spread: Less than 25.
      b. Smoke developed: Less than 450.
      c. R-value: 6.0 per IN
      d. Minimum values provided on Drawings.

2.10 ACCESSORIES

A. Interior Wall Liner Panel:
   1. Thickness: 26 gauge.
   2. Factory cut panels to lengths required.
   3. Factory finished.
   4. Height:
      a. Partial Height: 12’-0”.
   5. Color:
      a. To be selected from manufacturer’s full range of primary and secondary colors.
   6. Liner panels based on: Butler Manufacturing.
   7. Profile: Mod-36 - Corrugations at 3 IN on center.
   8. Panel width: 36 IN nominal.
   9. Panel depth: 1/2 IN to 1 IN nominal.
   10. Color:

a. To be selected from manufacturer's full range of primary and secondary colors.
11. Liner panels based on: Butler Manufacturing.
12. Profile: Mod-36 - Corrugations at 3 IN on center.
13. Panel width: 36 IN nominal.
14. Panel depth: 1/2 IN to 1 IN nominal.

B. Soffit Panel:
1. Steel.
2. Thickness: 26 gauge.
3. .Interlocking panel system.
4. Factory cut panels to lengths required.
5. Factory finished.
6. Color:
a. To be selected from manufacturer's full range of primary and secondary colors.
7. Soffit panels based on: Butler Manufacturing.
8. Profile: Moduleze II, no corrugations.
9. Panel width: 12 IN nominal.
10. Panel depth: 1 IN nominal.

C. Overhead Doors: See Division 08.

D. Metal Pedestrian Doors and Frames:
1. See Specification Section 08 11 00.

E. Louvers:
1. See Specification Section 08 90 00.

F. Gutters and Downspouts:
1. Sizes (minimum):
a. Gutters: 4 x 4 IN.
b. Downspouts: 3 x 5IN.
c. Profiles:
1) Profiles based on SMACNA Architectural Sheet Metal Manual.
2) Gutters: Style A.
3) Downspouts: Figure 1-32F (closed) and Figure 1-32H (open at bottom for 24 IN).
2. Material
a. 24 GA steel.
3. Finish:
a. Corrosion protection treatment and final finish same as roof panels.
b. Color shall match wall and roof panels.
1) Metal building manufacturer shall provide colored stock material to gutter and downspout suppler as necessary for color matching requirement.
c. Color:
1) Downspouts: Match siding color.
2) Gutters: Match roofing color.
4. Expansion joints: 150 FT maximum spacing but not less than 1 per side of building requiring gutters.
5. Locate/arrange downspouts to avoid drainage on sidewalks, landings, stoops, driveways, etc.
6. Provide standard precast concrete splash block at each downspout location with the approximate size of 30 IN x 12 IN x 4 IN (L x W x H).

G. Heating, Ventilation and Air Conditioning Equipment:
1. Refer to the mechanical drawings for HVAC requirements for each building.

H. Roof Curbs for Mechanical Penetrations:
1. Minimum 18 GA steel galvanized per ASTM A653/A653M.
2. Insulated: Minimum 1-1/2 IN 3.0 PCF density rigid insulation.
3. Integral cricket.

4. Minimum 8 IN high.
5. Fabricated to conform to roof pitch and profile specified.
6. ThyCurb Model TC-3, M.B.D.N.

I. Roof Crickets:
1. Provide roof crickets on all roof curbs to direct water to each side of the curb.
2. Roof cricket material shall be same material as roof panels.

J. Snow Retention Systems:
1. Provided by the Metal Building System manufacturer.
   a. To be covered by the warranty provided by the Metal Building System manufacturer.
2. Mechanical non-penetrating system for sloped metal roof systems to prevent ice and snow from sliding off roof.
3. Components:
   a. Clamps (non-penetrating attachment):
      1) 6061-T6 aluminum extrusions conforming to ASTM B221.
      2) Fasteners: 300 Series stainless steel.
   b. Cross Members:
      1) 6061-T6 aluminum extrusions conforming to ASTM B221.
      2) Receptacle in face to receive color-matched metal strips.
      3) Provide splice connectors ensuring alignment and structural continuity at end joints.
   c. Color Strips:
      1) Same material and finish as roof panels; obtained from roof panel manufacturer.
   d. Snow and Ice Clips:
      1) Aluminum, with rubber foot, minimum 3 IN wide.
      2) Height as required for roof profile.
   e. Finish:
      1) Mill.
4. Performance Requirements:
   a. Provide snow guards to withstand exposure to the weather and environmental elements, and resist design forces without failure due to defective manufacture.
   b. Utilize a factor of safety greater than 2 to determine allowable loads from ultimate tested clamp tensile load values.
5. Installation:
   a. Provide clamps or brackets at 32 IN maximum spacing.
   b. Install snow guards starting 2 FT from the eave edge of the roof and extending uniformly upward and laterally over the entire roof area spaced at not more than 16 IN OC in each direction.
   c. Fasten to roof surface as recommended by manufacturer.
      1) Fasteners shall be compatible with roof panel system and shall not void any roof warranties.
      2) Fasteners shall not damage panel finish.
6. Refer to Drawings for roof areas to receive snow guards.
7. Basis of Design: S-5! Metal Roof Innovations; Colorgard series or equal.

K. Roof Penetration Flashing (Maximum 13 IN DIA):
1. Flashing material: EPDM rubber with an aluminum sealing ring base.
2. Minimum projection above the weather surface of the roof: 8 IN.
3. Configuration of the flanges to match the roof panel.

L. Specification Section for manufacturer's internal quality control requirements.

M. Testing:
1. Owner may employ and pay for the services of a qualified independent testing agency to inspect and test all structural steel work for compliance with Contract Documents.
2. Independent testing agency shall have a minimum of five (5) years performing similar work and shall be subject to Owner's approval.

2.11 MAINTENANCE MATERIALS

A. Provide 8 OZ of touch up paint for each color provided on the building.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
   1. Install tolerances in accordance with AISC 303, Code of Standard Practice.
      a. Install products straight without bowing, sagging, or warping.
   2. Install all fasteners.
   3. Install base plates on grout bed.
      a. Grout bed to be 1 IN thick unless noted otherwise on the Drawings.

3.2 INSTALLATION – METAL ROOF SYSTEM

A. Metal Roof System Installation:
   1. Install roof system in accordance with metal building system manufacturer’s instructions at locations indicated on the Drawings.
   2. Install roof system weathertight.
   3. Position panel clips by matching hole in clip with factory-punched holes in secondary structural members.
   4. Position and properly align panels by matching factory-punched holes in panel end with factory-punched holes in eave structural member and by aligning panel with panel clip.
   5. Field seam panel side laps by self-propelled and portable electrical lock-seaming machine.
      a. Machine field forms the final 180 DEG of a 360-degree Pittsburgh double-lock standing seam.
      b. Factory apply side lap sealant.
   6. Panel End Laps: Minimum of 6 IN, sealed with sealant (weather sealing compound), and fastened together by clamping plates.
      a. Sealants: Contain hard nylon beads, which prevent mastic from flowing out due to clamping actions.
      b. Join panel laps by 2-piece clamped connection consisting of a bottom reinforcing plate and a top panel strap.
      c. Locate panel end laps directly over, but not fastened to, supporting secondary roof structural member and stagger, to avoid 4-panel lap-splice condition.

B. Metal Roof System Installation:
   1. Install roof system in accordance with metal building system manufacturer’s instructions at locations indicated on the Drawings.
   2. Install roof system weathertight.
   3. Attach roof panels to supporting structural members with seamed-in-clip device.
      a. Install clip at panel major corrugation.
   4. Design roof panel side laps to be interlocking seams with return leg on lower edge of female rib.
      a. Factory apply side lap sealant.
   5. Roof Panel End Laps:
      a. Minimum of 6 IN.
      b. Seal with field-applied sealant.
      c. Swage 1 panel end to ensure nestible, watertight end laps.
      d. Install backing plate directly over, but not fastened to, structural support members.
      e. Self-Drilling Fasteners: Do not use to make panel end splices.

C. Metal Roof System Installation:.
   1. Install roof system in accordance with metal building system manufacturer’s instructions at locations indicated on the Drawings.
   2. Install roof system weathertight.

3. Factory cut-to-length roof panels in accordance with erection drawings furnished by metal building system manufacturer.
4. Position and align roof panels to hold 3 FT module throughout building length.
    a. Position and align optional factory-punched roof panels by matching factory-punched holes in panels with factory-punched holes in roof structural members.
5. Install side laps with minimum of 1 full corrugation.
6. End Laps:
    a. Minimum of 6 IN.
    b. Fasten together over and to structural members.
7. Panel Side and End Laps: Seal with "Panlastic" sealant to prevent entry of capillary moisture.

3.3 INSTALLATION – METAL WALL SYSTEM

A. Metal Wall System Installation:
1. Install wall system in accordance with metal building system manufacturer's instructions at locations indicated on the Drawings.
2. Install wall system weathertight.
3. Verify structural system is plumb before wall panels are attached.
4. Seal wall panels with molded-foam closure block that fits panel configuration at top and bottom of wall panels.
5. Exterior Trim: Match exterior color and embossing of wall panel system.
6. Interior Trim: Painted.
7. Flashings, Trim, Closures, and Similar Items: Install as indicated on erection drawings furnished by metal building system manufacturer.

B. Metal Wall System Installation:
1. Install wall system in accordance with metal building system manufacturer's instructions at locations indicated on the Drawings.
2. Install wall system weathertight.
3. Verify structural system is plumb before wall panels are attached.
4. Align and attach wall panels in accordance with erection drawings furnished by metal building system manufacturer.
5. Install side laps with minimum of one full corrugation.
6. Seal wall panels at base with metal trim.
7. Windows: Factory paint aluminum extrusions (thermally broken).
8. Flashings, Trim, Closures, and Similar Items: Install as indicated on erection drawings furnished by metal building system manufacturer.

3.4 INSTALLATION – OTHER ITEMS

A. Separate the roof support member from the roof panel, except at each concealed structural fastener, with a spacer of material having a density of not less than 2 PCF and, if of a combustible material, having a flame spread rating no greater than 25.

B. Fasten roof panels to purlins or secondary support members in accordance with manufacturer's recommendations.

C. Install liner panels in accordance with manufacturer's recommendations.
1. Completely seal air tight around all building structural members and bracing when these members penetrate the liner panel.

D. Insulation Support System Installation:
1. Install insulation support system in accordance with metal building system manufacturer's instructions at locations indicated on the Drawings.
2. Verify roof structural system is in place before installation of insulation support system.
3. Keep insulation support system in place after metal roof system is installed.

E. Install wall panels to supporting structure with concealed fasteners.
1. Finish of fasteners to match panel finish.

F. Install door frames, louvers, trim and other miscellaneous items in accordance with manufacturer's instructions and details.

3.5 FIELD QUALITY CONTROL

A. All inspections and tests are to be performed at the Project site by a third party independent testing agency.

B. Inspect field welding in accordance with AWS D1.1/D1.1M, Section 6 including the following non-destructive testing:
   1. Visually inspect all welds.
   2. Test 50 PCT of full penetration welds and 10 PCT of fillet welds with liquid dye penetrant.
   3. Test 20 PCT of full penetration welds with ultrasonic or radiographic testing.

C. Inspect high-strength bolting in accordance with the RCSC Specification for Structural Joints, Section 9.
   1. Inspect while work is in progress.

D. Inspect structural steel which has been erected.

E. Prepare and submit test reports to Engineer.

3.6 ADJUSTING AND CLEANING

A. See Specification Section 01 75 00 for Adjusting requirements.

B. See Specification Section 01 74 00 for Cleaning requirements.

C. Touch up paint any scratched factory finished surfaces or remove and replace as directed by Engineer.

D. Remove and replace any damaged wall or roof panels, frames, etc., as directed by Engineer.

END OF SECTION

SECTION 13 34 33
MODULAR SHELTERS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish labor, materials, tools, equipment, and services for Modular Shelters, as indicated, in accordance with provisions of Contract Documents.

B. This section applies to the fire pump house, and the two scale houses.

C. Completely coordinate with work of other trades.

D. Buildings listed below are included in the modular shelters contractor scope. Locations for buildings on-site can be found on civil drawings.
   1. Outbound Scale House
   2. Inbound Scale House
   3. Fire Pump Building.

1.2 SUBMITTALS

A. Shop Drawings:
   1. Provide anchorage details.

B. Product Data:
   1. Manufacturers product literature representing specified products and systems.

C. Samples:
   1. 4 IN square samples of wall material, one of each color.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Modular Shelters:
   1. Base:
      a. Porta-King Building Systems.
   2. Optional:
      a. Handi-hut, Inc.
      b. Portafab Modular Building Systems.
      c. Allied Modular Building Systems.

B. Other manufacturers desiring approval comply with Section 01 61 00.

2.2 MATERIALS

A. Enclosed Shelter:
   1. Modular units, fabricated of Durasteel insulated wall and ceiling panels with steel tube support structure.
      a. ASTM A500 Grade B welded steel tubing.
   2. Insulation - Class II fire retardant with flame spread under 75 when tested in accord with ASTM-E84.
   3. Exterior finish: Smooth, electrostatically painted.
   4. Interior finish: Smooth, electrostatically painted.
   5. Color as selected by Architect from manufacturer's standard finishes.
   6. Window Types:
      a. Heavy duty aluminum sliding.
      b. Fixed Aluminum.
   7. Glazing:

a. 3/16 IN thick clear tempered safety glass.
b. Set in molded neoprene gasket with integral locking strip.

8. Mounting hardware: Provide steel or aluminum square tubes encapsulated into each unit.
   a. Provide cadmium plated steel mounting brackets and bolts.
9. Roof System:
   a. Manufacturer's standard Durasteel flat insulated roofing system with EDPM membrane roofing.
10. Flooring:
    a. 1-1/2 IN solid insulating floor structure with aluminum treadplate finished floor.
11. Seating/counters:
    a. See Section 06 41 00 and drawings for casework at scale house.

12. Electrical:
    a. Lighting: 110V fluorescent fixtures, length and diameter as required.
    b. Duplex outlets: 2 minimum, 110volt, 15 amp.
    c. Single outlet:1- 220 volt, 20 amp.
    d. Provide ballast, light baffle and interior grade plastic coated wiring run through conduit in wall.
13. Heating, Ventilation and Air Conditioning:
    a. Refer to the mechanical plan sheets for HVAC requirements for each modular building.
14. Doors: Provide swinging doors where indicated.
    a. Provide hardware required for complete installation.
    b. Provide door with cylinder locking device keyed to building system. Cylinder furnished by Section 08 70 00.
15. Telephone/data mounts: Provide where indicated.
16. Refuse receptacle: Provide where indicated.

B. Open Shelter:
1. Modular units, fabricated of durable steel tube support structure.
   a. ASTM A500 Grade B welded steel tubing.
2. Insulation - Class II fire retardant with flame spread under 75 when tested in accordance with ASTM-E84.
3. Exterior finish: Smooth, electrostatically painted.
4. Interior finish: Smooth, electrostatically painted.
5. Color as selected by Architect from manufacturer's standard finishes.
6. Window Types:
   a. See window schedule in drawings.
   b. Provide hollow metal frames or manufacturer equivalent.
7. Glazing:
   a. 3/16 IN thick clear tempered safety glass.
   b. Set in molded neoprene gasket with integral locking strip.
8. Mounting hardware: Provide steel or aluminum square tubes encapsulated into each unit.
   a. Provide cadmium plated steel mounting brackets and bolts.
9. Roof System:
   a. Manufacturer's standard Durasteel flat insulated roofing system with EDPM membrane roofing.
10. Seating/counters:
    a. Provide seating bench constructed of steel or aluminum to match shelter construction.
    b. Bolt to reinforced rib section of wall unit.
11. Lighting:
    a. 110V fluorescent fixtures, length as required.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify suitability of site to accept installation.

B. Installation signifies responsibility for performance.

3.2 INSTALLATION

A. Install in accordance with manufacturer's recommendations.

B. Complete mechanical and electrical connections as indicated.

C. Prior to occupancy, adjust mechanical, electrical and hardware for proper operation.

END OF SECTION

DIVISION 21

FIRE SUPPRESSION

SECTION 21 05 00
FIRE PROTECTION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Sprinkler systems (single-interlocked pre-action system with a Nitrogen generating system).
2. Fire pump system.
3. Fire protection piping.

B. Related Specification Sections include but are not necessarily limited to:
1. Division 00 - Procurement and Contracting Requirements.
2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
1. American Society of Mechanical Engineers (ASME).
   a. B31.1, Power Piping.
2. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
3. National Fire Protection Association (NFPA):
   a. 10, Portable Fire Extinguishers
   b. 13, Standard for the Installation of Sprinkler Systems.
   c. 20, Standard for the Installation of Stationary Pumps for Fire Protection.
   d. 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances.
   e. 70, National Electrical Code (NEC).
   f. 72, National Fire Alarm and Signaling Code .
4. Underwriters Laboratories, Inc. (UL):
   a. 508, Standard for Industrial Control Equipment.
5. Building code:
   a. California Building Code and associated standards, referred to herein as Building Code .
6. Fire Code:
   a. California Fire Code and associated standards, referred to herein as Fire Code.

B. Qualifications:
1. Use subcontractors with prior, demonstrable experience with fire protection systems.
2. Fire protection system to be designed by a Professional Engineer, registered in the State of California.
   a. Drawings to include certification, signature, and registration number of the Professional Engineer.
3. Installers: Use workmen skilled in this trade.

C. Design, furnish and install complete fire protection systems as indicated and as required by local authorities.
1. Where there is conflict between local authority requirements or other standards agency requirements and these Drawings and Specifications, requirements of standards agencies of local authorities shall govern.
2. Design and install entire system in accordance with indicated codes, standards, and regulations.

1.3 SYSTEM DESCRIPTION

A. Design Requirements:

1. Design fire sprinkler and water supply systems.
    a. Confirm high and low level requirements for the fire water retention pond. Elevations noted on the plans are diagrammatic in nature. Setting levels shall be confirmed on site and approved by the Owner and A/E prior to construction of the wet well.
    b. A 48-inch wet well shall serve a vertical turbine fire pump. A 20-inch transfer pipe installed at a minimum slope of a ¼-inch per foot shall be installed from the fire water retention pond to the wet well.
    c. Coordinate the vertical turbine fire pump enclosure placement with the location of the wet well.
    d. Designs shall include a minimum safety allowance of 10 PSIG below the fire pump supply curve.

B. Completely coordinate work of this Specification Section with all other work in order to provide a complete and workable system acceptable to fire authorities and in accordance with the Contract Documents.

1.4 SUBMITTALS

A. Shop Drawings:
1. Submit complete layout drawings of sprinkler systems, premanufactured fire pump system enclosure, alarm, and signal devices. See Specifications 21 30 00.
2. Submit wiring diagrams of control, alarm, and signal devices.
3. Indicate hazard classification of all sprinkled spaces on Shop Drawings.
4. Submit complete hydraulic and/or pipe schedule (as applicable), sizing and design calculations for all portions of the sprinkler system.
5. Submit catalog data and specifications for all manufactured components supplied as part of the fire protection system.
6. Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70. Include any required calculations per Section 01 61 03.

B. Certifications:
1. Certification that all plans and calculations, including sprinkler flow calculations have been approved by all agencies with jurisdiction.
2. Certification that all required post installation tests and inspections have been completed and approved by all agencies with jurisdiction.
3. Fire pump certified test performance curves including:
    a. Brake horsepower versus capacity in gpm.
    b. Total head in feet versus capacity in gpm.
    c. Efficiency in percent versus capacity in gpm.

C. Contract Closeout Information:
1. Operation and Maintenance Data:
    a. See Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

D. Recommended Spare Parts:
1. Spare parts inventory with individual cost.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Fire department valves:
    a. Elkhart.
    b. Potter-Roemer.
    c. Seco.
    d. Grinnell.

e. Croker-Standard.

2. Fire department connections:
   a. Elkhart.
   b. Potter-Roemer.
   c. Seco.
   d. Croker-Standard.
3. Alarm and signal devices:
   a. Notifier
   b. Autocall.
   c. Automatic Fire-Trol.
   d. Gem.
   e. Viking.
4. Sprinkler heads:
   a. Grinnell.
   b. Viking.
5. Fire pump system and enclosure:
   a. See Specifications 21 30 00.
6. Pipe hangers:
   a. Star Sprinkler Corp.
   b. Anvil.
   c. Erico.
7. Nitrogen generator system:
   a. Potter.
   b. General Air.
   c. Engineered Corrosion Solutions.

B. Submit request for substitution in accordance with Section 01 33 00.

2.2 MATERIALS

A. Use only new, unused material, designed and guaranteed to perform service required and approved by NFPA.

B. Pipe and Fittings:
   1. Optional pipe materials and joining methods approved by NFPA 13 are allowed if in accordance with applicable agency approval requirements.
   2. Fire sprinkler piping below ground: in accordance with Section 40 05 00.

2.3 MANUFACTURED UNITS

A. Pipe Hangers:
   1. All purpose type, UL listed and FM approved.
   2. Space in accord with requirements of NFPA.
   3. Hangers, hanger rods, inserts and clamps constructed as approved by NFPA.

B. Valves and Hose Connections:
   1. General:
      a. UL and FM approved.
      b. Minimum: 175 PSI class.
      c. Outlet/inlet threads to fit local fire department standards.
   2. Fire department valves (FDV): 2-1/2 IN fire department valve with 300 LB cast brass body, cap and chain; rough brass finish.
   3. Indicator post: Two-piece indicator post for non-rising stem gate valve, target plate OPEN and SHUT, 5 IN sleeve.
   4. Automatic ball drip valve:
      a. Straight or angle cast brass ball drip, 1/2 IN.
      b. Mount on siamese side of check valves and fire pump test header OS&Y valve.
      c. Potter-Roemer 148 or 181.
   5. Outside valve boxes:

a. Three-piece cast iron, extension type, 5-1/4 IN shaft, 5-1/4 IN drop lid, screw or slip type.
b. Screw type lid: Tyler 6860 with No.6 bell base.
c. Slip type lid: Tyler 6865 with No.8 bell base.
d. Mark lids with "Water" cast in metal.

6. Single Interlock Preaction valve:
   a. 175 LB UL listed, FM approved iron body, cast bronze clapper, clamp ring, valve seat.
   b. Valve seat Teflon coated.
   c. Neoprene diaphragm and seat rubber.
   d. Stainless steel seat rubber retaining ring.
   e. Include drip check, drain cup, check valve, drain valve, priming valve, priming check valve, priming strainer, restricted orifice, flow test valve, emergency release, pressure operated relief valve, strainer in relief line, magnetic release control and main control valve.

C. Sprinkler Heads:
1. General:
   a. Provide heads of type required for service indicated.
   b. High-temperature 286 DEGF rating except when noted otherwise.
   c. In no case use heads rated less than 50 DEGF higher than anticipated ambient temperature.
   d. All sprinklers UL listed.
   e. Head application:
      1) Rooms without ceilings: Type 1.
      2) Finished rooms: Type 2 except as indicated.
      3) Sprinkler head Type 1:
         a) Upright or pendent design as required.
         b) Standard bronze finish.
      4) Sprinkler head Type 2:
         a) Pendent design.
         b) Satin chrome finish with escutcheon plate.

D. Alarm and Signal Devices:
1. Water-flow detector:
   a. Vane type flow switch with retard mechanism or manual adjustment to prevent false alarm.
   b. 175 PSI rated.
   c. 115 VAC/30 VDC rated for pilot duty only.
   d. Suitable for working pressure of 150 PSI with sensitivity adjusting screw.
   e. Provide with contacts for remote signal wiring.
2. Water motor alarm:
   a. 175 LB UL listed, FM approved iron body mechanical alarm device with 8 IN DIA gong, 5 IN water motor.
   b. Drive shaft length compatible with wall thickness encountered.
   c. Red hood finish with nameplate.
   d. For use with alarm valve systems.
3. Valve tamper switch:
   a. 115 VAC/30 VDC.
   b. Switches for butterfly valves to be UL approved.
4. Pressure gauges:
   a. 3-1/2 IN dial, phosphor bronze tube, brass socket, 300 PSI range.
   b. Ametek P1590.

E. Fire Department Connections - Outside type:
1. FDC to supply the sprinkler system:
   a. Size: 4 x 2-1/2 x 2-1/2 IN unless otherwise indicated.
   b. Finish: Rough brass.

c. Lettering for sprinkler system FDC: AUTO. SPKR.
d. Flush wall connections: Double-clapper, 2-way body, plugs and chain, lettering; Potter-Roemer 5020.
e. Separate wall plate designating special service:
1) Polished brass, anchored to wall.
2) Provide where indicated.
3) Potter-Roemer 5970.

2.4 PERFORMANCE AND DESIGN REQUIREMENTS

A. Sprinkler Systems:
1. Provide sprinkler system types as designated on the Drawings.
1) Wet Pipe:Black Schedule 40 pipe.
2. Pre-action (single interlocked) fire protection sprinkler systems:
1) Galvanized Schedule 40 pipe throughout the Tipping Floor and Tunnel.
a) Grooved fittings and couplings shall be painted.
b) Threaded fittings shall be galvanized.
b. Description: Automatic system shall employ closed sprinklers attached to a piping system filled with pressurized air / nitrogen and connected to a preaction / deluge valve that is opened only by the actuation of the linear or spot-type heat detection monitored by the dedicated function RSFACU and installed in same areas as sprinklers.
1) Normal operation:
a) Actuation of linear heat detection sends signal to the RSFACU and releases preaction / deluge valve, allowing water to flow into the sprinkler piping network.
b) Water flow through preaction / deluge valve sends signal to the RSFACU, and sounds local waterflow alarm.
c) Actuation of sprinklers allows water to flow through the open sprinkler heads.
2) Failure operation:
a) Failure of linear heat detection sends a signal to the RSFACU, and readies deluge valve for opening upon release of air pressure in the piping.
b) Failure of sprinkler relieves supervised air pressure in piping, sending a signal to the RSFACU. Preaction / deluge valve does not open.
c. Preaction / Deluge valve actuation / release:
1) Electric, initiated upon activation of linear or spot-type heat detection.
d. Air source:
1) Provide a dedicated nitrogen generation system with air maintenance device
e. Load out area tunnel:
1) Coverage: Minimum discharge density of 0.25 GPM/SQFT over the hydraulically most remote 3000 SQFT, while allowing 500 GPM for hose streams for a minimum duration of 90 minutes.
2) Sprinkler heads: 286 DEGF ordinary temperature rated.
3) Sprinkler head spacing: 100 SQFT maximum per head.
4) Sprinklers in the tunnel shall be ENT corrosion resistant and installed such that they are protected from damage via impact from vehicles and/or debris that may not be fully contained within the transfer truck
f. Tipping floor, fire pump room:
1) Coverage: Minimum discharge density of 0.25GPM/SQFT over the hydraulically most remote 3000 SQFT, while allowing 500 GPM for hose streams for a minimum duration of 90 minutes.
2) Sprinkler heads: 286 DEGF high temperature rated. ENT corrosion resistant.
3) Sprinkler head spacing: 100 SQFT maximum per head.
g. Business area:
1) Coverage: Minimum discharge density of 0.10 GPM/SQFT over the hydraulically most remote 1500 SQFT, while allowing 100 GPM for hose streams for a minimum duration of 30 minutes.
2) Sprinkler heads: 165 DEGF ordinary temperature rated.

3) Sprinkler head spacing: 225 SQFT maximum per head.

h. Provide separate branch flow detector switch and alarm for each area.

B. Fire Pump:

1. Pump rated head and capacity: As required by hydraulic calculations for most hydraulically demanding portion of sprinkler system.
2. Provide pump rated to deliver not less than 150 PCT of rated capacity at 65 PCT of rated head with maximum head not to exceed 120 PCT of rated head.
3. The pressure maintenance or jockey pump should be arranged to stop at the lowest normal shutoff pressure plus the minimum static supply pressure.
4. The jockey pump should be arranged to start at a pressure of 10 PSI below its stop pressure.
5. The fire pump should be arranged to start at a pressure of 5 PSI below the jockey pump start point.
6. A run timer should not be provided with the fire pump.
   a. The fire pump should be arranged for manual stop only.
   b. This will help to prevent against "cycling" of the pump during a fire situation and possible failure of the pump to restart.
7. The maximum pressure used in the design of the sprinkler systems (supplied by the fire pump) should be pump rated pressure at the flange.
8. The fire department shall have the capability to access the fire pump / riser room.

C. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes. See Section 01 61 03 for information on how to determine the available fault current, such that, the SCCR rating meets or exceeds the available fault current.

D. Nitrogen Generating System (serving preaction systems)

1. General:
   a. Provide all required equipment, materials, labor, and services needed to install a dedicated nitrogen generation system. Nitrogen generation system shall be capable of delivering a minimum of 98 percent nitrogen composition throughout all of the system piping within 14 days from the commencement of the inerting process.
   b. The complete nitrogen generation system shall be self-contained and skid mounted with “drop-in” operability with a simple one step direct connection of the nitrogen gas supply line to each zone.
   c. The nitrogen generator system shall comply with the NFPA 13 requirement to have the compressor capacity capable of restoring normal gas pressure in the system within 30 minutes.
2. A self-contained, factor-assembled generator unit with:
   a. UL Listed oil-less compressor.
   b. UL Listed refrigerated dryer.
   c. Leak detection system.
   d. Purge vent assembly.
   e. Particle and coalescing filters.
   f. Nitrogen membrane separator.
   g. Nitrogen receiver.
   h. Manual bypass valves.
   i. Digital compressor runtime monitor.
   j. Visual indicators for normal and bypass modes.
   k. Single-point connection for 460 VAC three phase power, 4.6 amps, 2 HP.
   l. Leveling feet.
   m. Single drain connection point for all required drains.
3. Air maintenance device:
   a. The preaction sprinkler riser shall be equipped with an air maintenance device to properly regulate the nitrogen and air pressure to suit the valve installed in the riser. The device shall be equipped with an adjustable regulator and adjusted at system commissioning to the pressure required by the preaction / deluge valve. The device

shall also be equipped with bypass valving for fast-fill in 30 minutes or less as required by NFPA 13.

4. Purge vent assemblies:
   a. The sprinkler system piping shall be equipped with at least one purge vent assembly. At least one (1) purge vent assembly shall be provided per sprinkler system riser. The purge vent assembly shall be equipped with a manually-operated isolation ball valve, strainer, float valve that closes when sprinkler water reaches the device, fixed restriction orifice, and nitrogen purity analyzer port. The purge vent assembly shall permit purging of the sprinkler system piping per manufacturer recommendations, and monitoring of the nitrogen purity within the piping. Locate purge vent assembly at the highest possible point of fire sprinkler zone or per the manufacturer's recommendations
5. Nitrogen analyzer:
   a. The system shall be supplied with a hand-held portable battery-operated nitrogen purity analyzer. The analyzer shall have a digital display, showing the nitrogen purity in percent (measurement range 0 to 99.9 percent) with a 0.1 percent resolution. Flexible tubing shall connect the body of the analyzer to a female quick-connect fitting, compatible with the male quick-connect fittings located in the nitrogen generator cabinet and each purge vent assembly. Proper performance of the nitrogen generation system shall be established with readings taken with the analyzer.
6. Steel pipe or approved tubing to connect the self-contained unit to the sprinkler system. Consult manufacturer for recommended piping sizing.
7. All manufacturer installation guidelines shall be followed.

2.5 SOURCE QUALITY CONTROL

A. Fire Pump:
   1. Hydrostatically test fire pump to twice working pressure but not less than 250 PSI.
   2. Conduct complete running tests to determine pump performance characteristics including:
      a. Brake horsepower versus capacity in GPM.
      b. Total head in feet versus capacity in GPM.
      c. Efficiency in percent versus capacity in GPM.

2.6 MAINTENANCE MATERIALS

A. Sprinkler System:
   1. Provide spare sprinkler heads in types and quantities required by NFPA 13.
      a. Include sprinkler wrench and cabinet.
   2. Spare heat detectors for pre-action system quantity: Two (2).

PART 3 - EXECUTION

3.1 PREPARATION

A. Cooperate with other trades to insure adequate space for equipment and piping placement.

B. Review plans, Specifications and Shop Drawings of other trades to coordinate work.

C. Do not begin installation until all Agency approvals are submitted to Engineer.

D. Impairments of the existing fire pump during construction shall be in accordance with NFPA 25 and local AHJ requirements. The Owner and Contractor shall coordinate the impairment plan with the Fire Marshal.

3.2 INSTALLATION

A. General:
   1. Install in strict accord with approved Shop Drawings.
   2. Install all piping, valves, and connections from mains to building fire protection systems.

B. Piping, Valves and Accessories:
   1. Install sprinkler piping within first 6 IN of space under floor construction.

a. Where conditions of construction require piping installation at a lower elevation, route piping to avoid interference with work of other trades.
b. Offset, crossover and otherwise route piping to install system in available space.
1) All offsets not shown.
c. Pitch all branch lines, cross mains, feed mains and risers to drainage points.
d. Provide globe or ball drain valves at all low points.

2. Provide Indicating Butterfly valve and flow switch within sprinkler system at each of following locations:
a. Each zone takeoff within sprinkler piping system.
b. Base of all sprinkler risers.
3. Install monitor switch on each OS&Y or butterfly valve within fire protection piping system, including valve assembly at fire pump or sprinkler control sprinkler zone, and/or isolation valves and post indicator valve.
4. Provide automatic ball drip valves at outside fire department connections between hose connection and check and/or shutoff valve.
5. Flush outside fire water mains prior to connecting to inside system.
6. Provide valve boxes at each outside (underground) valve.
7. Grout base of fire pump for proper alignment.
8. Route drain line from fire pump base and bearing brackets to the wet well.
9. Install indicator posts approximately 3 FT above grade. Where subject to potential impact by vehicles or equipment, protective bollards shall be installed.
10. Install system pressure switches controlling fire pump operation downstream of alarm and check stations.
11. Provide corrosion resistant materials in accordance with NFPA 13

C. Sprinkler:
1. Install in accordance with approved Shop Drawings.
a. Modifications made to system design or arrangement after approval of drawings by local authority may only be made after receiving written approval of authority and Engineer.
b. Such modifications do not include minor relocations in piping or head placement.
c. Make all revisions in accord with NFPA 13.
d. All fire sprinklers on the Tipping Floor and Tunnel shall be corrosion resistant.
2. Install approved dirt legs and drain valves at low points of all piping to permit complete drainage of system without disconnection of any piping.
a. Drain valves at base of risers to have 1-1/2 IN hose adapters matching threads of hose systems in the building.
3. Extend 2 IN main drain(s) and 1 IN inspector's test connections on ends of sprinkler branches to nearest floor drain or janitor's sink.
4. Provide chrome plated escutcheon plates at pipe penetrations of ceilings, floors and walls.

D. Electrical Wiring:
1. Electrical Contractor (Division 26) responsible for providing:
a. 3 Phase power wiring to fire pump.
b. 3 Phase (as required) power wiring to jockey pump.
c. Supervised wiring from pump controller for remote alarm communication to be located in a continually supervised area.
2. Work under this section shall include:
a. Fire pump controller control wiring.
b. Jockey pump control wiring.
c. Pre-action system fire detection, alarm and supervisory wiring.

3.3 INSTALLATION OF HANGERS AND SUPPORTS

A. Support pipe by means of simple rod hangers from above or structural cross members from below.

B. Hanger spacing and seismic supports shall be installed in accordance with NFPA 13 and local AHJ requirements.

C. All hanger details, sketches, takeoffs, etc., shall be the responsibility of the Contractor.
   1. Hangers shall be selected by hanger manufacturer and shall meet the requirement of ASME B31.1, Paragraph 121 "Design of Pipe Supporting Elements."

D. Hanger assemblies shall include hanger, washers, nuts, bolts, turnbuckles, rods, beam clamps, and all other items necessary to make a complete assembly.

3.4 FIELD QUALITY CONTROL

A. Test fire pump under hydrostatic pressure to twice the working pressure but not less than 250 PSI.
   1. Conduct complete running test and prepare characteristic curves from test results.
   2. Perform all operating and pressure tests in presence of local authority and Owner's representative.

B. Test sprinkler, including outside supplies, under hydrostatic pressure to 200 PSI for 2 HR period.
   1. Prove system tight to satisfaction of Engineer.
   2. Inside piping to show no leakage.
   3. Leakage in underground piping in accordance with NFPA 24.

C. Test complete alarm system including control and signal circuits wired by Electrical Contractor.
   1. Complete testing prior to acceptance by Owner.

D. Provide services of factory trained engineer to supervise installation of sprinkler systems, conduct final field pump acceptance tests, and instruct Owner's personnel.

E. Give advance notice and arrange for field tests and inspections by local authority, including paying for inspection fees and securing permits for same.

F. Each hydraulically calculated system should be identified by a permanent placard attached to the base of the riser indicating the design characteristics of the system.
   1. Information on the placard should include the design density, area and the flow pressure required at the base of the riser.

END OF SECTION

SECTION 21 30 00
FIRE PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. This section requires a pre-packaged fire pump system and building enclosure that is fully assembled at the factory and delivered to the site as a single unit. It will be above a 48-inch wet well supplied from the adjacent fire water retention pond. The building shall be designed to provide a water tight enclosure for the fire pump and ancillary equipment. The enclosure shall be designed for wind and seismic conditions found in Nevada County, California. The building shall be mounted to the slab as designed by the manufacturer. The fire pump will be diesel driven with a rated capacity of 1250 gpm at 128 psi at the discharge flange. The packaged system shall include, but not be limited to, the following to provide a complete and tested system:

1. Complete fire pump house with lights, thermostat controlled ventilation and access doors.
2. Approved Fire Pump.
3. Approved Fire Pump Controller.
4. Jockey Pump.
5. Approved Jockey Pump Controller.
6. Pressure sensing lines per NFPA 20.
7. All control valves required by NFPA 20.
8. Tamper switches on all valves.
9. Main system flow switch.
10. Required pressure gages.
11. Automatic casing air release valve.
12. Hose header with valves, caps and chains.
13. Lighting.
14. All electrical components pre-wired at the factory.
15. Dual batteries with racks and chargers.
16. Approved double wall fuel tank with low fuel level and leak detection alarms with minimum 2 HR supply.
17. Muffler.
18. Flexible exhaust connector.
19. Engine shall be closed circuit, heat exchanger.
20. Acceptance testing.
21. Main system pressure relief valve.
22. Drains discharging to safe location outside of building.
23. All building penetrations for fire protection piping and utilities for the building.

B. All piping shall be installed to prevent freezing. Piping from the fire pump house to the fire riser room will be installed below grade.

C. The pump house requires sprinklers in accordance with NFPA 13 and NFPA 20. The sprinkler system shall be provided with a valve with tamper switch and flow switch.

D. Except as modified in this Section or on the Drawings, install fire pumps in conformance with NFPA 20, NFPA 70, and NFPA 72, including all recommendations and advisory portions, which shall be considered mandatory; this includes advisory provisions listed in the appendices of such standards, as though the word "shall" had been substituted for the word "should" wherever it appears. In the event of a conflict between specific provisions of this Specification and applicable NFPA standards, this Specification governs. Devices and equipment for fire protection service shall be Underwriters Laboratories (UL) Fire Prot Dir listed or FM APP GUIDE approved. Interpret all reference to the Authority Having Jurisdiction (AHJ).

1.2 SEQUENCING

A. Fire Pump:
   1. Fire pump shall automatically operate upon sensing the system pressure drop as caused by the operation of the fire protection system or manually when the starter is operated. Pump shall continue to run until shut down manually.

B. Pressure Maintenance Pump:
   1. Pressure maintenance pump shall automatically operate to maintain system pressure without cycling the Fire Pump.

1.3 SYSTEM DESCRIPTION

A. General:
   1. Provide a complete packaged fire pump system and building enclosure as described in the Contract Documents and according to criteria of the AHJ (AHJ) and all applicable national and local codes such as NFPA, Building Code, Owner's insurance carrier, etc. Tigerflow or approved equal.
      a. Where discrepancies exist among the AHJ requirements, NFPA, Owner's insurance carrier, and Contract Documents, the most stringent requirements shall take precedence.
      b. Contractor shall perform a thorough examination of Contract Documents and shall coordinate with other disciplines and trades, e.g. verification of hazardous area locations requiring equipment rated for that type of environment.
      c. Contractor shall be responsible for providing a fully functional and code compliant pre-packaged fire pump system and building enclosure at no additional cost to the Owner.
      d. Contractor shall be responsible for coordinating all work and equipment to be provided by others. Work and equipment designated to be provided by others shall be included as part of the Contract and there shall not be any incurred cost to the Owner.

1.4 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
   1. American Water Works Association (AWWA):
      a. 10084, Standard Methods for the Examination of Water and Wastewater.
      b. C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
      c. C606, Grooved and Shouldered Joints.
   2. ASME International (ASME):
      a. B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
      b. B16.22, Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
      c. B16.26, Standard for Cast Copper Alloy Fittings for Flared Copper Tubes.
      d. B16.3, Malleable Iron Threaded Fittings, Classes 150 and 300.
      e. B16.39, Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300.
      f. B16.5, Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard.
   3. ASTM International (ASTM):
      a. A183, Standard Specification for Carbon Steel Track Bolts and Nuts.
      b. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
      c. A536, Standard Specification for Ductile Iron Castings.
      d. B135, Standard Specification for Seamless Brass Tube.
      e. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
      f. B75/B75M, Standard Specification for Seamless Copper Tube.
      g. B88, Standard Specification for Seamless Copper Water Tube.
      h. C533, Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
      i. F436, Hardened Steel Washers.
   4. California Building Codes:
      a. CBC, California Building Code.
   5. National Fire Protection Association (NFPA):

a. 13, Standard for the Installation of Sprinkler Systems.
b. 20, Standard for the Installation of Stationary Pumps for Fire Protection.
c. 22, Standard for Fire Water Tanks for Private Fire Protection.
d. 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances.
e. 70, National Electrical Code.
f. 72, National Fire Alarm and Signaling Code.
g. 1142*, Standard on Water Supplies for Suburban and Rural Fire Fighting. *NFPA 1142 is not referenced by the IBC or KBC and is not a required code. NFPA 1142 is included for information and design practices on Water Supplies for Suburban and Rural Fire Fighting.

6. Underwriters Laboratories (UL):
   a. 1247, Engines for Driving Stationary Fire Pumps.
   b. 142, Steel Aboveground Tanks for Flammable and Combustible Liquids.
   c. 448, Centrifugal Stationary Pumps for Fire-Protection Service.
   d. Fire Prot Dir, Fire Protection Equipment Directory.

1.5 SUBMITTALS

A. Shop Drawings:
   1. General:
      a. The pre-packaged fire pump house design is a delegated design and the Contractor shall review for project information and general conformance with Contract Documents.
      b. Pre-packaged fire pump house submittals and Shop Drawings shall be made as a complete package which includes product data and Drawings. Incomplete/partial submittals will be returned without being reviewed.
   2. Product Data:
      a. Submit catalog data and Specifications for all manufactured components supplied as part of the pre-packaged fire pump house.
   3. Project Information:
      a. Submit detailed complete pre-packaged fire pump house layout approved by AHJ and prepared in accordance with the requirements for Working Plans described in applicable NFPA standards.
         1) Upon receipt of comments from AHJ, make resubmissions, if required, to make clarifications or revisions to obtain approval.
         2) The AHJ and manufacturer's fire pump rep shall witness final testing and inspection in order to obtain final approval for system.
      b. Submit a copy of the manufacturer's factory fire pump test results. A new test shall be performed if the fire pump has been deemed deficient per the manufacturer's anticipated results. The Contractor shall review the final test results for general conformance with Contract Documents.
   4. Certifications:
      a. Certification that all plans have been approved by the AHJ.
      b. Certification that all required post installation tests and inspections have been completed and approved by the AHJ.

B. Contract Closeout Information:
   1. Letter, with Owner acceptance signature, stating spare parts and extra materials per NFPA requirements have been delivered.
   2. Operating and maintenance data.
   3. Owner instruction report.
   4. Test reports:
      a. Certification that the acceptance test as performed by the manufacturer's fire pump rep has been successfully completed and approved by AHJ.
   5. As-Built Drawings:
      a. As-Built Shop Drawings shall be submitted no later than 14 days after completion of the Final Tests. The Sprinkler System Drawings shall be updated to reflect as-built

conditions after all related work is completed. Provide Electronic Drawings in 'dwg' and 'pdf' format.

1.6 EXTRA MATERIALS

A. Submit Spare Parts data for each different item of equipment and material specified. The data shall include a complete list of parts and supplies and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. Include a list of special tools and test equipment required for maintenance and testing of the products supplied.

1.7 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):
   1. Work specified in this section shall be performed under the supervision of and certified by the AHJ.

B. Qualifications of Welders:
   1. Submit certificates of each welder's qualifications prior to site welding; certifications shall not be more than one year old.

C. Qualifications of Installer:
   1. Prior to installation, submit data for approval showing that the fire protection Contractor has successfully installed fire pumps and associated equipment of the same type and design as specified herein, or that he has a firm contractual agreement with a subcontractor having such required experience. The data shall include the names and locations of at least two installations where the Fire Protection Contractor, or the subcontractor referred to above, has installed such systems. Indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months.

D. Final Test Certification:
   1. Concurrent with the Final Acceptance Test Report, submit certification by the AHJ that the fire pump installation is in accordance with the contract requirements, including signed approval of the Final Acceptance Test Reports. Submit data for approval showing the name and certification of all involved individuals with such qualifications at or prior to submittal of Drawings.

E. Manufacturer's Representative:
   1. Work specified in this Section shall be performed under the supervision of and certified by a representative of the fire pump manufacturer. Submit the name and documentation of certification of the proposed Manufacturer's Representative, concurrent with submittal of the AHJ Qualifications. The Manufacturer's Representative shall be regularly engaged in the installation of the type and complexity of fire pump(s) specified in the Contract Documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect all equipment delivered and placed in storage from the weather, excessive humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall be either capped or plugged until installed.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

B. Submit manufacturer's catalog data included with the Fire Pump Installation Drawings for each separate piece of equipment proposed for use in the system. Catalog data shall indicate the name of the manufacturer of each item of equipment, with data annotated to indicate model to be provided. In addition, a complete equipment list that includes equipment description, model number and quantity shall be provided. Catalog data for material and equipment shall include, but not be limited to, the following:
   1. Fire pumps, drivers and controllers including manufacturer's certified shop test characteristic curve for each pump. Shop test curve may be submitted after approval of catalog data but shall be submitted prior to the final tests.
   2. Pressure maintenance pump and controller.
   3. Piping components.
   4. Valves, including gate, check, globe and relief valves.
   5. Gauges.
   6. Hose valve manifold test header and hose valves.
   7. Restrictive orifice union.
   8. Associated devices and equipment.

C. All equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, contract number and accepted date; capacity or size; system in which installed and system which it controls and catalog number. Pumps and motors shall have standard nameplates securely affixed in a conspicuous place and easy to read. Fire pump shall have nameplates and markings in accordance with UL 448. Diesel driver shall have nameplate and markings in accordance with UL 1247. Electric motor nameplates shall provide the minimum information required by NFPA 70, Section 430-7.

2.2 FIRE PUMP

A. Fire pump shall be diesel engine driven. Pump capacity shall be rated at 1250 gpm with a rated net pressure of 128 psi at the pump flange. Fire pump shall furnish not less than 150 percent of rated flow capacity at not less than 65 percent of rated net pressure. Pump shall be a vertical turbine fire pump. Pump shall be equipped with automatic air release devices. The maximum rated pump speed shall be in accordance with the manufacturer’s rated capacity. Pump shall be automatic start and manual stop. Pump shall conform to the requirements of UL 448. Fire pump discharge and suction gages shall be oil-filled type.

2.3 REQUIREMENTS FOR FIRE PROTECTION SERVICE

A. General Requirements:
   1. Materials and Equipment shall have been tested by Underwriters Laboratories (UL) and listed in UL Fire Prot Dir or approved by Factory Mutual and listed in FM APP GUIDE. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL Fire Prot Dir or FM APP GUIDE.

B. Alarms:
   1. Provide audible and visual alarms as required by NFPA 20 on the controller. Provide remote supervision as required by NFPA 20 and in accordance with NFPA 72. Provide remote alarm devices as required. Alarm signal shall be activated upon the following conditions: loss of electrical power engine drive controller has operated into an engine running condition, engine drive controller main switch has been turned to OFF or to MANUAL position, trouble on engine driven controller or engine. Exterior alarm devices shall be weatherproof type. Provide alarm silencing switch and red signal lamp, with signal lamp arranged to come on when switch is placed in OFF position.

2.4 UNDERGROUND PIPING COMPONENTS

A. Fire protection piping shall be provided as specified in Utilities Specification (Division 33) and in accordance with AHJ requirements.

B. Provide ells, tees, reducing tees, wyes, couplings, increasers, crosses, transitions, and end caps of the same type and class of material as the pipe or have equal or superior physical and chemical properties.

C. Fire protection ductile iron piping shall be as follows and installed in accordance with AHJ requirements.
   1. AWWA/ANSI C151/A21.51.
   2. Ductile Iron pipe and fittings shall be furnished with push-on joints, push-on restrained joints, mechanical joints, flanged joints, and grooved joints as required. Ductile Iron pipe shall be used for the wet well transfer piping.
   3. Push-on joints shall conform to AWWA C111. The pressure rating for push-on joints shall be a minimum of 250 psi or the specified pressure rating of the pipe, whichever is less. Standard allowable joint deflection for 4 IN - 24 IN Pushtite pipe shall be five degrees.
   4. Flange fittings shall be ductile iron in accordance with AWWA C110 or AWWA C153. The flanges shall be rated for at least 250 psi working pressure. Bolts, gaskets, and installation shall be in accordance with AWWA C110 or AWWA C115, Appendix A requirements. Flange gaskets shall have a raised bulb in the sealing area. Flange facing shall be smooth or with shallow serrations per AWWA C110 or AWWA C153.
   5. Fire protection Polyvinyl Chloride (PVC) piping shall meet AWWA C900, C905 or C906 requirements.
      a. Polyvinyl Chloride (PVC) piping may be used below grade on the discharge side of the fire pump and below grade for the dry hydrants supply mains.
         1) All PVC piping shall be UL listed and FM approved.
         2) All supports shall be in accordance with NFPA 24.

2.5 ABOVEGROUND PIPING COMPONENTS

A. Use only new, unused material, designed and guaranteed to perform service required and UL listed, FM Approved and allowed by NFPA.

B. Pipe and Fittings – General:
   1. Meet or exceed applicable NFPA standards.
   2. Working pressure: Not less than 175 PSI.
   3. The following are not permitted:
      a. Lightwall and Schedule 5 or 7 pipe.
      b. Plain end, pressure fit type fittings.
      c. Hole cut mechanical tee fittings.
      d. Threaded fittings on piping less than Schedule 40.
   4. Fittings: Galvanized where galvanized piping is used.
   5. Corrosion Resistance Ratio (CRR) of all pipe used: Greater than one.

C. Above Ground Pipe Normally Containing Water:
   1. Examples: Wet-pipe and standpipe-and-hose fire protection systems.
   2. Sprinkler piping 4 IN and greater:
      a. Black steel, Schedule 10:
         1) Welded joints.
         2) Mechanical coupling joints:
            a) Rolled groove type (cut grooving not allowed).
   3. Mechanical locking (push-on) type, (Plain end not allowed).Sprinkler piping less than 4 IN:
      a. Black steel, Schedule 40:
         1) Threaded joints.
         2) Welded joints.
         3) Mechanical joints:
            a) Cut or rolled groove type.
            b) Mechanical locking (push-on) type.
   4. Seamless copper tubing.
      a. High temperature soldered joints.
   5. Sprinkler piping exposed to environment.

a. Galvanized, Schedule 40:
    1) Mechanical coupling joints:
        a) Threaded or Rolled groove type (cut grooving not allowed).

D. Pipe Freeze Protection:
    1. Aboveground supply pipe within the pre-packaged fire pump house maintain temperature above 40 DegF

E. Pipe Hangers and Seismic Supports:
    1. Pipe hangers and support shall be provided in accordance with NFPA 13 and NFPA 24

F. Valves:
    1. Valves shall be provided in accordance with NFPA 13 and NFPA 24.

G. Gate Valves and Control Valves:
    1. Gate valves and control valves shall be outside screw and yoke (O.S.&Y) type which open by counterclockwise rotation. Butterfly-type control valves are permitted in locations as allowed per NFPA 20.

H. Tamper Switch:
    1. The suction control valves, the discharge control valves, valves to test header and the by-pass control valves shall be equipped with valve tamper switches for monitoring by the fire alarm system.

I. Check Valve:
    1. Check valve shall be clear open, swing type check valve with flange or threaded inspection plate.

J. Relief Valve:
    1. Relief valve shall be spring operated type conforming to NFPA 20. A means of detecting water motion in the relief lines shall be provided where the discharge is not visible within the pump house.

K. Circulating Relief Valve:
    1. An adjustable circulating relief valve shall be provided for each fire pump in accordance with NFPA 20.

L. Hose Valve Manifold Test Header:
    1. Construct header of steel pipe. Provide ASME B16.5, Class 150 flanged inlet connection to hose valve manifold assembly. Provide approved bronze hose gate valve with 2.5 IN National Standard male hose threads with cap and chain; locate 3 FT above grade in the horizontal position for each test header outlet.

M. Pipe Sleeves:
    1. A pipe sleeve shall be provided at each location where piping passes entirely through walls, ceilings, roofs, and floors, including pipe entering buildings from the exterior. Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, and floors. Provide 1 IN minimum clearance between exterior of piping or pipe insulation, and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal space at both ends of the sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal.
        a. Sleeves in Masonry and Concrete Walls, Ceilings, Roofs, and Floors: Provide hot-dip galvanized steel, ductile-iron, or cast-iron pipe sleeves. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves provided that cavities in the core-drilled hole be completely grouted smooth.
        b. Sleeves in Other Than Masonry and Concrete Walls, Ceilings, Roofs, and Floors: Provide galvanized steel sheet pipe not less than 0.90 psf.

N. Escutcheon Plates:

1. Provide one-piece or split-hinge metal plates for piping entering floors, walls, and ceilings in exposed areas. Provide polished stainless steel or chromium-plated finish on copper alloy plates in finished spaces. Provide paint finish on plates in unfinished spaces. Plates shall be secured in place.

2.6 DIESEL ENGINE DRIVER

A. Diesel engine driver shall conform to the requirements of UL 1247 and shall be UL listed UL Fire Prot Dir or FM approved FM APP GUIDE for fire pump service. Driver shall be of the make recommended by the pump manufacturer. The engine shall be closed circuit, liquid-cooled with radiator and engine-driven fan. Diesel engine shall be electric start type taking current from 2 battery units. Engine shall be equipped with a fuel in-line filter-water separator. Engine conditions shall be monitored with engine instrumentation panel that has a tachometer, hour meter, fuel pressure gage, lubricating oil pressure gage, water temperature gage, and ammeter gage. Engine shall be connected to horizontal-shaft pump by flexible couplings. For connections to vertical-shaft fire pumps, right-angle gear drives and universal joints shall be used. An engine jacket water heater shall be provided to maintain a temperature of 120 DegF in accordance with NFPA 20.

B. Engine Capacity:
   1. Engine shall have adequate horsepower to drive the pump at all conditions of speed and load over the full range of the pump performance curve. The horsepower rating of the engine driver shall be as recommended by the pump manufacturer and shall be derated for temperature and elevation in accordance with NFPA 20. Ambient temperature at the pump location shall be 40-110 DegF. Site elevation shall be 2260 FT above mean sea level (MSL).

C. Fire Pump Drive (Engine):
   1. Provide with electric starting equipment, charging generator and heat exchanger cooling system with inlet piped complete with strainers, pressure gauge, pressure reducing valve, solenoid valve, bypass line with globe valve to pump discharge.
   2. The diesel fire pump heat exchanger cooling loop shall be sized as required by the pump manufacturer and installed in accordance NFPA 20 and NFPA 22. Typically the supply comes from the discharge side of the fire pump. The cooling loop discharge shall be routed to the water storage tank. The cooling loop shall include all necessary equipment including strainers, pressure gauge, pressure reducing valve, activation solenoid, manual bypass, etc. as detailed in NFPA 20 - 2010 Ed. §11.2.8. All heat exchanger pipe to be threaded pipe in accordance with NFPA 20.
   3. Provide weather resistant insulation for heat exchanger piping subject to freezing conditions. Insulation shall provide minimum R-factor of 10 for insulation thermal resistance.

D. Exhaust System External to Engine:
   1. Exhaust system shall comply with the requirements of NFPA 20 and NFPA 37. An exhaust muffler shall be provided for each diesel engine driver to reduce noise levels less than 95 dBA. A flexible connector with flange connections shall be provided at the engine. Flexible sections shall be stainless steel suitable for diesel-engines exhaust gas at 1000 DegF.
   2. Piping Insulation:
      a. Products containing asbestos will not be permitted. Exhaust piping system including the muffler shall be insulated with ASTM C533 calcium silicate insulation, minimum of 3 IN. Insulation shall be secured with not less than 0.375 IN width fibrous glass reinforced waterproof tape or Type 304 stainless steel bands spaced not more than 8 IN on center. An aluminum jacket encasing the insulation shall be provided. The aluminum jacket shall have a minimum thickness of 0.016 IN, a factory-applied polyethylene and kraft paper moisture barrier on the inside surface. The jacket shall be secured with not less than 0.5 IN wide stainless steel bands, spaced not less than 8 IN on centers. Longitudinal and circumferential seams of the jacket shall be lapped not

less than 3 IN. Jackets on horizontal line shall be installed so that the longitudinal seams are on the bottom side of the pipe. The seams of the jacket for the vertical lines shall be placed on the off-weather side of the pipe. On vertical lines, the circumferential seams of the jacket shall overlap so the lower edge of each jacket overlaps the upper edge of the jacket below.

2.7 FIRE PUMP CONTROLLER

A. Controller shall be the automatic type and UL listed UL Fire Prot Dir or FM approved FM APP GUIDE for fire pump service. Pump shall be arranged for automatic start, and manual push-button stop. Automatic stopping shall be accomplished only after automatic periodic exercises. Controllers shall be completely terminally wired, ready for field connections, and mounted in a NEMA Type 2 drip-proof enclosure arranged so that controller current carrying parts will not be less than 12 IN above the floor. Controller shall be equipped with a bourdon tube pressure switch or a solid state pressure switch with independent high and low adjustments, automatic starting relay actuated from normally closed contacts, visual alarm lamps and supervisory power light. Controller shall be equipped with a thermostat switch with adjustable setting to monitor the pump room temperature and to provide an alarm when temperatures fall below 40 DegF.

B. Controller for Diesel Engine Driven Fire Pump:
   1. Controller shall require the pump to run for 30 minutes prior to automatic shutdown. Controller shall be equipped with two battery chargers; two ammeters; two voltmeters, one for each set of batteries. Controller shall automatically alternate the battery sets for starting the pumps. Controller shall be equipped with the following supervisory alarm functions:
      a. Engine Trouble (individually monitored):
         1) Engine overspeed.
         2) Low Oil Pressure.
         3) High Water Temperature.
         4) Engine Failure to Start.
         5) Battery.
         6) Battery Charger/AC Power Failure.
      b. Main Switch Mis-set.
      c. Pump Running.
      d. Pump Room Trouble (individually monitored):
         1) Low Fuel.
         2) Low Pump Room Temperature.
         3) Low Reservoir Level.
   2. Alarms shall be individually displayed in front of panel by lighting of visual lamps, except that individual lamps are not required for pump running and main switch mis-set. Controller shall be equipped with a 7-day electric pressure recorder with 24-HR back-up mounted inside the controller. The pressure recorder shall provide a readout of the system pressure from 0 to 300 psi, time, and date. The controller shall be equipped with an audible alarm which will activate upon any engine trouble or pump room trouble alarm condition and alarm silence switch. Controller shall be equipped with terminals for field connection of a remote alarm for main switch mis-set, pump running, engine trouble and pump room trouble; and terminals for remote start. When engine emergency overspeed device operates, the controller shall cause the engine to shut down without time delay and lock out until manually reset.

2.8 BATTERIES

A. Batteries for diesel engine driver shall be sealed lead calcium batteries. Batteries shall be mounted in a steel rack with non-corrosive, non-conductive base, not less than 12 IN above the floor.

2.9 PRESSURE SENSING LINE

A. A completely separate pressure sensing line shall be provided for each fire pump and for the jockey pump. The sensing line shall be arranged in accordance with Figure A-7-5.2.1. of NFPA

20. The sensing line shall be 1/2 IN H58 brass tubing complying with ASTM B135. The sensing line shall be equipped with two restrictive orifice unions each. Restricted orifice unions shall be ground-face unions with brass restricted diaphragms drilled for a 3/32 IN. Restricted orifice unions shall be mounted in the horizontal position, not less than 5 FT apart on the sensing line. Two test connections shall be provided for each sensing line. Test connections shall consist of two brass 1/2 IN globe valves and 1/4 IN gage connection tee arranged in accordance with NFPA 20. One of the test connections shall be equipped with a 0 to 300 psi water oil-filled gage. Sensing line shall be connected to the pump discharge piping between the discharge piping control valve and the check valve.

2.10 PRESSURE MAINTENANCE PUMP

A. General:
   1. Submerssible pressure maintenance pump shall be electric motor driven, centrifugal type sized to maintain supervisory water pressure on the system. Pump shall draft from the wet well and shall discharge into the system at the downstream side of the pump discharge gate valve. An approved indicating gate valve of the outside screw and yoke (O.S.&Y) type shall be provided in the maintenance pump discharge and suction piping. Oil-filled water pressure gage and approved check valve in the maintenance pump discharge piping shall be provided. Check valve shall be swing type with removable inspection plate.

B. Pressure Maintenance Pump Controller:
   1. Pressure maintenance pump controller shall be arranged for automatic and manual starting and stopping and equipped with a "manual-off-automatic" switch. The controller shall be completely prewired, ready for field connections, and wall-mounted in a NEMA Type 2 drip-proof enclosure. The controller shall be equipped with a bourdon tube pressure switch or a solid state pressure switch with independent high and low adjustments for automatic starting and stopping. A sensing line shall be provided connected to the pressure maintenance pump discharge piping between the control valve and the check valve. The sensing line shall conform to paragraph, PRESSURE SENSING LINE. The sensing line shall be completely separate from the fire pump sensing lines. An adjustable run timer shall be provided to prevent frequent starting and stopping of the pump motor. The run timer shall be set for 2 minutes.

2.11 DIESEL FUEL SYSTEM EXTERNAL TO ENGINE

A. Fuel system shall be provided that meets all requirements and advisory provisions of NFPA 20 and NFPA 37. The fuel tank vent piping shall be equipped with screened weatherproof vent cap. Vents shall be extended to the outside. Provide a double-walled fuel tank. Tank shall be equipped with a fuel level gage. Flexible bronze or stainless steel piping connectors with single braid shall be provided at each piping connection to the diesel engine. Supply, return, and fill piping shall be steel piping, except supply and return piping may be copper tubing. Fuel lines shall be protected against mechanical damage. Fill line shall be equipped with 16 mesh removable wire screen. Fill lines shall be extended to the exterior. A weatherproof tank gauge shall be mounted on the exterior wall near each fill line for each tank. The fill cap shall be able to be locked by padlock. The engine supply (suction) connection shall be located on the side of the fuel tank so that 5 percent of the tank volume provides a sump volume not useable by the engine. The elevation of the fuel tank shall be such that the inlet of the fuel supply line is located so that its opening is no lower than the level of the engine fuel transfer pump. The bottom of the tank shall be pitched 1/4 IN/FT to the side opposite the suction inlet connection, and to an accessible 1 IN plugged globe drain valve.

B. Steel Pipe:
   1. ASTM A53/A53M, hot-dipped zinc-coated, Schedule 40, threaded connections. Fittings shall be ASME B16.3, zinc-coated, threaded malleable iron fittings. Unions shall be ASME B16.39 zinc-coated, threaded unions.

C. Copper Tubing:
   1. ASTM B88, Type K, soft annealed, with ASME B16.26 flared fittings.

D. Diesel Fuel Tanks:
   1. UL 80 or UL 142 for above ground tanks.

E. Valves:
   1. An indicating and lockable ball valve shall be provided in the supply line adjacent to the tank suction inlet connection. A check valve shall be provided in fuel return line. Valves shall be suitable for oil service. Valves shall have union end connections or threaded end connections.
      a. Globe valve: MSS SP-80 Class 125.
      b. Check valve: MSS SP-80, Class 125, swing check.
      c. Ball valve: Full port design, copper alloy body, 2-position lever handle.

2.12 JOINTS AND FITTINGS FOR COPPER TUBE

A. Wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B75/B75M. Cast copper alloy solder-joint pressure fittings shall conform to ASME B16.18. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B62. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used. Grooved mechanical joints and fittings shall be designed for not less than 125 psig service and shall be the product of the same manufacturer. Grooved fitting and mechanical coupling housing shall be ductile iron conforming to ASTM A536. Gaskets for use in grooved joints shall be molded synthetic polymer of pressure responsive design and shall conform to ASTM D2000 for circulating medium up to 239 DegF. Grooved joints shall conform to AWWA C606 Coupling nuts and bolts for use in grooved joints shall be steel and shall conform to ASTM A183.

2.13 PUMP BASE PLATE AND PAD

A. The vertical turbine fire pump and motor shall be mounted to the structural steel of the enclosure

2.14 HOSE VALVE MANIFOLD TEST HEADER

A. Hose valve test header shall be connected by ASME B16.5, Class 150 flange inlet connection. Hose valves shall be UL listed UL Fire Prot Dir or FM approved FM APP GUIDE bronze hose gate valves with 2.5 IN American National Fire Hose Connection Screw Standard Threads (NH) in accordance with NFPA 1963. The number of valves shall be in accordance with NFPA 20. Each hose valve shall be equipped with a cap and chain, and located no more than 3 FT and no less than 2 FT above grade.

2.15 BUILDING POWER

A. See Electrical Specifications Division 26. It shall be the responsibility of the contractor to contact the Engineer if the electrical requirements of the premanufactured fire pump house are in conflict with the contract documents.

PART 3 - EXECUTION

3.1 EXAMINATION

A. After becoming familiar with all details of the work, verify all dimensions in the field, and advise the contractor of any discrepancy before performing the work.

3.2 INSPECTION BY AHJ AND FIRE PUMP MANUFACTURER'S REP

A. The AHJ and fire pump manufacturer's rep shall perform a thorough inspection of the fire pump installation, including visual observation of the pump while running, to assure that the installation conforms to the contract requirements. There shall be no excessive vibration, leaks

(oil or water), unusual noises, overheating, or other potential problems. Inspection shall include piping and equipment clearance, access, supports, and guards. Any discrepancy shall be brought to the attention of the contractor in writing, no later than three working days after the discrepancy is discovered. The AHJ and fire pump manufacturer's rep shall witness the final acceptance tests and, after completion of the inspections and a successful final acceptance test, shall sign test results and certify in writing that the installation the fire pump installation is in accordance with the contract requirements.

3.3 INSTALLATION

A. Equipment, materials, workmanship, fabrication, assembly, erection, installation, examination, inspection and testing shall be in accordance NFPA 20, except as modified herein. In addition, the fire pump and engine shall be installed in accordance with the written instructions of the manufacturer.

B. Installation Drawings:
   1. Submit Fire Pump Installation Drawings consisting of a detailed plan view, detailed elevations and sections of the pump room, equipment and piping, drawn to a scale of not less than 1/4 IN = 1 FT. Drawings shall indicate equipment, piping, and associated pump equipment to scale. Indicate all clearance, such as those between piping and equipment; between equipment and walls, ceiling and floors; and for electrical working distance clearance around all electrical equipment. Include a legend identifying all symbols, nomenclatures, and abbreviations. Indicate a complete piping and equipment layout including elevations and/or section views of the following:
      a. Fire pumps, controllers, piping, valves, and associated equipment.
      b. Sensing line for each pump including the pressure maintenance pump.
      c. Engine fuel system for diesel driven pumps.
      d. Engine cooling system for diesel driven pumps.
      e. Pipe hangers and sway bracing including support for diesel muffler and exhaust piping.
      f. Restraint of underground water main at entry-and exit-points to the building including details of pipe clamps, tie rods, mechanical retainer glands, and thrust blocks.
      g. A complete point-to-point connection drawing of the pump power, control and alarm systems, as well as interior wiring schematics of each controller.

C. Pump Room Configuration:
   1. Provide detail plan view of the pump room including elevations and sections showing the fire pumps, associated equipment, and piping. Submit working drawings on sheets not smaller than 24 by 36 IN; include data for the proper installation of each system. Show piping schematic of pumps, devices, valves, pipe, and fittings. Provide an isometric drawing of the fire pump and all associated piping. Show point to point electrical wiring diagrams. Show piping layout and sensing piping arrangement. Show engine fuel and cooling system. Include:
      a. Pumps, drivers, and controllers.
      b. Hose valve manifold test header.
      c. Circuit diagrams for pumps.
      d. Wiring diagrams of each controller.

D. Accessories:
   1. Tank supports, piping offsets, fittings, and any other accessories required shall be furnished as specified to provide a complete installation and to eliminate interference with other construction.

3.4 PIPE AND FITTINGS

A. Piping shall be inspected, tested and approved before burying, covering, or concealing. Fittings shall be provided for changes in direction of piping and for all connections. Changes in piping sizes shall be made using tapered reducing pipe fittings. Bushings shall not be used.

B. Cleaning of Piping:

1. Interior and ends of piping shall be clean and free of any water or foreign material. Piping shall be kept clean during installation by means of plugs or other approved methods. When work is not in progress, open ends of the piping shall be securely closed so that no water or foreign matter will enter the pipes or fittings. Piping shall be inspected before placing in position.

C. Threaded Connections:
   1. Jointing compound for pipe threads shall be Teflon pipe thread paste and shall be applied to male threads only. Exposed ferrous pipe threads shall be provided with one coat of zinc molybdate primer applied to a minimum of dry film thickness of 1 mil.

D. Pipe Hangers and Supports:
   1. Additional hangers and supports shall be provided for concentrated loads in aboveground piping, such as for valves and risers.
   2. Vertical Piping:
      a. Piping shall be supported at each floor, at not more than 10 FT intervals.
   3. Horizontal Piping:
      a. Horizontal piping supports shall be spaced as follows:

MAXIMUM SPACING (FEET)										
Nominal Pipe Size (in)	1 and Under	1.25	1.5	2	2.5	3	3.5	4	5	6+
Copper Tube	6	7	8							
Steel Pipe	7	8	9	10	11	12	13	14	16	17

E. Piping:
   1. Installation of piping and fittings shall conform to NFPA 24. Joints shall be anchored in accordance with NFPA 24. After installation in accordance with NFPA 24, rods and nuts shall be thoroughly cleaned and coated with asphalt or other corrosion-retard material approved by the Contractor.

F. Grooved Mechanical Joint:
   1. Grooves shall be prepared according to the coupling manufacturer's instructions. Grooved fittings, couplings, and grooving tools shall be products of the same manufacturer. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gage, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations, such as behind solid walls or ceilings, unless an access panel is shown on the drawings for servicing or adjusting the joint.

3.5 ELECTRICAL WORK

A. Electric motor and controls shall be in accordance with NFPA 20, NFPA 72 and NFPA 70, unless more stringent requirements are specified herein or are indicated on the Drawings. Electrical wiring and associated equipment shall be provided in accordance with NFPA 20. Provide wiring in rigid metal conduit or intermediate metal conduit, except electrical metallic tubing conduit may be provided in dry locations not enclosed in concrete or where not subject to mechanical damage.

3.6 FLUSHING

A. The fire pump suction and discharge piping shall be flushed at 150 percent of rated capacity of each pump. The new pump may be used to attain the required flushing volume. No underground piping shall be flushed by using the fire pump. Flushing operations shall continue

until water is clear, but not less than 10 minutes. Submit a signed and dated flushing certificate before requesting field testing to be witnessed by the AHJ and contractor for final approval.

3.7 FIELD TESTS

A. Submit system diagrams that show the layout of equipment, piping, and storage units, and typed condensed sequence of operation, wiring and control diagrams, and operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system.

B. Hydrostatic Test:
   1. Piping shall be hydrostatically tested in accordance with NFPA 20, NFPA 13, and NFPA 24.

C. Inspection and Tests:
   1. Submit the request for inspection at least 10 days prior to the date the inspection is to take place. An experienced technician regularly employed by the pump installer shall be present during the inspection. Where pumps are engine driven, an experienced technician regularly employed by the engine manufacturer capable of demonstrating that all engine trouble alarms and operating features perform as required shall be present. Submit proposed date and time to begin formal inspection and tests, with the acceptance procedures. Notification shall be provided at least 10 days prior to the proposed start of the test. Notification shall include a copy of the Contractor's Material & Test Certificates. Submit 3 copies of the completed inspection and tests reports, no later that 7 days after the completion of the tests. All items in the reports shall be signed by the AHJ and the Manufacturer's Representative. Test reports showing all field tests and measurements taken during the final pump test, and documentation that proves compliance with the specified performance criteria, upon completion of the installation and final testing of the installed system. Each test report shall indicate the final position of the controls and pressure switches. The test reports shall include the description of the hydrostatic test conducted on the piping and flushing of the suction and discharge piping. A copy of the manufacturer's certified pump curve shall be included in the report.
   2. Correcting Defects:
      a. Correct defects in the work, and make additional tests until the Contractor has demonstrated that the system complies with the contract requirements.
   3. Documentation of Test:
      a. Manufacturer's certified shop test characteristic curve for the pump being tested must be furnished by the Contractor at the time of the pump acceptance test.

D. Final Acceptance Test:
   1. Pump Acceptance Test:
      a. The AHJ and manufacturer's representative, a representative of the fire pump controller manufacturer, shall witness the complete operational testing of the fire pump and drivers. The fire pump controller manufacturer's representative shall be an experienced technician capable of demonstrating operation of all features of respective components including trouble alarms and operating features. Fire pumps, drivers and equipment shall be thoroughly inspected and tested to insure that the system is correct, complete, and ready for operation. Tests shall ensure that pumps are operating at rated capacity, pressure and speed. Tests shall include manual starting and running to ensure proper operation and to detect leakage or other abnormal conditions, flow testing, automatic start testing, testing of automatic settings, sequence of operation check, test of required accessories; test of pump alarms devices and supervisory signals, test of pump cooling, operational test of relief valves, and test of automatic power transfer, if provided. Pumps shall run without abnormal noise, vibration or heating. If any component or system was found to be defective, inoperative, or not in compliance with the contract requirements during the tests and inspection, the corrections shall be made and the entire test shall be repeated. Submit Tests Reports, to include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and

Test Certificate for Aboveground Piping. All items in the Report shall be signed by the AHJ and the Manufacturer's Representative.

2. Flow Tests:
   a. Flow tests using the test header, hoses and playpipe nozzles shall be conducted. Flow tests shall be performed at churn (no flow), 75, 100, 125 and 150 percent capacity for each pump and at full capacity of the pump installation. Flow readings shall be taken from each nozzle by means of a calibrated pitot tube with gage or other approved measuring equipment. Rpm, suction pressure and discharge pressure reading shall be taken as part of each flow test.
3. Starting Tests:
   a. Pumps shall be tested for automatic starting and sequential starting. Setting of the pressure switches shall be tested when pumps are operated by pressure drop. Tests may be performed by operating the test connection on the pressure sensing lines. As a minimum, each pump shall be started automatically 10 times and manually 10 times, in accordance with NFPA 20. Tests of engine-driven pumps shall be divided equally between both set of batteries. The fire pumps shall be operated for a period of a least 10 minutes for each of the starts. Pressure settings that include automatic starting and stopping of the fire pump(s) shall be indicated on an etched plastic placard, attached to the corresponding pump controller.
4. Battery Changeover:
   a. Diesel driven fire pumps shall be tested for automatic battery changeover in event of failure of initial battery units.
5. Alarms:
   a. All pump alarms, both local and remote, shall be tested. Supervisory alarms for diesel drivers shall be electrically tested for low oil pressure, high engine jacket coolant temperature, shutdown from overspeed, battery failure and battery charger failure.
6. Miscellaneous:
   a. Valve tamper switches shall be tested. Pressure recorder operation relief valve settings, valve operations, operation and accuracy of meters and gages, and other accessory devices shall be verified.
7. Correction of Deficiencies:
   a. If equipment was found to be defective or non-compliant with contract requirements, perform corrective actions and repeat the tests. Tests shall be conducted and repeated if necessary until the system has been demonstrated to comply with all contract requirements.
8. Test Documentation:
   a. The Manufacturer's Representative shall supply a copy of the manufacturer's certified curve for each fire pump at the time of the test. The AHJ shall record all test results and plot curve of each pump performance during the test. Complete pump acceptance test data of each fire pump shall be recorded. The pump acceptance test data shall be on forms that give the detail pump information such as that which is indicated in Figure A-11-2.6.3(f) of NFPA 20.

E. Test Equipment:
   1. Provide all equipment and instruments necessary to conduct a complete final test, including 2.5 IN DIA hoses, playpipe nozzles, pitot tube gages, portable digital tachometer, voltage and ampere meters, and calibrated oil-filled water pressure gages. Provide all necessary supports to safely secure hoses and nozzles during the test.

3.8 SYSTEM STARTUP

A. Fully enclose or properly guard coupling, rotating parts, gears, projecting equipment, etc. so as to prevent possible injury to persons that come in close proximity of the equipment. Conduct testing of the fire pumps in a safe manner and ensure that all equipment is safely secured. Hoses and nozzles used to conduct flow tests shall be in excellent condition and shall be safely anchored and secured to prevent any misdirection of the hose streams. Discharge water back into the pond when applicable.

1. Post operating instructions for pumps, drivers, and controllers.

3.9 CLOSEOUT ACTIVITIES

A. Field Training:
   1. The contractor and Manufacturer's Representative shall conduct a training course for the owner's maintenance personnel. Submit the proposed schedule for field training at least 10 days prior to the start of related training. Training shall be provided for a period of up to 2 hours of normal working time and shall start after the fire pump installation is functionally complete and after the Final Acceptance Test. The field instruction shall cover all of the items contained in the approved Operating and Maintenance Instructions. Submit manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment.

B. As-Built Drawings:
   1. Submit As-Built Drawings, no later than 14 days after completion of the Final Tests. Update the Fire Pump Installation Drawings to reflect as-built conditions after all related work is completed and shall be provided electronically to the Contractor.

3.10 PROTECTION

A. Carefully remove materials so as not to damage material which is to remain. Replace existing work damaged by the Contractor's operations with new work of the same construction.

END OF SECTION

DIVISION 22

PLUMBING

SECTION 22 05 23
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following valves for plumbing piping systems:
   1. Gate valves.
   2. Ball valves.
   3. Check valves.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 01 - General Requirements.
   2. Section 09 96 00 - High Performance Industrial Coatings.
   3. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.

1.2 REFERENCES

A. Manufacturers Standardization Society of the Valve and Fittings Industry:
   1. MSS SP 67 - Butterfly Valves.
   2. MSS SP 70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
   3. MSS SP 71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
   4. MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.
   5. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product Data: Submit manufacturers catalog information with valve data and ratings for each service.
   2. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

1.4 QUALITY ASSURANCE

A. For drinking water service, provide valves complying with NSF 61.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Apollo.
   2. Crane.
   3. Milwaukee Valve Co.
   4. Nibco, Inc.
   5. Stockham.
   6. Zurn
   7. Or equal.

2.2 GATE VALVES

A. 3 IN and Smaller: MSS SP 80, 200 psi cold working pressure, bronze body, bronze trim, union bonnet, non-rising stem, hand-wheel, inside screw, solid wedge disc, solder or threaded ends.

B. Larger than 3 IN: MSS SP 70, Class 125, cast iron body, bronze trim, bolted bonnet, non-rising stem, hand-wheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends. Furnish chain-wheel operators for valves 6 IN and larger mounted over 8 FT above floor.

2.3 BALL VALVES

A. 3 IN and Smaller: MSS SP 110, 400 psi WOG, two-piece bronze body, chrome plated brass ball, full port, teflon seats, blow-out proof stem, solder or threaded ends with union, quarter turn lever handle.

2.4 CHECK VALVES

A. Horizontal Swing Check Valves:
   1. 2 IN and Smaller: MSS SP 80, Class 150, bronze body and cap, bronze seat, Buna-N or Teflon disc, solder or threaded ends.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install valves with stems upright or horizontal, not inverted.

B. Install 3/4 IN gate or ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.

C. Install valves with clearance for installation of insulation and allowing access.

D. Provide access where valves and fittings are not accessible.

E. Refer to Section 22 05 29 for pipe hangers.

F. Refer to Section 40 42 00 for insulation requirements for valves.

3.2 VALVE APPLICATIONS

A. Install ball or gate valves for drain service at locations indicated on Drawings in accordance with this Section.

B. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

C. Install ball valves in domestic water systems for shut-off service and for isolating equipment.

3.3 SCHEDULES

SYSTEM DESCRIPTION	VALVE SERVICE		
	SHUTOFF	THROTTLING	CHECK
Domestic Cold and Hot Water	Ball or Gate	Gate	Swing Check Valve

END OF SECTION

SECTION 22 05 29
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Pipe hangers and supports.
   2. Hanger rods.
   3. Inserts.
   4. Flashing.
   5. Formed steel channel.

B. Related Sections:
   1. Section 03 31 30 – Concrete, Materials and Proportioning.
   2. Section 05 50 00 – Metal Fabrications.
   3. Section 07 92 00 - Joint Sealants.
   4. Section 09 96 00 - High Performance Industrial Coatings.

1.2 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. B31.9, Building Services Piping.

B. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS):
   1. SP 58, Pipe Hangers and Supports - Materials, Design and Manufacturer.
   2. SP 69, Pipe Hangers and Supports - Selection and Application.

C. Intertek Testing Services (Warnock Hersey Listed):
   1. WH - Certification Listings.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers.

C. Product Data:
   1. Hangers and Supports: Submit manufacturers catalog data including load capacity.

D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.

E. Manufacturer's Installation Instructions:
   1. Hangers and Supports: Submit special procedures and assembly of components.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 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 3 years documented experience.

1.5 RESPONSIBILITY

A. Contractor shall design complete support systems for piping 12 IN and smaller where supports are not shown on the Drawings.

B. Provide all labor, materials, equipment and incidentals as shown, specified and required to design, furnish and install the system of hangers, supports, guidance, anchorage and appurtenances.

C. General piping support details may be indicated on the Drawings in certain locations for pipe 12 IN DIA and smaller.

A. Each type of pipe hanger or support shall be the product of one manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 65 50 - Product Delivery, Storage and Handling.

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 damage, by storing in original packaging.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.9 WARRANTY

A. Furnish five year manufacturer warranty for pipe hangers and supports.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Manufacturers:
1. Anvil International.
2. PHD Manufacturing.
3. Cooper B-Line.
4. Erico International.
5. Tolco Inc.
6. Or equal.

B. Plumbing Piping - DWV:
1. Conform to ASME B31.9.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 IN: Malleable iron, adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 IN and Larger: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes 3 IN and Smaller: Cast iron hook.
6. Wall Support for Pipe Sizes 4 IN and Larger: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.

C. Plumbing Piping - Water:
1. Conform to ASME B31.9.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 IN: Malleable iron, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 IN and Larger: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 IN: Carbon steel, adjustable, clevis.
5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
6. Wall Support for Pipe Sizes 3 IN and Smaller: Cast iron hook.

7. Wall Support for Pipe Sizes 4 IN and Larger: Welded steel bracket and wrought steel clamp.
8. Vertical Support: Steel riser clamp.
9. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
10. Floor Support for Hot Pipe Sizes 4 IN and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
11. Copper Pipe Support: Copper-plated, Carbon-steel ring.

2.2 ACCESSORIES

A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.
   1. Electro-galvanized or cadmium plated after threads are cut.

2.3 INSERTS

A. Manufacturers:
   1. Hilti.
   2. Simpson.
   3. Tolco.
   4. Cooper B-Line.
   5. Grinnell.
   6. Or equal.

B. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 FLASHING

A. Metal Flashing: 26 gage thick galvanized steel.

B. Metal Counterflashing: 22 gage thick galvanized steel.

C. Lead Flashing:
   1. Waterproofing: 5 LB/SQFT sheet lead.
   2. Soundproofing: 1 LB/SQFT sheet lead.

D. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.

E. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.5 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.

B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

C. Sealant: Acrylic.

2.6 MECHANICAL SLEEVE SEALS

A. Manufacturers:
   1. GPT Industries
   2. Proco Products, Inc.
   3. Flexicraft Industries.
   4. Or equal.

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.

2.7 FORMED STEEL CHANNEL

A. Manufacturers:
   1. Unistrut Corporation.
   2. Cooper B-Line.
   3. Erico.
   4. Or equal.

B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 IN on center.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive sleeves.

3.2 INSTALLATION - INSERTS

A. Install inserts for placement in concrete forms.

B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 IN and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

3.3 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install in accordance with MSS SP 58 or MSS SP 69.

B. Support horizontal piping as scheduled.

C. Install hangers with minimum 1/2 IN space between finished covering and adjacent work.

D. Place hangers within 12 IN of each horizontal elbow.

E. Use hangers with 1-1/2 IN minimum vertical adjustment.

F. Support horizontal cast iron pipe adjacent to each hub, with 5 FT maximum spacing between hangers.

G. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

H. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.

I. Support riser piping independently of connected horizontal piping.

J. Provide copper plated hangers and supports for copper piping.

K. Design hangers for pipe movement without disengagement of supported pipe.

L. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

M. Provide clearance in hangers and from structure and other equipment for installation of insulation.

3.4 INSTALLATION - FLASHING

A. Provide flexible flashing and metal counterflashing where piping penetrates weather or waterproofed walls, floors, and roofs.

B. Flash vent and soil pipes projecting 3 IN minimum above finished roof surface with lead worked 1 IN minimum into hub, 8 IN minimum clear on sides with 24 x 24 IN sheet size. For pipes through outside walls, turn flanges back into wall and seal, metal counter-flash, and seal.

C. Adjust storm collars tight to pipe with bolts; seal around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.5 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with mechanical sleeve seals.

B. Set sleeves in position in forms. Provide reinforcing around sleeves.

C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

D. Terminate sleeves through floor flush with finished floor slab. Seal sleeves air and water tight with non-shrink grout.

E. Install chrome plated steel escutcheons at finished surfaces.

3.6 SCHEDULES

PIPE HANGER SPACING		
PIPE MATERIAL	MAXIMUM HANGER SPACING FEET	HANGER ROD DIAMETER INCHES
Cast Iron (All Sizes)	5	5/8
Copper Tube, 1-1/4 IN and smaller	6	1/2
Copper Tube, 1-1/2 IN and larger	10	1/2
PVC (All Sizes)	4	3/8

END OF SECTION

SECTION 22 05 48

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Vibration isolators.
   2. Seismic Bracing of piping.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment.
   2. Section 01 81 10 – Wind and Seismic design Criteria. All vibration and seismic component design and installation must comply with Section 01 81 10 unless otherwise dictated by a more stringent requirement in this Specification Section.

1.2 REFERENCES

A. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
   1. Handbook - HVAC Applications.

B. American Society of Mechanical Engineers (ASME):
   1. B31.9, Building Services Piping.

C. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
   1. SP-58, Pipe Hangers and Supports - Materials, Design and Manufacture.
   2. SP-69, Pipe Hangers and Supports - Selection and Application.

1.3 PERFORMANCE REQUIREMENTS

A. Provide vibration isolation on motor driven equipment over 0.5 HP, plus connected piping.

B. Provide minimum static deflection of isolators for equipment as follows:
   1. Under 400 RPM: 1 IN.
   2. 400 - 600 RPM: 1 IN.
   3. 600 - 800 RPM: 0.5 IN.
   4. 800 - 900 RPM: 0.2 IN.
   5. 1100 - 1500 RPM: 0.14 IN.
   6. Over 1500 RPM: 0.1 IN.

1.4 SUBMITTALS

A. Specification Section 01 33 00: Submittal procedures.

B. Product Data: Submit manufacturer catalog information indicating, materials of construction and dimensional data for equipment and appurtenances furnished under this section.

C. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions.

D. Manufacturer's Certificate: Certify isolators meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Division 1 Sections: Closeout procedures.

B. Project Record Documents: Record actual locations of hangers including attachment points.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Specification Section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this Specification Section with minimum three years documented experience.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.8 WARRANTY

A. Division 01 Sections: Product warranties and product bonds.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers:
   1. Knetics Noise Control, Inc.
   2. Mason Industries, Inc.
   3. Or equal.

B. Spring Hanger:
   1. Spring Isolators:
      a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
      b. Code: Color code springs for load carrying capacity.
   2. Springs: Minimum horizontal stiffness equal to 75 PCT vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
   3. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators.
   4. Misalignment: Capable of 20 degree hanger rod misalignment.

C. Neoprene Pad Isolators:
   1. Rubber or neoprene-waffle pads.
      a. 30 durometer.
      b. Minimum 1/2 IN thick.
      c. Maximum loading 40 PSI.
      d. Height of ribs: not to exceed 0.7 times width.
   2. Configuration: 1/2 IN thick waffle pads bonded each side of 1/4 IN thick steel plate.

D. Rubber Mount or Hanger: Molded rubber designed for 0.5 IN deflection with threaded insert.

2.2 SEISMIC RESTRAINTS

1. Galvanized steel aircraft cables or steel angles or channels.
2. Prestretch steel aircraft cables to establish a certified minimum modulus of elasticity.
   a. Design cable restraints to resist seismic tension loads.
   b. Design steel restraints to resist both tension and compression loads with a minimum safety factor of 2.
3. Design restraint and connection assemblies that swivel to the final installation angle.
4. Do not mix cable and steel angle restraints to brace the same system.
5. Clamp steel angles to the threaded hanger rods at the seismic sway restraint locations utilizing a minimum of two ductile iron clamps.
6. Provide transverse bracing at 40 FT-0 IN maximum spacing unless noted otherwise.
7. Provide longitudinal bracing at 80 FT-0 IN maximum spacing unless noted otherwise.
8. At vertical pipe risers, wherever possible, support the weight of the riser at a point or points above the center of gravity of the riser.
   a. Provide lateral bracing at the top and bottom of the riser, and at intermediate points not to exceed 30 FT-0 IN OC.

B. Provide seismic restraints on all piping with the exception of the following:
   a. Piping less than 1 IN DIA when used for gas and compressed air.

b. Piping less than 2-1/2 IN DIA for all other cases.
c. Piping suspended by individual hangers where the distance from the top of the pipe to the bottom of the support for the hanger is 12 IN or less.
d. These restraints shall be capable of resisting seismic loads as defined in the California Building Code.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Specification Section 01 30 00: Coordination and project conditions.

B. Verify equipment and piping is installed before work in this section is started.

3.2 INSTALLATION

A. Install isolation for motor driven equipment.

B. Install spring hangers without binding.

C. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.

D. Support piping connections to isolated equipment resiliently as follows:
1. Up to 4 IN Diameter: First three points of support.
2. 5 to 8 IN Diameter: First four points of support.
3. Select three hangers closest to vibration source for minimum 1.0 IN static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 IN static deflection or 1/2 static deflection of isolated equipment.

3.3 FIELD QUALITY CONTROL

A. Division 1 Sections: Field inspecting, testing, adjusting, and balancing.

3.4 SCHEDULES

A. Pipe Isolation Schedule:

PIPE SIZE INCH	ISOLATED DISTANCE FROM EQUIPMENT
1	120 diameters
2	90 diameters
3	80 diameters
4	75 diameters
6	60 diameters
8	60 diameters

END OF SECTION

SECTION 22 05 53
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Nameplates.
   2. Tags.
   3. Stencils.
   4. Pipe markers.
   5. Labels.

1.2 REFERENCES

A. American Society of Mechanical Engineers:
   1. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

A. Product Data: Submit manufacturers catalog literature for each product required.

B. Shop Drawings: Submit a list of wording, symbols, letter size, and color coding for plumbing piping systems and equipment identification.

C. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

B. Maintain one copy of each document on site.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Nameplates, Tags and Stencils:
      a. WH Brady Company.
      b. Panduit.
      c. Seton.
      d. National Band and Tag Company.
      e. Carlton Industries, Inc.
      f. Or equal.

2.2 NAMEPLATES

A. Laminated two-layer phenolic or DR (high impact) acrylic with engraved black letters on light contrasting background color.
   1. Thickness: Minimum 1/16 IN.
   2. Color: Manufacturer standard or as specified.

B. Alternate: Laminated three-layer plastic with engraved black letters on light contrasting background color.
   1. Thickness: Minimum 60 mils.

2. Color: Manufacturer standard or as specified.

2.3 TAGS

A. Nonmetallic Tags:
   1. Fiberglass reinforced engraved black letters on light contrasting background color.
      a. Tag size: Minimum 1-1/2 IN diameter.
      b. Thickness: Minimum 100 mils.
      c. Color: Manufacturer standard or as specified.

B. Metal Tags:
   1. Aluminum or stainless steel disc with stamped letters and finished edges.
      a. Tag size: Minimum 1-1/2 IN diameter.
      b. Thickness: Minimum 0.035 IN (20 Ga).
      c. Color: Black color filled into stamped text with natural metal background.

C. Tag Chart: Typewritten letter size list of applied tags and location in anodized aluminum frame.

2.4 STENCILS

A. With clean cut symbols and letters of following size:
   1. Up to 2 IN Outside Diameter of Insulation or Pipe: 1/2 IN high letters.
   2. 2-1/2 to 6 IN Outside Diameter of Insulation or Pipe: 1 IN high letters.
   3. Over 6 IN Outside Diameter of Insulation or Pipe: 1-3/4 IN high letters.
   4. Equipment: 1-3/4 IN high letters.

B. Stencil Paint: As specified in Section 09 96 00, colors and lettering size conforming to ASME A13.1.

2.5 SELF ADHESIVE PIPE AND EQUIPMENT MARKERS

A. Color and Lettering: Conform to ASME A13.1.

B. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
   1. Thickness: Minimum 5 mils.
   2. Letter Height:
      a. Manufacturer's standard for the pipe diameter.
   3. Indoor/outdoor grade.
   4. Weather and UV resistant inks.
   5. Permanent adhesive.

2.6 UNDERGROUND WARNING TAPE

A. Description: Polyethylene tape with metallic core for detection and location of piping with metal detector resistant to acids, alkalis and other soil components.
   1. Size:
      a. 6 IN wide (minimum).
      b. Thickness: 3.5 MILS.
   2. Fabrication:
      a. Legend: Preprinted and permanently imbedded.
      b. Message continuous printed.
      c. Tensile strength: 1750 PSI

2.7 TRACER WIRE

A. 12 GA AWG.

B. Solid.

C. Waterproof type wire nuts.

D. Brass split bolts.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Section 09 96 00 for stencil painting.

3.2 INSTALLATION

A. Apply stencil painting in accordance with Section 09 96 00.

B. Install identifying devices after completion of coverings and painting.

C. All identification devices to be printed by mechanical process. Hand printing is not acceptable.

D. Install nameplates with adhesive where equipment has sufficient surface area and texture.
   1. Attach tags with 1/8 IN flat head screws where adhesive application is not suitable.
   2. Attach tabs with plastic strap where screws should not or cannot penetrate substrate.

E. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer.

F. Install tags using corrosion resistant chain. Number tags consecutively by location.

G. Install underground plastic pipe markers 6 to 8 IN below finished grade, directly above buried pipe.

H. Identify air tanks, and water treatment devices with nameplates. Identify in-line pumps and other small devices with tags.

I. Tag single items of equipment enclosed in a housing or compartment on outside of housing.
   1. Tag multiple items mounted inside a housing or compartment individually inside the housing.

J. Identify control panels and major control components outside panels with plastic nameplates.

K. Tag automatic controls, instruments, and relays. Key to control schematic.

L. Identify piping, concealed or exposed, with pipe markers. Use tags on piping 3/4 IN diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 FT on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

M. Tracer Wire:
   1. Attach to buried nonmetallic pipe at maximum of 10 FT intervals with tape or tie-wraps.
   2. Install continuously from structure to structure including valve boxes and buildings.
   3. Splice wire with split bolts or wire nuts only as needed; use continuous strands of no less than 100 FT length.

3.3 SCHEDULES

A. Above Grade Piping:
   1. Install labels on all piping in accordance with Article 3.2.
      a. Stencils or self-adhesive labels.
   2. Color Coding: Per ASME A13.1.
      a. Black lettering on yellow background:
         1) Hazardous, flammable or high temperature fluids:
            a) Domestic Hot Water
      b. White lettering on red background:
         1) Fire quenching fluids:
            a) Fire Protection Water
      c. White lettering on green background:
         1) Low temperature water:
            a) Domestic Cold Water

b) Non-potable Water

d. White lettering on blue background:
   1) Compressed Air.

B. Below Grade Piping
   1. Use underground warning tape in accordance with Article 3.2.
      a. Lettering: Minimum: 1-1/4 IN.
      b. Wording:
         1) First line: “CAUTION CAUTION CAUTION”
         2) Second line: “BURIED (Pipe Descriptor) LINE BELOW”
      c. Pipe Descriptors and color coding:
         1) Sewer or Waste: Black Lettering on Green Background.
         2) Water (potable): Black lettering on blue background.
         3) Water (non-potable): Black lettering on Green background.

C. Equipment:
   1. Provide nameplate or stencil as warranted per Article 3.2.
   2. Label with equipment tag as shown on the Drawings.
      a. Black lettering on white background.
   3. Provide OSHA warning sign for equipment that starts automatically.
   4. Label all equipment control panels located remote from unit.
   5. Label all thermostats with self-adhesive markers with tag of equipment served.

END OF SECTION

SECTION 22 11 26
PACKAGED DOMESTIC WATER PRESSURE BOOSTER SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Packaged variable speed water pressure booster system for potable water service.

1.2 QUALITY ASSURANCE

A. Reference Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. B31.9 Building Services Piping.
      b. Boiler and Pressure Vessel Code (BPVC) Section IX.
   2. American Society for Testing Materials (ASTM):
      a. A36 Standard Specification for Carbon Structural Steel.
      b. A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
      c. A234 Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
      d. A312 Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
      e. A351 Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
      f. A403 Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.
   3. Hydraulic Institute.
   4. NEMA - National Electrical Manufacturers Associations.
   5. UL - Underwriters Laboratories.
   6. NEC - National Electric Code.
   7. National Sanitation foundation:
      a. NSF-61 Drinking Water System Components – Health Effects.
      b. NSF-372 Drinking Water System Components – Lead Content.

B. Manufacturer Qualifications:
   1. UL listed as control panel manufacturer.
   2. Written and operational Quality Assurance program.
   3. Minimum ten (10) years experience in manufacturing and application of pumping systems.
   4. Accepting full responsibility for proper pressures and flows of the system.

C. Factory Tests:
   1. Hydrostatically test assembled pumping systems.
   2. Test power and control systems, and simulate control sequences and alarms.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Packaged domestic-water pressure-booster system.
      a. System arrangement and dimension drawings.

B. Product Data:
   1. Packaged domestic-water pressure-booster system.
      a. System design information including manufacturer equipment data sheets.
      b. Description of system operation, including sequences of operation, shutdown modes, safety shutoffs, alarms and monitoring points.
      c. Packaged pump system construction drawings indicating equipment dimensions and materials of construction.
      d. Pump curves indicating design points and operating horsepower.

e. Control panel wiring diagrams. Indicate electrical power supply requirements, voltage, phase, etc.
f. Provide control panel interior and exterior elevations.
g. Manufacturer catalog information on piping, valves and strainers including materials of construction, pressure and flow ratings.
h. Manufacturer data sheets for Variable Frequency Drives (VFDs).

C. Contract Closeout Information:
1. Operation and Maintenance Data.
a. System design information sheet.
b. Description of system operation.
c. Packaged system dimension and general arrangement drawing.
d. Electrical power and control wiring diagram.
e. Bill of material.
f. Pump operation and maintenance instructions.
g. Special electrical component operation instructions.
2. Factory-test reports.

1.4 DELIVERY OF EQUIPMENT

A. Configure system to be deliverable and installable through passages and doorways as indicated on Architectural drawings.
1. Factory disassemble systems for shipping and field assembly as required.
2. Provide field assembly instructions.

B. Remove drain plugs from equipment where possibility of freeze damage may exist.

C. Comply with manufacturer's instructions for rigging, unloading, and transporting equipment.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Packaged Domestic Water Pressure Booster System:
1. FlowTherm Systems FMV Variable Speed Duplex Pressure Booster System
2. Armstrong Vertical Multistage Booster System
3. Pentair Aurora Variable Speed Pressure Booster System
4. Basis of design:
a. FlowTherm FMV series, model QFMV2.1-3.

B. Pumps:
1. Goulds.
2. Grundfos.
3. Armstrong.
4. Pentair Aurora.
5. Basis of design:
a. Goulds eSV series, model 10SV5.

2.2 MATERIALS

A. Packaged System:
1. Provide components factory assembled, piped, and wired. Include the following:
a. Steel base frame, constructed of ASTM A-36 steel.
b. Electrical control panel.
c. Duplex pump assembly consisting of two pumps for lead/lag operation.
d. Motors (refer to section 23 05 13).
e. Variable Frequency Drives (VFDs).
f. Interconnecting piping, fittings, and valves arranged as shown on the contract drawings.
g. Instrumentation and control components as required to allow the system to perform in accordance with the sequences of operation noted herein and as noted on the drawings.

h. All components and interconnecting control and power wiring assembled and installed on the skid such that the system is delivered as a single packaged unit.

2. Provide a single electrical power point of connection.
3. All parts of the packaged pumping system in contact with the conveyed fluid shall be NSF-61 and NSF-372 compliant.
4. If the package needs to be broken down to allow transportation to the installed location, construct it to be broken down and assembled modularly.
   a. Modular construction:
      1) Field reconnections must be by unions, flanges, bolts, screws, and electrical plugs.
      2) Reconnection requiring cutting, welding, soldering, multiple connections to screw terminals, is not allowed.
5. Assemble package so ample room exists within the package for servicing of components.

B. Pumps:
   1. Type:
      a. Vertical inline, centrifugal, multi-stage pumps. Piped in parallel arrangement.
   2. Construction:
      a. Pumps shall consist of a base and pump head, with an impeller stack and outer sleeve secured between the base and pump head with stay bolts. Pumps shall be ground-mounted in a vertical orientation with the motor mounted vertically on top of the pump head directly coupled to the pump shaft.
      b. Pumps shall be equipped with cartridge-type mechanical shaft seals with silicone-carbide bearing rings and EPDM rubber parts.
      c. Pump base and head shall be cast iron. Impellers, pump shaft, chamber and outer sleeve shall be stainless-steel. Furnish with EPDM Outer sleeve O-rings and PTFE neck rings.
      d. All parts in contact with the water conveyed shall be type 304 stainless steel.
      e. Pumps shall be furnished with permanently lubricated ball bearings. Cast iron surfaces shall be coated with the manufacturer's standard factory applied coating.
      f. Designed so that pump can be serviced without disconnecting piping.
      g. Pumps shall not overload at any point on the pump curves.
   3. Capacity:
      a. Water Supply Pumps (BP-1 and BP-2):
         1) Flow: 53 GPM (each)
         2) Total Dynamic Head (TDH): 175 FT (each)
         3) Horsepower: 5 HP (each)
         4) Speed: 3500 RPM
         5) Voltage/Phase/Hertz: 460/3/60

C. Piping, Fittings, Manual Valves, and Piping Specialties:
   1. Piping: Type 304 stainless steel, Schedule 40, per ASTM A312.
   2. Joints: Threaded or welded.
   3. Fittings: Type 304 stainless steel, per ASTM A351, Class 150 pressure rating; or type 304 ASTM A-403 butt-welded fittings for welded joints.
   4. Provide isolation valves on suction and discharge from each pump.
   5. Provide spring-loaded check valve on discharge from each pump.
   6. Provide wye type strainer on pump suction side.
   7. Supports:
      a. Provide supports for the following:
         1) Suction header.
         2) Suction and discharge piping on each pump.
         3) Discharge header.
      b. Support piping independently of pump connections.
   8. Pressure gauges on suction and discharge header.
   9. Shut-off valves on control sensing lines and gauges.
   10. Welded piping shall conform to ASME B31.9 Building Services Piping and ASME BPVC Section IX.

11. Packaged pump systems shall be hydrostatically leak tested at 125 psi for a duration of one hour.

D. Electrical Control Panel:
   1. UL listed.
   2. NEMA 1 enclosure.
   3. Disconnect switch accessible from exterior of panel enclosure.
   4. Individual circuit breakers for each pump VFD.
   5. Hand-off-auto switches for each pump accessible from exterior of panel.
   6. Lead pump selector with automatic and manual alternation.
   7. Microprocessor based PLC controls to monitor all sensor inputs.
      a. Control pump speed based on pressure feedback.
      b. Field programmable.
      c. Data entry in engineering units by keypad or digital touchscreen interface.
      d. PID control.
      e. Digital graphic display for monitoring pump status, alarms and adjusting system setpoints.
      f. Digital display shall be visible and accessible from exterior of panel.
      g. Control circuit transformer with protected primary and secondary.
      h. Monitor suction and discharge pressure at pressure transducers by means of a hardwired 4-20 mA DC or 0-10 VDC signals.
   8. Power on light.
   9. Run light for each pump, and contact for remote output.
   10. Elapsed run-time meter for each pump.
   11. Low-suction and high discharge pressure cutout with alarm and contact for remote output.
   12. Pump failure alarm light, reset pushbutton, and contact for remote output.
   13. Pressure/Temperature transmitters:
      a. Self-contained, variable capacitance type.
      b. Install pressure transducers in suction and discharge side of each pump factory wired to the control panel.
      c. Temperature transducers on the discharge header of each pump factory wired to control panel.
   14. Transient snubbers on inductive loads in panel.
   15. Integrate variable frequency drives with control panel.
   16. Provide signal isolating buffers on internal and external 4-20mA circuits where utilized by more than 2 devices.

2.3 SEQUENCES OF OPERATION

A. Provide HAND-OFF-AUTO switches for each pump for manual or automatic operation.

B. Provide lead pump selector switch with automatic and manual alternation.

C. When in HAND mode, the pump shall run continuously.

D. When in AUTO mode, the pump speed shall automatically adjust as needed to match system pressure to the discharge pressure setpoint (adjustable) in the discharge header.

E. Lead pump shall start on a drop in system pressure. When system pressure drops below setpoint (adjustable), the lead pump sleep timer shall start. After the sleep time period (adjustable) has expired, the lead pump shall start. The lead pump shall stop when the system pressure reaches setpoint, or after an adjustable minimum run time.

F. When the lead pump is at maximum speed and the system pressure continues to drop, the lag pump sleep timer shall start. After the sleep time period (adjustable) has expired, the lag pump shall start and operate with the lead pump. The lag pump shall stop when the system pressure reaches setpoint, or after an adjustable minimum run time.

G. Alarms:
   1. Low suction pressure alarm with automatic pump shutoff and contacts for remote output.

2. High discharge pressure alarm with automatic pump shut-off and contacts for remote output.
3. High discharge temperature with automatic pump shut-off with contacts for remote output.

H. Refer to the drawings for additional control requirements.

2.4 DEMONSTRATION

A. System manufacturer or manufacturer's representative: Provide start-up and adjustment service for the packaged pumping system.

B. System manufacturer or manufacturer's representative: Provide a minimum 2 HRS of training for the owner's personnel on the operation and maintenance of the packaged pumping system.

C. System manufacturer: Have factory trained authorized service agency located within 100 miles of the project site.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The Contractor shall start up each piece of equipment and system and shall make all adjustments so that the system is placed in proper operating condition to the satisfaction of the Owner and Engineer.

B. Complete installation and startup checks according to manufacturer's instructions. Ensure that the pump system is operating in accordance with control sequences noted on the drawings and in accordance with manufacturer recommendations.

C. The Contractor shall not install any equipment or materials until the Owner and Engineer have approved all submittals. If any equipment or materials are installed prior to approval of the submittals, it shall be at the Contractor's risk.

D. Properly maintain and service all equipment and systems until the particular equipment or the system has been accepted by the Engineer.

E. Manufacturer's representatives who have complete knowledge of the proper operation and maintenance of the equipment shall be provided to instruct Operations staff on proper operation and maintenance.

F. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION

SECTION 22 20 00
PLUMBING FIXTURES AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Plumbing fixtures, trim, and equipment.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 01 61 03 - Equipment: Basic Requirements.
   4. Section 23 05 13 - Common Motor Requirements for Plumbing and HVAC Equipment.
   5. Section 40 05 00 – Pipe and Pipe Fittings – Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Americans with Disabilities Act (ADA):
      a. Accessibility Guidelines for Buildings and Facilities (ADAAG).
   2. American National Standards Institute (ANSI):
      a. Z358.1, Emergency Eyewash and Shower Equipment.
   3. American Society of Heating, Refrigerating and Air Conditioning Engineers/Illuminating Engineering Society of North America (ASHRAE/IESNA):
      a. 90.1 IP, Energy Standard for Buildings Except Low-Rise Residential Buildings.
   4. American Society of Mechanical Engineers (ASME):
      a. A112.19.3, Stainless Steel Plumbing Fixtures (Designed for Residential Use).
   5. American Society of Sanitation Engineers (ASSE):
      a. 1011, Performance Requirements for Hose Connection Vacuum Breaker.
   6. Canadian Standards Association (CSA).
   7. National Sanitation Foundation, International (NSF).
   8. Underwriters Laboratories, Inc. (UL).

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Color and finish options for Owner selection.
   3. Fabrication and/or layout drawings:
      a. Layout plan(s) showing dimensions, elevations, etc.
      b. Details showing connections, installation, rough-in locations, etc.
   4. Product technical data including:
      a. Manufacturer data sheets for all equipment and fixtures indicating:
         1) Dimensions, pipe connection sizes, weights, materials of construction and finishes.
         2) Performance information including rated flow.
         3) Maximum operating pressure and temperature.
         4) Electrical power supply requirements.
      b. Acknowledgement that products submitted meet requirements of standards referenced.
      c. Manufacturer's installation instructions.
      d. Chemical-resistance data.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:

a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Plumbing fixtures (vitreous china):
      a. American Standard.
      b. Sloan.
      c. Crane.
      d. Kohler.
      e. Eljer.
      f. Or equal.
   2. Premolded mop sinks:
      a. Powers - Fiat.
      b. Standard - Elsmer Granite Co.
      c. Williams.
      d. Florestone.
      e. Or equal.
   3. Water closet seats:
      a. American Standard.
      b. Sloan.
      c. Church.
      d. Beneke.
      e. Or equal.
   4. Lavatory fittings:
      a. American Standard.
      b. Chicago Faucets.
      c. Kohler.
      d. Sloan.
      e. Or equal.
   5. Mop sink fittings:
      a. American Standard.
      b. Chicago Faucets.
      c. Kohler.
      d. Or equal.
   6. Floor drains, carriers, and shock absorbers:
      a. Wade.
      b. Josam.
      c. Zurn.
      d. JR Smith.
      e. Or equal.
   7. Hose bibs:
      a. Nibco.
      b. Woodford.
      c. Milwaukee.
      d. Or equal.
   8. Yard Hydrants:
      a. Woodford.
      b. Simmons Manufacturing Company.
      c. Or equal.
   9. Reduced pressure backflow preventer:
      a. Watts.

b. Febco.
c. Clayton.
d. Or equal.

10. Hydro-pneumatic bladder tanks:
    a. Wessels.
    b. Amtrol.
    c. Watts.
    d. Or equal.

2.2 MANUFACTURED UNITS

A. Plumbing Fixtures (Vitreous China):
1. Water closet (WC):
    a. White.
    b. Fully glazed trap-way.
    c. 1.28 GAL per flush.
    d. Pressure-assisted, tank-type, siphon jet action.
    e. Elongated bowl.
    f. Close-coupled tank.
    g. Chrome flush handle.
    h. Heavy duty frontless seat, less the cover.
    i. Bolt caps.
    j. Type:
        1) WC-1: handicapped accessible, floor mounted, Sloan WETS 8029.8010.
2. Lavatory (L):
    a. White.
    b. Front overflow.
    c. Faucet holes 4 IN on center.
    d. Type:
        1) L-1: wall hung, 20 x 18 IN, American Standard "Lucerne" 0355.027.
3. Mop sink (MS):
    a. Precast terrazzo (marble chips cast in Portland cement, ground and polished with all air voids grouted).
    b. One-piece.
    c. Drop front.
    d. 2 IN wide shoulder.
    e. Stainless steel threshold.
    f. Integral drain body, removable strainer and 3 IN drain pipe.
    g. Type:
        1) MS-1: Fiat MSB 2424, (square) 24 x 24 x 10 IN.

B. Toilet Seat:
1. Molded plastic.
2. Open front.
3. No cover.
4. Stainless steel hinge with check.
5. For elongated bowl.

C. Lavatory Fittings, for L-1:
1. Aerator.
2. 1-1/4 IN tail piece.
3. Coupling nuts.
4. Chrome plated.
5. Electronic Faucet:
    a. Hardwired type
    b. ADA compliant.
    c. Max Flow: 0.5 GPM
    d. Above deck mixing valve.

e. Sensor range adjustment screw.
f. LED indicator lights.
g. Filtered solenoid valve with serviceable "Y" strainer filter.
h. Bak-chek tee.
i. Supply stop valves.
j. Trim plate (4 IN center) with anti-rotation pin.
k. 120 VAC/24 VAC transformer.
l. Vandal resistant spray head.
m. Type: Sloan Optima Model ETF-80.

D. Mop Sink Fittings:
1. Mop Sink Faucet:
a. Mounted on wall with pipe chase behind.
b. Independent hot and cold levers.
c. Integral supply stop valves and vacuum breaker.
d. Chrome plated cast brass construction.
e. Bucket hook and 3/4" male hose threads on spigot.
f. Type:
1) MS-1: American Standard 8344.012.

E. Drains:
1. Floor drain (FD):
a. Bottom outlet.
b. Clamping seepage flange.
c. Seepage openings.
d. No-hub or push-on gasketed piping connection.
e. Size as shown on Drawings.
f. Type: Cast iron body.
1) FD-1 (finished area): Adjustable satin nickel bronze strainer, Wade W-1100-A.
2) FD-2 (sump and trench drains): Heavy duty cast iron grate and sump, Wade 1310.

F. Traps:
1. Floor and equipment drains:
a. Same material and coating as the piping system.
b. 3 IN minimum seal.
2. Fixture drains:
a. 2 IN minimum seal.
b. Cast brass.
c. Chrome plated.
d. Size as required.

G. Cleanouts (CO):
1. Cleanouts for cast iron pipe:
a. Tapped extra heavy duty cast iron ferrule, coated for corrosion protection.
b. Inside caulk or no-hub pipe connection.
c. Brass or ABS threaded plug.
2. Cast iron access housing with adjustable heavy duty cast iron scoriated cover.
3. Cleanouts turning out through walls and up through floor shall be made by long sweep ells or "y" and 1/8 bends with plugs and face or deck plates to conform to architectural finish in room.
4. Where definite finish is not indicated, wall plates shall be chrome-plated cast-brass and floor plates polished brass.
5. Provide cleanouts of same size as pipe up to 4 IN and not less than 4 IN for larger pipes.
6. Close access openings for concealed cleanouts with flush floor or flush wall cover plates or flush ceiling access panels.
7. Provide wall plates with chrome plated cast-brass round cleanout cover with flanged ring.
a. Provide screws which match cover plate material.

8. Cleanouts installed in completely accessible pipe chases or where piping is exposed do not require special covers.
9. Manufacturer make/model:
    a. Floor Cleanouts: Zurn Z1400.
    b. Wall Cleanouts: Zurn Z1446.

H. Hose Bibb (HB-1):
1. Gate valve with 3/4 IN male hose threads and attached vacuum breaker.
2. Vacuum breaker: Non-removable, manual draining, meeting the requirements of ASSE 1011.
3. Type: Woodford Model 24.

I. Hose Bibb (HB-2):
1. 3/4 IN angle globe valve.
2. Brass or bronze body construction, Class 125, female threaded end connections.
3. Furnish with ASSE 1011 vacuum breaker and male hose thread adapter.
4. Type: Midline model 96564

J. Yard hydrant (YH-1):
1. Freeze-proof.
2. Automatic draining.
3. Backflow protected.
4. Galvanized steel or corrosion resistant casing.
5. 1 IN female threaded inlet connection.
6. 3/4 IN male hose thread outlet connection.
7. Bury depth of valve body as noted on the drawings.
8. Type:
    a. YH-1: Woodford model Y-2.

K. Hose Racks:
1. Wall mounted.
2. Stainless steel construction.
3. Capable of holding 50ft in length of 3/4-IN hose.
4. Provide 50 ft of 3/4-IN industrial rubber hose at each hose rack.
5. Provide an industrial hose nozzle with each hose with adjustable spray pattern, cast brass construction, pistol grip and insulated handle.
6. Type:
    a. Strahman Valves Inc, model HR-100, or equal.

L. Reduced Pressure Backflow Preventer:
1. Backflow preventers consist of two check valves in series, test cocks and relief valve, all assembled as an integral unit.
2. Provide dielectric fittings or flanges when connecting to dissimilar pipe materials.
3. 150 psi maximum working pressure.
4. Pressure loss through backflow preventer not exceeding 12 PSI at design flow.
5. Pipe drain discharge to nearest floor or hub drain or to within 6 IN of finished floor. Provide 1 IN air gap when discharging into drain.
6. Provide wye strainer upstream to protect valve seats.
7. Provide air gap drain at relief valve.
8. Lead free construction.
9. NSF and IAPMO approval.
10. Type:
    a. For line sizes 2-inch and smaller:
        1) Bronze body construction, stainless steel seats, quarter turn ball valves, threaded end connections,
        2) Watts LF909 Small, or equal.
    b. For line sizes 2-1/2 inch and larger:

1) Cast iron valve body construction, stainless steel seats, resilient seated gate valves, non-rising stem, flanged end connections.
2) Watts LF909 Large, or equal.

M. Hydro-pneumatic Pressure Tank:
1. ASME rated, designed and constructed in accordance with Section VIII of the latest edition of the Boiler and Pressure Vessel code.
2. Pressure tanks shall contain a heavy-duty pre-charged butyl bladder separating the air space from the water. Bladders in contact with the water shall be NSF-61 certified for use in potable drinking water systems.
3. Threaded NPT piping connections.
4. Constructed of carbon sheet steel with manufacturer's standard coating on the outside of the tank.
5. Tanks shall be furnished pre-charged and shall contain a standard Schrader valve for adjusting tank air pressure to match field conditions.
6. Expansion tanks shall be constructed for a maximum 150 psig operating pressure.
7. Tanks shall have skirts for floor mounting in vertical orientation unless noted otherwise.
8. Tanks shall have the following capacities:
   a. Tag Number: PT-1
      1) Tank volume: 132 gallons
      2) Acceptance volume: 132 gallons
      3) Connection size: 1-1/2"
      4) Diameter: 31"
      5) Height: 61"
      6) Weight: 265 lbs. (dry)
      7) Manufacturer and Model: Wessels FX-500V

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fixtures:
1. Install fixtures at locations indicated on Drawings and in compliance with local Codes.
2. Connect plumbing supply, drain and vent line sizes as shown on Drawings.
3. Seal fixture joints abutting walls and floors with silicone sealant.
4. Connect exposed traps and supply pipes for fixtures and equipment to rough piping systems at wall, unless otherwise specified.

B. Drains:
1. Install drains at locations indicated on Drawings and in compliance with local Codes.
2. In uncovered concrete slabs:
   a. Install at the low points of surface areas to be drained or as indicated.
   b. Set tops of drains flush with the finished floor.
   c. Install drain flashing collar or a flange so that no leakage occurs between the drain and the adjoining surfaces.
   d. Maintain the integrity of waterproof membranes, where penetrated.

C. Yard Hydrants:
1. Install plumb.
2. For buried applications, install Schedule 80 PVC drainage nipple sized to match drain port as provided by manufacturer.
3. Extent nipple into crushed rock.
4. For applications at elevated slabs, provide 1/2 IN Schedule 80 PVC from drain port to drain.

D. Hose Racks:
1. Adjacent to yard hydrants and hose bibs (HB-2), top of hose racks at 36 IN above finished floor or grade.

2. Concrete or masonry walls: Mount with 5/8 IN x 2-1/2 IN stainless steel expansion anchors.

E. Hose Bibbs:
   1. Install 36 IN above finished floor.
   2. In exterior locations, provide interior isolation valve.

F. Cleanouts:
   1. Install cleanouts:
      a. Above floor in each vertical riser that connects to horizontal branch below floor.
      b. At test tee to receive proper test plugs in each vertical riser at least every other floor.
      c. As required by local Code.

3.2 FIELD QUALITY CONTROL

A. Test piping and fixtures for leaks per Specification Section 40 05 00.

END OF SECTION

SECTION 22 33 13
INSTANTANEOUS DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. All labor and materials for the complete installation of electric instantaneous domestic water heaters indicated and scheduled on Contract Drawings including but not limited to the following components: controls, piping, valves, wiring, vents, supports, accessories and testing for a code compliant operable installation.

B. Related sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 40 05 00 – Pipe and Pipe Fittings – Basic Requirements.
   4. Section 40 42 00 – Pipe, Duct and Equipment Insulation.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
   2. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
      a. 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
   3. International Code Council (ICC):
      a. IPC, International Plumbing Code.
   4. International Organization for Standardization (ISO):
      a. 9001, Quality Management Systems- Requirements.
   5. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code.
   6. NSF International (NSF).
   7. Underwriters Laboratories, Inc. (UL).

B. Design heaters to limit the maximum temperature to avoid scalding possibilities at low flow rates and provide constant set hot water temperatures whether one or multiple faucets are open simultaneously.

C. Manufacturer Qualifications:
   1. Company shall have minimum three years documented experience specializing in manufacturing the products specified in this Specification Section.
   2. Water heaters shall be manufactured by a company that has achieved certification to the ISO 9001.
   3. Provide equipment with manufacturer's name, model number, and rating/capacity permanently identified.

D. Installer Qualifications:
   1. Company shall have minimum three years documented experience specializing in performing the Work of this Specification Section.
      a. Installation of plumbing systems shall be performed by individuals licensed as a Journeyman or Master Plumber by the state in which the work is performed.
      b. Installation may be performed by Apprentice Plumbers provided they are registered with the state and under direct supervision of a licensed plumber.
      c. All installation shall be supervised by a licensed Master Plumber.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Submit product technical data including:
      a. Dimension drawings of water heaters indicating piping connection sizes, components and required connections.
      b. Manufacturer's data sheets indicating capacity, water heating performance and installation instructions.
      c. Wiring diagrams, electrical characteristics, minimum water pressure requirements and connection types.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
   2. Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

1.4 DELIVERY, STORAGE AND HANDLING

A. Accept products on Site in factory packaging.
   1. Inspect for damage.
   2. Maintain products in factory packaging until installation.

B. Provide temporary inlet and outlet caps when not factory provided.
   1. Maintain caps in place until installation.

C. Protect components from damage after installation.

D. Do not allow use of heater for any reason, other than testing, during the construction phase of this project.

1.5 WARRANTY

A. Provide full written description of manufacturer's warranty.

B. Water heaters shall be warranted in writing against failure due to leaks of heater body and element assembly under normal use and service for a minimum period of five years after date of Substantial Completion.
   1. Electric heating element shall be warranted for a minimum period of one year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.

2.2 GENERAL

A. Furnish and install instantaneous domestic hot water heaters with dimensions, capacities and electrical characteristics as scheduled on the Contract Drawings and as outlined herein.
   1. This Specification describes minimum quality and performance requirements.
   2. Variations of system components by the individual referenced manufacturers are acceptable for installation in this project provided they meet or exceed all of the requirements indicated herein and on the schedules, are compatible with the electrical service provided and fit properly in the allocated space.

2.3 POINT OF USE DOMESTIC WATER HEATER (TANKLESS)

A. Manufacturers:

1. Eemax.
2. Stiebel Eltron.
3. Seisco.
4. EcoSmart.
5. Rheem.
6. Or equal.

B. All point-of-use water heaters provided within this project shall be the product of one manufacturer.

C. Water Heater shall be tankless, instantaneous electric type with microprocessing temperature control capable of maintaining set outlet temperature with ±1 DEGF accuracy with a minimum water supply pressure of 25 PSIG.

D. Unit shall be rated for a maximum operating pressure of 150 PSIG.

E. Unit shall have field replaceable heating elements.

F. Heating element shall be iron free, Nickel Chrome, stainless steel or brass/copper material.

G. Heater shall be fitted with 1/2 IN pipe compression nuts (5/8 IN OD) or 3/8 IN sleeves.
   1. Solder type piping connections are not acceptable.

H. Heater shall have a thermostat with fully adjustable temperature range between 100-130 DEGF, unless indicated otherwise on Contract Drawings.

I. ASHRAE 90.1.

J. UL listed.

K. ISO-9001.

2.4 MAINTENANCE MATERIALS

A. For electric type heaters, furnish and provide to Owner a minimum of one spare heating element for each size and type of heater provided within this project.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All installation shall be in accordance with:
   1. The California Plumbing Code.
   2. NFPA 70, National Electrical Code,

B. All installation shall be in accordance with manufacturer's installation instructions.

C. Furnish all supports required by the equipment included in this Contract in accordance with the manufacturer's published instructions.

D. Furnish and install all necessary valves, strainers, unions, etc. to facilitate proper functioning and servicing of equipment.

E. Provide dielectric isolation device where copper lines connect to ferrous lines or equipment.

F. Install heater in a vertical position as close as possible to the hot water outlets with a minimum of 6 IN" of clearance on all sides for servicing or as shown on the Contract Drawings.
   1. Coordinate location of unit to avoid conflicts with piping, electrical outlets, casework and handicap access to plumbing fixture.
   2. Do not install unit where it would routinely be splashed with water.

G. Install a line size shutoff valve in cold water inlet close to each heater.

H. Flush water supply line to remove all air, scale and dirt prior to connecting heater.

I. Take precautions to prevent heat generated by soldering procedures from being transmitted to heater components.

J. Verify and insure that flow control outlets on faucets being served by water heater correspond with the flow requirements of the installed heater.

K. Coordinate with Electrical Contractor for power and wiring required.
   1. Verify that electrical power is connected to a properly grounded dedicated branch circuit of proper voltage rating and equipped with ground fault interrupter.
   2. Each electric heater shall be provided with an independent circuit.
   3. Insure that the correct wire and circuit breaker sizes are provided.

3.2 FIELD QUALITY CONTROL

A. When all plumbing installation is completed, check for leaks and take corrective action before proceeding.
   1. Flow hot water until temperature has stabilized.
   2. Verify that the water meets scheduled temperature at all outlets.

B. Clean heater water inlet line strainer prior to final inspection of installation.

END OF SECTION

DIVISION 23

HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 05 13
COMMON MOTOR REQUIREMENTS FOR PLUMBING AND HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Equipment furnished for plumbing and HVAC systems.
2. Single phase motors for plumbing and HVAC equipment.
3. Three-phase motors for plumbing and HVAC equipment.
4. Motors shipped loose for installation in plumbing and HVAC equipment.

B. Related Sections include but are not necessarily limited to:
1. Division 00 - Procurement and Contracting Requirements.
2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
1. American Bearing Manufacturers Association (ABMA).
2. International Electrotechnical Commission (IEC).
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE).
4. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   b. ICS 6, Enclosures for Industrial Control and System.
   c. MG 1, Motors and Generators.
5. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC):
6. Occupational Safety and Health Administration (OSHA):
   a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.
7. Underwriters Laboratories, Inc. (UL):
   a. 508A, Standard for Industrial Control Panels.
   b. 698A, Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations.

1.3 SUBMITTALS

A. Shop Drawings:
1. See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Equipment technical data including:
   a. Acknowledgement that products submitted meet requirements of standards referenced.
   b. Data sheets that include manufacturer's name and complete product model number.
      1) Clearly identify all optional accessories that are included.
   c. Equipment identification utilizing numbering system and name utilized in Drawings.
   d. Equipment installation details:
      1) Location of anchorage.
      2) Type, size, and materials of construction of anchorage.
      3) Anchorage setting templates.
      4) Manufacturer's installation instructions.
   e. Equipment physical characteristics:
      1) Dimensions (both horizontal and vertical).
      2) Materials of construction and construction details.
      3) Shipping and operating weight.
      4) Duct and piping connection sizes, type and location.

f. Equipment lining and coatings:
   1) Equipment factory primer and paint data.
g. Operating characteristics:
   1) Electrical requirements.
   2) Performance curves.
   3) Equipment capacity and efficiency.
h. Electric motors:
   1) Nameplate data.
   2) Performance data.
i. Control panels:
   1) Panel layout and construction.
   2) Control ladder diagrams.
   3) Nameplate schedule.
   4) Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70, include any required calculations.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, refer to individual equipment Specification Sections for acceptable manufacturers.

B. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Motors:
      a. Baldor.
      b. General Electric.
      c. Hyundai Heavy Industries.
      d. Marathon Electric.
      e. Rockwell - Reliance.
      f. Siemens.
      g. TECO-Westinghouse.
      h. Toshiba U.S.
      i. U.S. Motors, Nidec Motor Corporation.
      j. WEG.
      k. Or equal.

2.2 MANUFACTURED UNITS

A. Equipment: Refer to individual equipment Specification Sections for product requirements.

B. Electric Motors:
   1. Design for frequent starting duty equivalent to duty service required by driven equipment.
   2. Design for full voltage starting.
   3. Design bearing life based upon actual operating load conditions imposed by driven equipment.
   4. Size for altitude of Project.
   5. Furnish with stainless steel nameplates which include all data required by NFPA 70 (NEC), Article 430.
   6. Use of manufacturer's standard motor will be permitted on integrally constructed motor driven equipment specified by model number in which a redesign of the complete unit would be required in order to provide a motor with features specified.

7. AC electric motors less than 1/3 HP:
    a. Single phase, 60 Hz, designed for the supply voltage shown on the Drawings.
    b. Permanently lubricated sealed bearings conforming to ABMA standards.
    c. Built-in manual reset thermal protector or manual motor starter with thermal overload element and stainless steel enclosure.
8. AC electric motors 1/3 to 1 HP:
    a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
    b. Permanently lubricated sealed bearings conforming to ABMA standards.
        1) For single phase motors, provide built-in manual reset thermal protector or manual motor starter with thermal overload element.
9. AC electric motors 1-1/2 to 10 HP:
    a. 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
    b. Permanently lubricated sealed bearings conforming to ABMA standards.
    c. For vertical motors provide 15 year, average-life thrust bearings conforming to ABMA standards.

C. NEMA Design Squirrel Cage Induction Motors:
1. Provide motors designed and applied in compliance with NEMA and IEEE for the specific duty imposed by the driven equipment.
2. Motors to meet NEMA MG 1 (NEMA Premium) efficiencies.
3. Do not provide motors having a locked rotor kVA per HP exceeding the NEMA standard for the assigned NEMA code letter.
4. For use on variable frequency type adjustable speed drives, provide:
    a. Induction motors that are in compliance with NEMA MG 1, Part 31.
    b. Nameplate identification meeting NEMA MG 1, Part 31 requirements.
    c. Insulated drive end bearing on all motors.
    d. Shaft grounding ring on all motors:
        1) Factory installed, maintenance free, circumferential, bearing protection ring with conductive microfiber shaft contacting material.
        2) Electro Static Technology AEGIS SGR Bearing Protection Ring or approved equal.
5. Design motor insulation in accordance with NEMA standards for Class F insulation with Class B temperature rise above a 40 DEGC ambient.
6. Design motors for continuous duty.
7. Size motors having a 1.0 service factor so that nameplate HP is a minimum of 15 PCT greater than the maximum HP requirements of the driven equipment over its entire operating range.
    a. As an alternative, furnish motors with a 1.15 service factor and size so that nameplate HP is at least equal to the maximum HP requirements of the driven equipment over its entire operating range.
8. Motor enclosure and winding insulation application:
    a. The following shall apply unless modified by specific Specification Sections:

MOTOR LOCATION	MOTOR ENCLOSURE / WINDING INSULATION
Unclassified Indoor Areas	DPFG (for horizontal motors)
Wet indoor Areas	TEFC, Standard Insulation
Wet outdoor Areas	TEFC, Extra Dip and Bake for Moisture
Corrosive Areas	TEFC, Severe/ Chemical Duty

NOTE: Provide TENV motors in the smaller horsepower ratings where TEFC is not available.

9. Provide oversize conduit box complete with clamp type grounding terminals inside the conduit box.

D. Submersible Motors: Refer to individual narrow-scope Specification Sections for submersible motor requirements.

E. V-Belt Drive:
   1. Provide each V-belt drive with sliding base or other suitable tension adjustment.
   2. Provide V-belt drives with a service factor of at least 1.5 at maximum speed.
   3. Provide static proof belts.

2.3 ACCESSORIES

A. Guards:
   1. Provide each piece of equipment having exposed moving parts with full length, easily removable guards, meeting OSHA requirements.
   2. Interior applications:
      a. Construct from expanded galvanized steel rolled to conform to shaft or coupling surface.
      b. Utilize non-flattened type 16 GA galvanized steel with nominal 1/2 IN spacing.
      c. Connect to equipment frame with hot-dip galvanized bolts and wing nuts.
   3. Exterior applications:
      a. Construct from 16 GA stainless steel or aluminum.
      b. Construct to preclude entrance of rain, snow, or moisture.
      c. Roll to conform to shaft or coupling surface.
      d. Connect to equipment frame with stainless steel bolts and wing nuts.

B. Data Plate:
   1. Attach a stainless steel data plate to each piece of rotary or reciprocating equipment.
   2. Permanently stamp information on data plate including manufacturer's name, equipment operating parameters, model number, serial number and speed.

C. Lifting Eye Bolts or Lugs:
   1. Provide on all equipment 50 LBS or greater.
   2. Provide on other equipment or products as specified in the narrow-scope Specification Sections.

2.4 FABRICATION

A. Manufacture individual parts to standard sizes and gages so that repair parts, furnished at any time, can be installed in field.

B. Furnish like parts of duplicate units to be interchangeable.

C. Ensure that equipment has not been in service at any time prior to delivery, except as required by tests.

D. Furnish equipment which requires periodic internal inspection or adjustment with access panels which will not require disassembly of guards, dismantling of piping or equipment or similar major efforts.
   1. Quick opening but sound, securable access ports or windows shall be provided for inspection of chains, belts, or similar items.

E. Provide common, lipped base plate mounting for equipment and equipment motor where said mounting is a manufacturer's standard option.
   1. Provide drain connection for 3/4 IN PVC tubing.

F. Machine the mounting feet of rotating equipment.

G. Fabricate equipment which will be subject to Corrosive Environment in such a way as to avoid back to back placement of surfaces that cannot be properly prepared and painted.
   1. When such back to back fabrication cannot be avoided, provide continuous welds to seal such surfaces from contact with corrosive environment.
   2. Where continuous welds are not practical, after painting seal the back to back surfaces from the environment.

H. Critical Speed:
   1. All rotating parts accurately machined and in as near perfect rotational balance as practicable.
   2. Excessive vibration is sufficient cause for equipment rejection.
   3. Ratio of all rotative speeds to critical speed of a unit or components: Greater than 1.2.

I. Control Panels Engineered and Provided with the Equipment by the Manufacturer:
   1. Manufacturer's standard design for components and control logic unless specific requirements are included in the specific equipment Specification Section.
   2. NEMA or IEC rated components are acceptable, whichever is used in the manufacturer's standard engineered design, unless specific requirements are included in the specific equipment Specification Section.
   3. Affix entire assembly with a UL 508A or UL 698A label "Listed Enclosed Industrial Control Panel" prior to delivery.
      a. Control panels without an affixed UL 508A or UL 698A label shall be rejected.
   4. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
      a. Determine the SCCR rating by one of the following methods:
         1) Method 1: SCCR rating meets or exceeds the available fault current of the source equipment when indicated on the Drawings.
         2) Method 2: SCCR rating meets or exceeds the source equipment's Amp Interrupting Current (AIC) rating as indicated on the Drawings.
         3) Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.
      b. The source equipment is the switchboard, panelboard, motor control center or similar equipment where the control panel circuit originates.
      c. For Method 3, provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.

2.5 SHOP OR FACTORY PAINT FINISHES

A. Electrical Equipment:
   1. Provide factory-applied paint coating system(s) for all electrical equipment components.

B. Field paint other equipment that did not receive a factory applied coating in accordance with Section 09 96 00.
   1. See Section 09 96 00 for factory applied primer/field paint compatibility requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment as shown on Drawings and in accordance with manufacturer's directions.

B. Utilize templates for anchorage placement for slab-mounted equipment.

C. For equipment having drainage requirements such as condensate, provide 3/4 IN PVC or clear plastic tubing from equipment base to nearest floor or equipment drain.
   1. Route clear of major traffic areas and as approved by Engineer.

D. Extend all non-accessible grease fittings using stainless steel tubing to a location which allows easy access of fittings from closest operating floor level.

E. Equipment Base:
   1. Construct level in both directions.
   2. Take particular care at anchor bolt locations so these areas are flat and level.

F. Machine Base:
   1. Mount machine base of rotating equipment on equipment base.

a. Level in both directions, using a machinist level, according to machined surfaces on base.

2. Level machine base on equipment base and align couplings between driver and driven unit using steel blocks and shims.
   a. Size blocks and shims to provide solid support at each mounting bolt location.
      1) Provide area size of blocks and shims approximately 1-1/2 times area support surface at each mounting bolt point.
   b. Provide blocks and shims at each mounting bolt.
      1) Furnish blocks and shims that are square shape with "U" cut out to allow blocks and shims to be centered on mounting bolts.
   c. After all leveling and alignment has been completed and before grouting, tighten mounting bolts to proper torque value.

3.2 INSTALLATION CHECKS

A. For all equipment specifically required in detailed specifications, secure services of experienced, competent, and authorized representative(s) of equipment manufacturer to visit site of work and inspect, check, adjust and approve equipment installation.
   1. In each case, representative(s) shall be present during placement and start-up of equipment and as often as necessary to resolve any operational issues which may arise.

B. Secure from equipment manufacturer's representative(s) a written report certifying that equipment:
   1. Has been properly installed and lubricated.
   2. Is in accurate alignment.
   3. Is free from any undue stress imposed by connecting piping or anchor bolts.
   4. Has been operated under full load conditions and that it operated satisfactorily.
      a. Secure and deliver a field written report to Owner immediately prior to leaving jobsite.

C. No separate payment shall be made for installation checks.
   1. All or any time expended during installation check does not qualify as Operation and Maintenance training or instruction time when specified.

3.3 FIELD HIGH PERFORMANCE INDUSTRIAL COATINGS

A. For required field High Performance Industrial Coatings, comply with Section 09 96 00.

3.4 WIRING CONNECTIONS AND TERMINATION

A. Clean wires before installing lugs and connectors.

B. Coat connection with oxidation eliminating compound for aluminum wire.

C. Terminate motor circuit conductors with copper lugs bolted to motor leads.

D. Tape stripped ends of conductors and associated connectors with electrical tape.
   1. Wrapping thickness shall be 150 PCT of the conductor insulation thickness.

E. Connections to carry full ampacity of conductors without temperature rise.

F. Terminate spare conductors with electrical tape.

END OF SECTION

SECTION 23 05 93
HVAC SYSTEMS - BALANCING AND TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Adjusting, balancing, and testing of all heating, ventilating and air conditioning (HVAC) systems, including the following systems:
      a. Exhaust and Supply fans.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 23 31 00 - HVAC - Ductwork.
   4. Section 23 34 00 - HVAC - Fans.
   5. Section 23 80 00 - HVAC - Equipment.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Associated Air Balance Council (AABC):
      a. National Standards for Total System Balance.
   2. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
      a. HVAC Systems and Equipment Handbook, Chapter entitled "Testing, Adjusting, and Balancing".
   3. National Environmental Balancing Bureau (NEBB):
      a. Procedural Standards for Testing Adjusting Balancing of Environmental Systems.

B. Qualifications:
   1. Work of this Section to be accomplished by an independent testing and balancing firm certified by one (1) of the following:
      a. Associated Air Balance Council (AABC).
      b. National Environmental Balancing Bureau (NEBB).
      c. Other certification entity approved by Engineer.
   2. The independent firm shall not be the same firm as the firm installing the HVAC equipment, nor under contract to the firm installing the equipment.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Certifications:
      a. Letter stating the name and qualifications of the firm proposed.
      b. Evidence that relevant subcontractors have been notified of the requirement to coordinate balance and test elements in the work with the testing and balancing firm.
   3. Report forms:
      a. Procedures and forms to be used in calibrating of test instruments, balancing systems, and recording and reporting test data.

B. Informational Submittals:
   1. Submit completed test and balance reports and data forms upon completion of installation, balance and testing of HVAC systems.
      a. Insert recorded information on report forms required by specifications and approved for use on project.

b. Additional written verification and other related information clearly identifying project, date and specifics of verification.
c. Utilize report forms similar to those shown in Section V of AABC Standard.
d. Provide completed forms typed and signed by the testing and balancing firm.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

A. Secure approved Shop Drawings of all HVAC equipment.

B. Procedures and Forms:
1. Submit procedures and forms to be used in calibration of test instruments, balancing systems, and recording and reporting test data.
2. Obtain approval before beginning balancing and testing.

C. Do not begin balancing and testing until HVAC systems are complete and in full working order.
1. Place HVAC systems into full operation and continue their operation during each working day of balancing and testing.

D. Provide qualified heating and ventilating Engineer(s) to supervise and perform balancing and testing.

E. Review design Drawings, specifications, approved Shop Drawings and other related items to become thoroughly acquainted with the design of HVAC systems.

F. Check all installed systems against Contract Drawings, Specifications and Shop Drawings to see that system is installed as required.
1. Report deficiencies to the Engineer.
2. Report deficiencies to Contractor for remedial action including providing corrective measures required in the function of any part of system to complete balancing.

G. Make necessary adjustments as required to balance the systems.

3.2 FIELD QUALITY CONTROL

A. Balance and Test Air Systems:
1. Adjust equipment RPM to design requirements.
2. Report motor full load amperes.
3. Obtain design CFM at exhaust and supply fans.
a. Make pitot tube traverse of main supply and exhaust ducts. Test and adjust actual airflow to within 5 PCT of design value.
4. Test and record system static pressures, suction and discharge.
5. Check and calibrate controls to ensure proper operation in accordance with control sequences and manufacturer requirements, including temperature setpoints and automatic damper operation. Record any discrepancy or deficiency in controls systems between design and actual conditions.
6. Prepare and submit reports.

END OF SECTION

SECTION 23 31 00
HVAC - DUCTWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. HVAC ductwork and accessories.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 08 90 00 - Louvers and Vents.
   4. Section 01 61 03 - Equipment - Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
      a. 52, Method of Testing Air Conditioning Devices Used in General Ventilation for Removing Particulate Matter.
   2. National Fire Protection Association (NFPA).
   3. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
      a. HVAC Duct Construction Standards - Metal and Flexible.
      b. Seismic Restraint Manual – Guidelines for Mechanical Systems.

B. Qualifications:
   1. Fabricator: Firms regularly engaged in the manufacture of the specific product, of type, size required, whose products have been in use in similar service for not less than three years.
   2. Installers: Firm with at least five years installation experience on products similar to that required for this Project.

1.3 DEFINITIONS

A. Installer or Applicator:
   1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
   2. Installer and applicator are synonymous.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Scaled ductwork drawings (at 1/4 IN equals 1 FT scale) showing duct and accessory layout and supports.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

C. Miscellaneous Submittal:
   1. Documentation of qualifications for fabricators and installers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Transverse joints (factory fabricated aluminum):
      a. Ductmate Industries, Inc.
      b. Or equal.
   2. Flexible ducts:
      a. Thermaflex.
      b. Condu-flex.
      c. Glass-flex.
      d. Or equal.
   3. Backdraft or gravity dampers:
      a. Air Balance.
      b. Ruskin.
      c. American Warming.
      d. Or equal.
   4. Manual (volume) dampers:
      a. Air Balance.
      b. Ruskin.
      c. American Warming.
      d. Or equal.
   5. Duct sealers:
      a. Durkee-Atwood.
      b. Unitec McGill.
      c. Benjamin Foster.
      d. Design Polymerics.
      e. Or equal.
   6. Temperature control and automatic dampers:
      a. Air Balance.
      b. Ruskin.
      c. American Warming.
   7. Louvers:
      a. Ruskin.
      b. Air Balance.
      c. American Warming.
      d. Or equal.

2.2 COMPONENTS

A. Duct and Fittings (Metallic):
   1. Materials:
      a. 3003 H-14 aluminum alloy:
         1) Comply with ASTM B209.
   2. Fabrication (aluminum):
      a. Minimum sheet material thickness:
         1) Ducts with largest side or diameter to 30 IN: 0.05 IN thick.
         2) Ducts with largest side or diameter greater than 30 IN: 0.08 IN thick.
      b. Utilize SMACNA HVAC Duct Construction Standards for minimum of 2 IN water gage static pressure for the minimum sheet material thickness specified herein.
         1) Heavier gage sheet material may be used with associated reinforcement as an alternate to minimum thickness specified.
         2) Lighter gage sheet material with associated reinforcement shall not be used as an alternate to minimum thickness specified.
      c. Longitudinal seams:
         1) 0.050 material:

a) Pittsburgh seam.
b) Continuously welded.
2) 0.080 material: Continuously welded.
d. Continuously weld seams on factory assembled units.
e. Transverse joints (Alternative A):
1) SMACNA T-22 companion flange.
2) Gasketed.
3) Rigidity class:
a) Ducts with largest side or diameter to 30 IN: SMACNA Class D (1-1/2 x 1-1/2 x 1/8 IN angles).
b) Ducts with largest side or diameter greater than 30 to 54 IN: SMACNA Class H (2-1/2 x 2-1/2 x 3/16 IN angles).
f. Transverse joints (Alternative B):
1) Materials and fabrication:
a) Angles: Aluminum.
(1) Ductmate 35.
b) Corners: Aluminum.
(1) Ductmate DC 35.
c) Snap cleats: Aluminized or stainless steel.
d) Gaskets: Closed cell neoprene.
e) Bolts: Stainless steel.
f) Sheet metal screws: Self-drilling stainless steel with unthreaded section under head.
2) Fabrication:
a) Rigidity class: SMACNA Class H.
b) 3/8 IN DIA x 1 IN bolts.

B. Duct and fittings, Manufactured:
1. Material: Aluminum alloy.
2. Spiral lockseam construction.
3. Reinforcing corrugations.
4. Material thickness: per SMACNA for the associated pressure class.

C. Supports and Hangers:
1. Materials (for aluminum duct):
a. Support angles: Aluminum or stainless steel, minimum 1-1/2 by 1-1/2 by 1/4 angle.
b. Hanger rods: Stainless steel.
c. Anchors: Stainless steel wedge type.
2. Fabrication: Trapeze type units.

D. Flexible Connections:
1. Materials: Hypalon, double coated closely woven glass fabric.
2. Fabrication: Withstand 4.5 IN water column, positive and negative pressure.

E. Drain Pan:
1. Materials: Aluminum.
2. Fabrication: 0.080 IN.

F. Backdraft and Gravity Dampers:
1. Material:
a. 6063 T5 aluminum.
b. Blade edge seals: Extruded vinyl.
2. Fabrication:
a. Frame thickness: 16 gage minimum.
b. Blade thickness: 18 gage minimum.
c. Linkage: 1/2 IN tie bars.
d. Bearings: Synthetic.

G. Automatic and Manually Operated Dampers:

1. Material:
    a. Body: 6063 T5 aluminum.
    b. Seal blade edge: Extruded vinyl.
2. Fabrication:
    a. Frame thickness: 0.081 IN minimum.
    b. Blade thickness: 0.070 IN minimum.
    c. Provide flanged connections for rectangular duct.
    d. Blades:
        1) Two-position damper: Parallel blade.
        2) Volume damper: Opposed blade (rectangular duct).
        3) Volume damper: Butterfly blade (round duct).
        4) Maximum 6 IN width.
    e. Linkage: Concealed in frame.
    f. Axles: 1/2 IN plated steel hex.
    g. Bearings: Molded synthetic.
    h. Seals:
        1) Jamb: Flexible compression type.
    i. Control shaft: Removable, 1/2 IN DIA.
    j. Air leakage (4 FT SQ damper) at 4 IN WG pressure: 99 CFM maximum.
    k. Provide stainless steel locking quadrants for manual (volume) dampers.

H. Duct sealer:
1. NFPA rating of "Non-Combustible".
2. Flame spread rating: 25 or lower, in dry condition.
3. Smoke developed rating: 50 or lower, in dry condition.
4. Resistant to water and water vapors.
5. Comply with UL 181.
6. Pressure rupture rating: 16 IN WG, minimum.

I. Louvers: See Specification Section 08 90 00.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Metal Ductwork:
1. Install with longitudinal seams sealed for zero leakage.
2. Install gaskets at each transverse joint and fasten sections together with bolts.
    a. Tighten for zero leakage.
3. Install supports and hangers with anchors in accordance with SMACNA HVAC Duct Construction Standards.
4. Install flexible connections where noted on the drawings and details:
    a. Locate as close as possible to fan.
    b. Allow 1 IN of slack to prevent vibration transmission.
5. Install access doors where indicated on Drawings and at smoke and fire damper in accordance with NFPA requirements.

B. Drain Pans:
1. Install at cooling coils and at other sources of moisture or condensation.
2. Provide drip pan and drain piping beneath piping or ductwork that crosses above electrical panels.
3. Provide copper drain pipe from drain pans and terminate above floor drain, equipment drain or as shown on Drawings.

END OF SECTION

SECTION 23 34 00
HVAC - FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Supply and Exhaust fans for Heating, ventilating, and cooling equipment.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 01 61 03 - Equipment: Basic Requirements.
   4. Section 23 05 13 - Common Motor Requirements for Plumbing and HVAC Equipment.
   5. Section 23 05 93 - HVAC Systems - Balancing and Testing.
   6. Section 23 31 00 - HVAC - Ductwork.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Air Movement and Control Association (AMCA).
      a. AMCA Publication 203 "Field Performance Measurement of Fan Systems"
      b. ANSI/AMCA 210 "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating".
   2. Air Conditioning and Refrigeration Institute (ARI).
   3. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
      a. HVAC Applications Handbook, Chapter entitled "Sound and Vibration Control."
      b. 20, Methods of Testing for Rating Remote Mechanical-Draft Air-Cooled Refrigerant Condensers.
      c. 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
   4. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   5. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   6. National Roofing Contractors Association (NRCA).
   7. Underwriters Laboratories, Inc. (UL):
      a. 507, Standard for Electric Fans.

B. Miscellaneous:
   1. Gage thickness specified herein shall be manufacturer's standard gage for steel and Brown and Sharpe gage for non-ferrous metals.
   2. Corrosion protection of equipment to be as specified herein.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Wiring diagrams.
      d. Control diagrams.
      e. Manufacturer's catalog cuts and technical data.
      f. Corrosion-protection information.

g. Fan curves.
h. Sound data.
i. Vibration isolation.
j. Performance data on all equipment.

3. Certifications:
   a. Provide certification of thickness of corrosion-protection coating.
   b. Fan systems have been tested in accordance with AMCA Standard 210 or 260, and are licensed to bear the AMCA Certified Ratings Seal.

B. Factory Performance test for any fan having a flow rate greater than 1,000 CFM or a total static pressure rating equal to or greater than 1.5 IN WC.
   1. Pursuant to AMCA Publication 203 or 210 with no plus tolerances on Power and no minus tolerances on flow or pressure.

C. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Roof-mounted centrifugal exhaust fans:
      a. Greenheck.
      b. Loren Cook.
      c. Penn Barry Ventilator Co, Inc.
      d. Or equal.
   2. Ceiling exhaust fans:
      a. Greenheck.
      b. Loren Cook.
      c. Or equal.
   3. Wall-mounted propeller-type exhaust fans:
      a. Greenheck.
      b. Loren Cook.
      c. PennBarry Ventilator Co., Inc.
      d. Or equal.

2.2 GENERAL

A. All Manufactured Units:
   1. Factory wired and assembled.
   2. Use fasteners made of same material as unit.
   3. Fabricate motor assemblies and unit housings with vibration isolation assemblies:
      a. Type: As per ASHRAE HVAC Applications Handbook.

B. Manufactured units shall be constructed with corrosion-resistant materials or have corrosion-resistant coating.
   1. Type:
      a. Corrosion-resistant materials:
         1) Aluminum.
         2) Stainless steel.
         3) Galvanized steel.
      b. Corrosion-resistant coating:
         1) Epoxy-based coating.

2) 3 MIL minimum dry thickness, air-dried coating, for surfaces exposed to temperatures less than 150 DEGF.
3) Factory applied.

2.3 MANUFACTURED UNITS

A. Roof-Mounted Centrifugal Exhaust Fans:
1. AMCA certified.
2. Non-overloading horsepower capability.
3. Materials:
a. Top cap: Spun aluminum.
b. Wheel and inlet shroud: Aluminum.
c. Baffle: Aluminum.
d. Base: One-piece aluminum.
e. Drive assembly supports: Steel.
f. Drive shaft: Solid stainless steel.
g. Minimum 10 GA motor mounting plate.
4. Backward inclined blades.
5. Tapered inlet shroud.
6. Statically and dynamically balanced wheel.
7. Bearings:
a. Cast iron pillow blocks.
b. Concentric bearing locking collar for drive shafts 1 IN and larger.
1) SKF "ConCentra."
2) Dodge "D Lock."
c. Regreaseable.
d. 200,000 HR average life.
e. Five-to-one load capability to actual load ratio.
8. Weathertight compartment for motor and drives.
a. Separated from airstream.
9. Motor:
a. See Specification Section 23 05 13.
b. Belt Drive Units:
1) Driver and driven sheaves:
a) Keyed hub type.
b) Drive sheaves: Fixed pitch diameter.
c) Driver:
(1) Shipped with variable pitch diameter sheave.
(2) Fixed pitch diameter size based on approved test and balance reports.
d) V-belt drives sized for 150 PCT motor horsepower.
2) Automatic drive belt tensioner.
c. Direct Drive Units:
1) Keyed hub type.
d. Vibration isolated drive assembly.
10. Accessories:
a. Prefabricated insulated galvanized steel roof curb.
b. Bird screen.
c. Extended grease lines and fittings.
11. Size and capacity as scheduled on Drawings.

B. Wall-Mounted Propeller-Type Supply and Exhaust Fans:
1. AMCA certified.
2. Industrial quality.
3. Materials:
a. Propeller: Cast aluminum.
b. Venturi: Spun aluminum.
c. Panel and supports: Aluminum or galvanized steel.

d. Drive shaft: Solid stainless steel.
e. Sheaves: Cast iron.

4. Propellers:
   a. Statically and dynamically balanced.
   b. Airfoil design.
   c. Minimum four (4) blades.
5. Bearings:
   a. Cast iron pillow blocks.
   b. Concentric bearing locking collar for drive shafts 1 IN and larger.
      1) SKF "ConCentra."
      2) Dodge "D Lock."
   c. Regreaseable.
   d. 200,000 HR average life.
6. Welded reinforced motor base plate.
7. Adjustable motor base.
8. Motor:
   a. See Specification Section 23 05 13.
   b. Belt Drive Units:
      1) Driver and driven sheaves:
         a) Keyed hub type.
         b) Drive sheaves: Fixed pitch diameter.
         c) Driver:
            (1) Shipped with variable pitch diameter sheave.
            (2) Fixed pitch diameter size based on approved test and balance reports.
         d) V-belt drives sized for 150 PCT motor horsepower.
      2) Automatic drive belt tensioner.
9. Accessories:
   a. Wall housing
   b. Inlet guard.
   c. Outlet guard.
   d. Backdraft damper (where noted on the schedule sheets).
   e. Mounting adapter.
   f. Bird screen.
   g. Extended grease lines and fittings.
10. Size and capacity as scheduled on Drawings.

C. Toilet Room Exhaust Fans:
1. AMCA certified.
2. UL listed.
3. Materials: Galvanized steel.
4. Centrifugal wheels.
5. Permanently lubricated motor.
6. Acoustically insulated housing.
7. Resilient rubber-in-shear vibration isolation.
8. Fan, motor, and wheel assembly removable from housing.
9. Duct flanged outlet.
10. Integral backdraft damper.
11. Accessories:
    a. Provide with exhaust grille from the manufacturer.
12. Size and capacity as scheduled on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Test and balance fans to the airflows noted on the drawings and schedules in accordance with Specification Section 23 05 93. Install fixed pitched drive sheave after sheave has been sized based on accepted test and balance report.

B. Do not operate fans for any purpose until ductwork is clean, filters are in place, bearings lubricated and fan has been test run under observation.

END OF SECTION

SECTION 23 80 00
HVAC - EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Unit Heaters.
   2. Unitary Split System Heat Pumps.
   3. HVAC control accessories including thermostats and motorized damper actuators.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 23 05 13 - Common Motor Requirements for Plumbing and HVAC Equipment.
   4. Section 23 05 93 - HVAC Systems - Balancing and Testing.
   5. Section 23 31 00 - HVAC - Ductwork.
   6. Section 26 05 00 - Electrical Basic Requirements.
   7. Section 26 05 19 - Wire and Cable - 600 Volt and Below.
   8. Section 26 05 33 - Raceways and Boxes.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Air Movement and Control Association (AMCA).
   2. Air Conditioning and Refrigeration Institute (ARI).
   3. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
      a. HVAC Applications Handbook.
   4. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   5. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   6. Underwriters Laboratories, Inc. (UL):
      a. 507, Standard for Electric Fans.

1.3 SYSTEM DESCRIPTION

A. Provide a complete system of automatic temperature and ventilation control, including thermostats, relays, damper operators and other associated control components and appurtenances required to maintain minimum conditions described in detail herein and on the Drawings.

B. Assemble control systems with a complete system of conduit and wiring to fulfill the requirements of the Contract Documents.

C. Install systems using competent technicians under direct supervision of control manufacturer.

D. Controls, as set out in the Control Sequences, are designed to illustrate operating functions only.

E. The items specified herein, and any additional controls components not indicated but required to meet performance as outlined in the Contract Documents, shall be furnished and installed at no additional cost to Owner to make a complete system that functions in accordance with the Contract Documents.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

2. Submit product technical data including:
    a. For heating or cooling equipment, provide manufacturer catalog data sheets indicating heating/cooling performance, airflow, electrical power requirements, controls accessories and any other options to be provided with the equipment.
    b. Manufacturer's installation instructions.
    c. Wiring diagrams.
    d. Control diagrams.
    e. Manufacturer data sheets for thermostats, damper actuators and control devices indicating electrical power requirements.
    f. Data sheets for all required accessories.

B. Contract Closeout Information:
1. Operation and Maintenance Data:
    a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Unit heater - electric:
    a. QMark
    b. Brasch.
    c. Chromalox.
    d. Or equal.
2. Unitary split system heat pump:
    a. Mitsubishi.
    b. Trane.
    c. Daikin.
    d. LG.
3. Thermostats:
    a. Johnson Controls.
    b. Honeywell.
    c. Chromalox.
    d. Or equal.
4. Electric Damper Actuators:
    a. Belimo.
    b. Schneider Electric.
    c. Siemens.
    d. Or equal.
5. Many public projects are not allowed to specify products "proprietary" with no "or-equal" items allowed. However, in certain cases, this may be necessary. Check with the PM, and if possible on the project, utilize the text contained in the following hidden paragraph.

2.2 GENERAL

A. All Manufactured Units:
1. Unit heaters shall be factory wired and assembled including factory-installed control transformer, control wiring and internal thermostat where noted on the drawings.
2. Split System Units:
    a. Indoor and Outdoor units shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion valves, drain pans, control circuit boards and fan motors.

2.3 MANUFACTURED UNITS

A. Unit Heater - Electric:
   1. Type: Vertical unit heaters with horizontal discharge.
   2. UL listed for non-rated areas.
   3. Material:
      a. Cabinet: Heavy gauge steel with factory applied standard coating.
      b. Heating elements: Aluminum finned copper-clad steel.
   4. Fan motors:
      a. Totally enclosed motor.
      b. Built-in automatic reset overload protection.
   5. Dynamically balanced fan.
   6. Built-in automatic reset thermal cutout protection.
   7. Accessories:
      a. Mounting bracket.
      b. Thermostat with 40 to 90 DEG F adjustable setpoint range, and 5 DEG F temperature differential, mounted to the unit heater cabinet.
      c. Control transformer, as required.
   8. Electrical, fan motor, and airflow data shall be as scheduled on Drawings.

B. Unitary Split System Heat Pump:
   1. Indoor and Outdoor units shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion valves, drain pans, control circuit boards and fan motors.
   2. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
   3. Provide hard-wired wall-mounted thermostats for each unit. 7-day programmable with digital backlit display.
   4. Units shall have a warranty period of five years from the date of installation.
   5. Size and capacity of each unit as scheduled on the Drawings.
   6. Outdoor Unit:
      a. Casing and frame:
         1) Material: Heavy gage galvanized steel, factory painted.
         2) Insulation: 1 IN thick neoprene-coated glass fiber.
         3) Installation: Base equipped with lifting brackets with lifting holes.
         4) Removable service panels for access to components and connections.
      b. Compressors:
         1) Inverter-driven, scroll type, hermetically sealed.
         2) Suction and discharge service valves.
         3) Thermal overload protection.
         4) Compressors shall be mounted on vibration isolators.
         5) Basepan heater shall be provided to protect against ice build-up on the coil during winter operation.
      c. Refrigeration circuit:
         1) Manual shut-off valve.
         2) Service ports.
         3) Refrigerant piping is specified in section 40 05 00.
      d. Condenser coils:
         1) Seamless copper tubing mechanically bonded to corrugated aluminum fins.
         2) Factory leak tested at 315 PSIG under water.
      e. Condenser fans:
         1) Direct drive, propeller type.
         2) Provide protective fan guard.
         3) Statically and dynamically balanced.
      f. Condenser fan motors:
         1) Variable speed.
         2) Heavy duty, inherently protected, non-reversing.

3) Permanently lubricated bearings.
4) Integral rain shield.
5) Fan motors mounted with vibration isolators.

g. Defrost control: Defrost cycles at a preselected time interval when the outdoor coil is below a preset initiation temperature.
h. Expansion valve: Designed and sized specifically for heat pump service.
i. Reversing valve: Four-way interchange reversing valve, operates on pressure differential between the outdoor unit and indoor unit.

7. Indoor unit:
   a. Materials:
      1) Casing: Heavy gage steel, white finish.
      2) Framework: Steel angle.
      3) Pan insulation: Foam-in-place insulation.
      4) Casing insulation: 1 IN, 3/4 LB fiberglass blanket.
      5) Provide with wall-mounting bracket for wall-mounted models.
   b. Casing:
      1) Sectionalized construction.
      2) Removable access panels for servicing.
      3) Insulated weatherproof casing.
   c. Evaporator fans:
      1) Double-width, double-inlet centrifugal type.
      2) Forward curved or airfoil.
      3) Solid steel shafts.
      4) Statically and dynamically balanced.
      5) Permanently lubricated ball bearings.
   d. Fan motors:
      1) Direct drive.
      2) Variable speed, with automatic and manual speed adjustment.
      3) Permanently lubricated ball-bearings.
      4) Fan motors mounted with vibration isolators.
   e. Filter section:
      1) Washable, re-usable return air filters.
      2) Access doors for filter removal.
   f. Evaporator coils:
      1) Coils shall be of nonferrous construction with smooth plate fins on copper tubing.
      2) The tubing shall have inner grooves for high efficiency heat exchange.
      3) All tube joints shall be brazed with silver alloy.
      4) The coils shall be pressure tested at the factory.
      5) A sloped, corrosion resistant condensate pan with drain shall be provided under the coil with threaded drain connection.
   g. Evaporator coil circuiting:
      1) Refrigerant flow from the outdoor unit shall be regulated by means of an electronically controlled, precision, linear expansion valve.
      2) Combination row/split face circuiting.

C. Thermostats for Supply and Exhaust Fan Control:
   1. Industrial type line voltage thermostats with coiled sensing element and manual setpoint adjustment knob on the face of the thermostat enclosure. Setpoint adjustment temperature range shall be 40-100°F.
   2. Thermostats shall have a differential deadband set to 2-3°F.
   3. Thermostats shall be rated for line voltage and full load amps of approved equipment.
   4. Furnish with durable wall mounted NEMA 12 coated steel enclosures.
   5. Locate where noted on the drawings. Mount at 4 ft above finished floor elevation.

D. Electric Damper Actuators:
   1. Provide operators of proper size and number to secure true throttling or two-position action as required.

2. Operator functionality is to be consistent with control sequences described herein and on the drawings.
3. Actuators shall be capable of operating in ambient temperatures between 0°F-130°F.
4. Actuator housings shall be cast aluminum with a NEMA rating appropriate for the environment in which it is installed.
5. Furnish damper operators for installation inside ductwork and attached to frame of damper, or installed outside ductwork and connected to extended damper shaft.
6. Actuators shall have electronic overload protection or digital rotation sensing circuitry to prevent actuator damage throughout the entire rotation. End switches to deactivate the actuator at the end of rotation or magnetic clutches are not acceptable.
7. Actuators for two-position service shall be fast acting type and shall have a 10-second maximum motor run time to fully open the damper and a 10-second maximum run time to fully close the damper.
8. Provide spring return actuators to return the damper to a normally closed position, unless noted otherwise on the drawings or in the control sequences. The spring return mechanism shall be internal and built into the actuator housing.
9. Actuators shall have a manual crank to allow manual positioning of the damper when the actuator is not powered.
10. Provide operators with sufficient power and torque to assure tight closing of dampers on fan shutdown or in the fail-safe position. Coordinate with dampers provided.
11. If single damper operator cannot meet torque requirement, provide sectional dampers to match operator torque.
12. Provide separate electrical circuits for damper operators with no more than four operators on a single circuit.
13. Actuators shall be furnished with end-switches where required by the control descriptions for interlocking damper operation with fans or equipment operation.
14. Refer to Specification Section 23 31 00 for dampers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The Contractor shall not install any equipment or materials until the Engineer has favorably reviewed all submittals. If any equipment or materials are installed prior to approval of the submittals, it shall be at the Contractor's risk.

B. The Contractor shall start up each piece of equipment and system and shall make all adjustments so that the system is placed in proper operating condition.

C. The Contractor shall install and start up each piece of equipment following the manufacturer’s recommendations.

D. Properly maintain and service all equipment and systems until the particular equipment or the system has been accepted by the Owner and Engineer.

E. Install unit heaters in accordance with manufacturer requirements. Maintain adequate clearances to combustibles and maintain recommended service clearances around the units.

F. Install unit heaters at the height noted on the drawings.

G. Comply with the requirements of Specification Sections 26 05 00, 26 05 19 and 26 05 33 for control wiring and conduit installation.

H. Control devices shall be installed and wired to equipment as required such that equipment operates in accordance with the control functions noted on the drawings and in the project specifications.

I. Contractor Responsibility:
   1. Wiring and conduit related to mechanical control systems:

a. Wiring and conduit not indicated on the electrical drawings to be furnished and installed by the Division 26 contractor shall be the responsibility of the mechanical contractor.

J. Test and Inspections:
   1. After installing the AC units and Unit Heaters, and after electrical circuitry has been energized, test units for compliance with performance requirements.
   2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
   3. 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.
   5. Adjust and set supply airflow, supply air temperature setpoints, room temperature setpoints and other user defined parameters to match design values.
   6. Complete installation and startup checks according to manufacturer's written instructions.
   7. Inspect for visible damage to unit casing.
   8. Inspect for visible damage to compressor, coils, and fans.
   9. Inspect for visible damage to internal insulation.
   10. Verify that labels are clearly visible.
   11. Verify that clearances have been provided for servicing.
   12. Verify that controls are connected and operable.
   13. Verify that filters are installed.
   14. Clean condenser coil and inspect for construction debris.
   15. Remove packing from vibration isolators.
   16. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.

END OF SECTION

DIVISION 26

ELECTRICAL

SECTION 26 05 00
ELECTRICAL - BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Basic requirements for electrical systems.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 01 61 03 - Equipment - Basic Requirements.
   4. Section 03 15 19 - Anchorage to Concrete.
   5. Section 10 14 00 - Identification Devices.
   6. Section 26 05 19 - Wire and Cable - 600 Volt and Below.
   7. Section 26 05 33 - Raceways and Boxes.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Aluminum Association (AA):
      a. ADM, Aluminum Design Manual.
   2. American Institute of Steel Construction (AISC):
      a. Steel Construction Manual.
   3. American National Standards Institute (ANSI).
   4. ASTM International (ASTM):
      a. A36/A36M, Standard Specification for Carbon Structural Steel.
      b. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
      c. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   5. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. C2, National Electrical Safety Code (NESC).
   6. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   7. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   8. Underwriters Laboratories, Inc. (UL).

B. Products to be listed by a Nationally Recognized Testing Laboratory (NRTL) in accordance with applicable product standards.
   1. Applicable product standards including, but not limited to, ANSI, FM, IEEE, NEMA and UL.
   2. NRTL includes, but is not limited to, CSA Group Testing and Certification (CS), FM Approvals LLC (FM), Intertek Testing Services NA, Inc. (ETL), and Underwriters Laboratories, Inc. (UL).

1.3 DEFINITIONS

A. For the purposes of providing materials and installing electrical work the following definitions shall be used.
   1. Outdoor area: Exterior locations where the equipment is normally exposed to the weather and including below grade structures, such as vaults, manholes, handholes and in-ground pump stations.

2. Architecturally finished interior area: Offices, laboratories, conference rooms, restrooms, corridors and other similar occupied spaces.
3. Non-architecturally finished interior area: Pump, chemical, mechanical, electrical rooms and other similar process type rooms.
4. Highly corrosive and corrosive area: Areas identified on the Drawings where there is a varying degree of spillage or splashing of corrosive materials such as water, wastewater or chemical solutions; or chronic exposure to corrosive, caustic or acidic agents, chemicals, chemical fumes or chemical mixtures.
5. Hazardous areas: Class I, II or III areas as defined in NFPA 70.
6. Shop fabricated: Manufactured or assembled equipment for which a UL test procedure has not been established.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of submittal process.
   2. See Specification Section 01 61 03 and individual specification sections for submittal requirements for products defined as equipment.
   3. General requirements:
      a. Provide manufacturer's technical information on products to be used, including product descriptive bulletin.
      b. Include data sheets that include manufacturer's name and product model number.
         1) Clearly identify all optional accessories.
      c. Acknowledgement that products are NRTL listed or are constructed utilizing NRTL recognized components.
      d. Manufacturer's delivery, storage, handling and installation instructions.
      e. Product installation details.
      f. Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70, include any required calculations.
      g. See individual specification sections for any additional requirements.

B. Operation and Maintenance Manuals:
   1. See Specification Section 01 33 04 for requirements for:
      a. The mechanics and administration of the submittal process.
      b. The content process of Operation and Maintenance Manuals.

C. When a Specification Section includes products specified in another Specification Section, each Specification Section shall have the required Shop Drawing transmittal form per Specification Section 01 33 00 and all Specification Sections shall be submitted simultaneously.

1.5 DELIVERY, STORAGE, AND HANDLING

A. See Specification Section 01 65 50.

B. Protect nameplates on electrical equipment to prevent defacing.

1.6 AREA DESIGNATIONS

A. Designation of an area will determine the NEMA rating of the electrical equipment enclosures, types of conduits and installation methods to be used in that area.
   1. Outdoor areas:
      a. Wet.
      b. Also, corrosive and/or hazardous when specifically designated on the Drawings or in the Specifications.
   2. Indoor areas:
      a. Dry.
      b. Also, wet, corrosive and/or hazardous when specifically designated on the Drawings or in the Specifications.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, refer to specific Electrical Specification Sections and specific material paragraphs below for acceptable manufacturers.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

C. Provide all components of a similar type by one (1) manufacturer.

2.2 MATERIALS

A. Electrical Equipment Support Pedestals and/or Racks:
   1. Manufacturers:
      a. Modular strut:
         1) Unistrut Building Systems.
         2) B-Line by Eaton.
         3) Globe Strut.
         4) Superstrut by Thomas & Betts.
   2. Material requirements:
      a. Modular strut:
         1) Galvanized steel: ASTM A123/123M or ASTM A153/A153M.
         2) Stainless steel: AISI Type 316.
         3) PVC coated galvanized steel: ASTM A123/A123M or ASTM A153/A153M and 20 MIL PVC coating.
         4) Aluminum: AA Type 6063-T6.
      b. Structural members (e.g., I beams, L and C channels):
         1) Galvanized steel: ASTM A36/A36M steel with galvanizing per ASTM A123/A123M.
         2) Aluminum: AA Type 6061-T6 or 6063-T6.
      c. Mounting plates:
         1) Galvanized steel: ASTM A36/A36M steel with galvanizing per ASTM A123/A123M.
         2) Aluminum: AA Type 6063-T6.
      d. Mounting hardware:
         1) Galvanized steel.
         2) Stainless steel.
      e. Anchorage per Specification Section 03 15 19.

B. Field touch-up of galvanized surfaces.
   1. Zinc-rich primer.
      a. One coat, 3.0 MILS, ZRC by ZRC Products.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and wire all equipment, including pre-purchased equipment, and perform all tests necessary to assure conformance to the Drawings and Specification Sections and ensure that equipment is ready and safe for energization.

B. Install equipment in accordance with the requirements of:
   1. NFPA 70.
   2. IEEE C2.
   3. The manufacturer's instructions.

C. In general, conduit routing is not shown on the Drawings.
   1. The Contractor is responsible for routing all conduits including those shown on one-line and control block diagrams and home runs shown on floor plans.

2. Conduit routings and stub-up locations that are shown are approximate; exact routing to be as required for equipment furnished and field conditions.

D. When complete branch circuiting is not shown on the Drawings:
   1. A homerun indicating panelboard name and circuit number will be shown and the circuit number will be shown adjacent to the additional devices (e.g., light fixture and receptacles) on the same circuit.
   2. The Contractor is to furnish and install all conduit and conductors required for proper operation of the circuit.
   3. The indicated home run conduit and conductor size shall be used for the entire branch circuit.
   4. See Specification Section 26 05 19 for combining multiple branch circuits in a common conduit.

E. Do not use equipment that exceed dimensions or reduce clearances indicated on the Drawings or as required by the NFPA 70.

F. Install equipment plumb, square and true with construction features and securely fastened.

G. Install electrical equipment, including pull and junction boxes, minimum of 6 IN from process, gas, air and water piping and equipment.

H. Install equipment so it is readily accessible for operation and maintenance, is not blocked or concealed and does not interfere with normal operation and maintenance requirements of other equipment.

I. Device Mounting Schedule:
   1. Unless indicated otherwise on the Drawings, mounting heights are as indicated below:
      a. Light switch (to center): 46 IN.
      b. Receptacle in architecturally finished areas (to center): 18 IN.
      c. Receptacle on exterior wall of building (to center): 18 IN.
      d. Receptacle in non-architecturally finished areas (to center): 46 IN.
      e. Telephone outlet in architecturally finished areas (to center): 18 IN.
      f. Telephone outlet for wall-mounted phone (to center): 46 IN.
      g. Safety switch (to center of operating handle): 54 IN.
      h. Separately mounted motor starter (to center of operating handle): 54 IN.
      i. Pushbutton or selector switch control station (to center): 46 IN.
      j. Panelboard (to top): 72 IN.

J. Avoid interference of electrical equipment operation and maintenance with structural members, building features and equipment of other trades.
   1. When it is necessary to adjust the intended location of electrical equipment, unless specifically dimensioned or detailed, the Contractor may make adjustments of up to 6 IN in equipment location without the Engineer's approval.
      a.

K. Provide all necessary anchoring devices and supports rated for the equipment load based on dimensions and weights verified from approved submittals, or as recommended by the manufacturer.
   1. Do not cut, or weld to, building structural members.
   2. Do not mount safety switches or other equipment to equipment enclosures, unless enclosure mounting surface is properly braced to accept mounting of external equipment.

L. Provide corrosion resistant spacers to maintain 1/4 IN separation between metallic equipment and/or metallic equipment supports and mounting surface in wet areas, on below grade walls and on walls of liquid containment or processing areas.

M. Do not place equipment fabricated from aluminum in direct contact with earth or concrete.

N. Screen or seal all openings into equipment mounted outdoors to prevent the entrance of rodents and insects.

O. Do not use materials that may cause the walls or roof of a building to discolor or rust.

P. Identify electrical equipment and components as required.

3.2 FIELD QUALITY CONTROL

A. Verify exact rough-in location and dimensions for connection to electrified equipment, provided by others.
   1. See Specification Section 01 73 20 for openings and penetrations in structures.

B. Replace equipment and systems found inoperative or defective and re-test.

C. Cleaning:
   1. See Specification Section 01 74 00.

D. The protective coating integrity of support structures and equipment enclosures shall be maintained.
   1. Repair galvanized components utilizing a zinc rich paint.
   2. Repair painted components utilizing touch up paint provided by or approved by the manufacturer.
   3. Repair PVC coated components utilizing a patching compound, of the same material as the coating, provided by the manufacturer of the component.
   4. Repair surfaces which will be inaccessible after installation prior to installation.
   5. See Specification Section 26 05 33 for requirements for conduits and associated accessories.

E. Replace nameplates damaged during installation.

F. Perform tests in the presence of the Engineer.

3.3 PERMITS AND APPROVALS

A. The Contractor shall obtain all permits necessary. The Contractor shall furnish inspection by an agency licensed or otherwise qualified to perform electrical inspections in the State of California.

B. The Contractor shall notify the Electrical Inspector, in writing, immediately upon the start of the work and a copy of the notice shall be sent to the Engineer.

C. Inspection shall be scheduled for rough-in as well as finish work. The rough-in inspection shall be divided into as many inspections as may become necessary to cover all roughing-in.

D. All costs incidental to the electrical inspection shall be borne by the Contractor.

E. The Contractor shall furnish certificates of final approval by the electrical inspector and final payment will be withheld until he has presented the Engineer with the aforementioned certificate of approval.

When it is determined by the Electrical Inspector that materials, equipment or installations shown on the Drawings or specified herein are in violation of the National Electrical Code, the Contractor shall contact the Engineer immediately. The Contractor shall be prepared to tell the Engineer the Articles of the National Electrical Code that are violated by the project requirements.

END OF SECTION

SECTION 26 05 09
MOTORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Induction motors.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 01 61 03 - Equipment - Basic Requirements.
   4. Section 26 05 26 - Grounding.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Bearing Manufacturers Association (ABMA).
   2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. 841, Standard for Petroleum and Chemical Industry - Premium-Efficiency, Severe-Duty, Totally-Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors - Up To and Including 370 kW (500 HP).
   3. National Electrical Manufacturers Association (NEMA):
      a. MG 1, Motors and Generators.
   4. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).

B. Miscellaneous:
   1. When motors are furnished with driven equipment, the driven equipment supplier shall be responsible for assembling the motor and driven equipment as a complete unit, correctly aligned and coupled with the coupling or sheave specified on the driven equipment data sheet, and designing for vibration, special, or unbalanced forces resulting from equipment operation.
   2. Variable speed equipment applications: The driven equipment manufacturer shall have single source responsibility for coordination of the equipment and VFD system and ensure their compatibility.

1.3 DEFINITIONS

A. Inverter Duty Motor: An AC induction motor complying with all requirements of NEMA MG 1 Part 31 for definite-purpose inverter-fed motors.

B. Abbreviations:
   1. DPFG - Dripproof Fully Guarded.
   2. ODP - Open Dripproof.
   3. RTD - Resistance Temperature Detector.
   4. TEFC - Totally Enclosed Fan Cooled.
   5. TENV - Totally Enclosed Non-ventilated.
   6. WP-I - Weather Protected Type I.
   7. WP-II - Weather Protected Type II.
   8. Motor controllers:
      a. FVNR - Full Voltage Non-Reversing.
      b. RVSS - Reduced Voltage Solid State.
      c. VFD - Variable Frequency Drive.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data:
      a. Identify each motor by driven machine identification.
      b. Motor manufacturer and model number.
      c. Complete motor nameplate data.
      d. Weight.
      e. NEMA design type.
      f. Enclosure type.
      g. Frame size.
      h. Winding insulation class and temperature rise.
      i. Starts per hour.
      j. Performance data:
         1) Motor speed-torque curve superimposed over driven machine speed-torque curve during start-up acceleration and at rated terminal voltage and minimum permissible or specified terminal voltage for all motors over 15 HP.
         2) Time-current plots with acceleration verses current and thermal damage curves at the operating and ambient temperatures and at rated terminal voltage and minimum permissible or specified terminal voltage for all motors over 15 HP.
         3) Guaranteed minimum efficiencies at 100 PCT, 75 PCT and 50 PCT of full load.
         4) Guaranteed minimum power factor at 100 PCT, 75 PCT and 50 PCT of full load.
         5) Locked rotor and full load current at rated terminal voltage and minimum permissible or specified terminal voltage.
         6) Starting, full load and breakdown torque at rated terminal voltage and minimum permissible or specified terminal voltage.
      k. Bearing data and lubrication system.
      l. Thermal protection system including recommended alarm and trip settings for winding and bearing RTDs.
   3. Fabrication and/or layout drawings:
      a. Dimensioned outline Drawing.
      b. Connection diagrams including accessories (strip heaters, thermal protection, etc.).
   4. Certifications:
      a. When utilized with a reduced voltage starter, certify that motor and driven equipment are compatible.
   5. Test reports:
      a. Motor test reports for all testing required in this Specification Section.

B. Operation and Maintenance Manuals:
   1. See Specification Section 01 33 04 for requirements for
      a. The mechanics and administration of the submittal process.
      b. The content of Operation and Maintenance Manual submittals.
   2. Installation instructions.
   3. Operation and maintenance instructions.
   4. Recommended spare parts list.

1.5 DELIVERY, STORAGE, AND HANDLING

A. See Specification Section 01 65 50.

B. Protect equipment during shipment, handling, and storage by suitable boxes, crates, or other complete enclosures.
   1. Protect equipment from exposure to elements and keep thoroughly dry.

C. Protect painted surfaces against impact, abrasion, discoloration, and other damage.
   1. Repaint damaged painted surfaces to satisfaction of Engineer.

D. Store all motors in a clean and dry indoor location until final installation.

E. Where space heaters are provided in motors, provide temporary electrical power and operate heaters during storage and after motors are installed in permanent location until equipment is placed in service.

F. For storage longer than one month, see manufacturer's storage instructions.

1.6 SITE CONDITIONS

A. Ambient air temperature: 75 DEGF.

B. Altitude: 2,411 FT above sea level.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. ABB.
   2. General Electric.
   3. Hyundai Heavy Industries.
   4. Marathon.
   5. Reliance by Rockwell Automation, Inc.
   6. Siemens.
   7. TECO-Westinghouse Motor Company.
   8. Toshiba U.S.
   9. Toshiba Mitsubishi-Electric Industrial Systems Corporation (TMEIC).
   10. U.S. Motors by Nidec Motor Corporation.
   11. WEG.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 EQUIPMENT

A. General Requirements:
   1. Standards: NEMA MG 1.
   2. Identify each motor by the driven machine identification.
   3. An embossed or engraved stainless steel nameplate, with the required NFPA 70 and NEMA data, to be permanently attached to the motor.
   4. Maximum motor loading shall not exceed motor nameplate horsepower rating, exclusive of service factor.
   5. All motors shall be sized to carry continuously all loads, which may be imposed through their full range of operation.
   6. Altitude: For applications above 3300 FT, motors to be specifically designed and certified for operation at the specified altitude.
   7. NEMA MG 1, Design B (unless otherwise required), constant speed squirrel-cage induction type having normal starting torque with low starting current.
   8. Suitable for the starting method indicated (e.g., full voltage, autotransformer, solid state reduced voltage, VFD, etc.).
   9. Where frequent starting occurs, design for frequent starting duty equivalent to duty service required by driven equipment.
   10. Lifting devices: Motors weighing 265 LBS or more shall have suitable lifting eyes for installation and removal.
   11. Grounding:
      a. Lug suitable to terminate ground wire in terminal box, sized as indicated on the Drawings.
      b. Frame ground pad on medium voltage induction motors.
   12. Stator windings: Copper.

13. Rotor cage: Aluminum or copper.
14. Motor leads shall be non-wicking with permanent identifiers.
15. Totally enclosed motor to have one-way breather drains.
16. Efficiency:
    a. Meet NEMA MG 1 (NEMA Premium) efficiencies.
    b. If motor type, horsepower or speed is not included in the NEMA requirements for NEMA Premium, provide manufacturers "premium energy efficient" design.
17. Power factor:
    a. Minimum of 80 PCT lagging at full load, except on motors with speed slower than 900 RPM.
    b. Power factor correction capacitors to be utilized when indicated on the Drawings.
18. Service factor:
    a. 100 hp or less: 1.15.
    b. Greater than 100 HP: 1.0 unless noted otherwise.
    c. Inverter duty: 1.0.
19. Standards: NEMA MG 1.

2.3 FRACTIONAL INDUCTION MOTORS

A. Electrical Ratings:
   1. Appropriate for the voltage system indicated, single phase, 60 Hz.
   2. Dual voltage rated motors (e.g., 115/230 V) are acceptable, provided all leads are brought out to the terminal box and permanently marked.

B. Enclosure: TENV or TEFC, rolled steel enclosure permitted.

C. Bearings: Lubricated-for-Life ball bearings.

D. Insulation: Class F insulation with temperature rise not to exceed the insulation class.

E. Thermal Protection: Integral manual or automatic reset thermal protector.

2.4 INDUCTION MOTORS, 600 VOLT AND LESS

A. Horizontal Shaft:
   1. Electrical rating:
      a. Appropriate for the voltage system indicated, 3 PH, 60 Hz.
      b. Dual voltage rated motors (e.g., 230/460 V) are acceptable, provided all leads are brought out to the terminal box and permanently marked.
   2. Enclosure:
      a. Cast iron (exception: fan covers can be steel).
      b. Type: DPFG, TEFC, WP-I or WP-II as indicated in the schedule.
   3. Terminal box:
      a. Gasketed.
      b. Diagonally split.
      c. Field adjustable in 90 DEG increments.
      d. Oversized to accept the required conductors and conduits.
      e. Located on “F1 IN side unless specifically indicated to be on the “F2 IN side.
      f. Separate terminal box with terminal blocks for winding thermal protection devices (RTD and thermocouples).
   4. Bearings:
      a. 5 HP and less: Lubricated-for-Life ball bearings.
      b. Greater than 5 HP:
         1) Relubricatable.
         2) Antifriction.
         3) Minimum rated ABMA L-10 life of 10 years or 100,000 HRS.
   5. Insulation:
      a. Class F insulation with Class B temperature rise.
   6. Accessories: See the ACCESSORIES Article in PART 2 and the SCHEDULES Article in PART 3.

7. Modifications:
    a. Inverter duty:
        1) At a minimum, applied to motors connected to a VFD.
        2) Windings insulated for 1600 peak volts and voltage rise times of 0.1 microseconds.
        3) Nameplate identification of meeting NEMA MG 1 Part 31 requirements.
        4) Have the following minimum turndown ratio without the use of a blower to provide continuous supply of cooling air over the motor.
            a) Variable torque: 10:1.
            b) Constant torque: 6:1.
        5) Insulated drive end bearing on all motors.
        6) Motors 100 HP and larger, insulted non-drive and bearings.
        7) Shaft grounding ring on all motors:
            a) Factory installed, maintenance free, circumferential, bearing protection ring with conductive microfiber shaft contacting material.
            b) Electro Static Technology AEGIS SGR Bearing Protection Ring or approved equal.
    b. Severe duty:
        1) Standard: IEEE 841.
        2) All cast iron enclosure.
        3) Terminal box threaded and gasketed.
        4) Internal and external epoxy base paint system.
        5) Drain and breather.

B. Vertical Solid or Hollow Shaft:
1. Electrical rating:
    a. Appropriate for the voltage system indicated, 3 PH, 60 Hz.
    b. Dual voltage rated motors (e.g., 230/460 V) are acceptable, provided all leads are brought out to the terminal box and permanently marked.
2. Enclosure:
    a. Cast iron.
    b. Type: DPFG, TEFC, WP-I or WP-II as indicated in the schedule.
3. Terminal box:
    a. Gasketed.
    b. Diagonally split.
    c. Oversized to accept the required conductors and conduits.
    d. Separate terminal box with terminal blocks for winding thermal protection devices.
4. Bearings (Solid Shaft):
    a. Relubricatable.
    b. Antifriction.
    c. Minimum rated AMBA L-10 life of 10 years or 100,000 HRS.
5. Bearings (Hollow Shaft):
    a. Relubricatable.
    b. Antifriction.
    c. Oil or grease lubricated thrust bearings.
    d. Grease lubricated guide bearings.
    e. Minimum rated ABMA L-10 life of 10 years or 100,000 HRS.

6. Insulation:
    a. Class F insulation with Class B temperature rise.
7. Accessories: See the ACCESSORIES Article in PART 2 and the SCHEDULES Article in PART 3.
8. Modifications:
    a. Inverter duty:
        1) At a minimum, applied to motors connected to a VFD.
        2) Windings insulated for 1600 peak volts and voltage rise times of 0.1 microseconds.
        3) Nameplate identification of meeting NEMA MG 1 Part 31 requirements.

4) Have the following minimum turndown ratio without the use of a blower to provide continuous supply of cooling air over the motor.
   a) Variable torque: 10:1.
   b) Constant torque: 6:1.
5) Insulated drive end bearing on all motors.
6) Motors 100 HP and larger the non-drive end shall have an insulted bearing carrier.
7) Shaft grounding ring on all motors:
   a) Factory installed, maintenance free, circumferential, bearing protection ring with conductive microfiber shaft contacting material.
   b) Electro Static Technology AEGIS SGR Bearing Protection Ring or approved equal.

b. Severe duty:
1) Standard: IEEE 841.
2) All cast iron enclosure.
3) Terminal box threaded and gasketed.
4) Internal and external epoxy base paint system.
5) Drain and breather.

2.5 ACCESSORIES

A. Thermal Protection:
1. Thermostats:
   a. One winding thermostat per phase for shutdown.
   b. Snap action, bi-metallic, temperature-actuated switch type.
   c. Normally closed, wired in series.
   d. Automatic reset.
   e. Switch point shall be pre-calibrated by the manufacturer.

B. Space Heaters:
1. Silicone rubber strip type, 120 V rated.
2. Provided on:
   a. All motors 10 HP and larger mounted outdoors.
   b. Indoor motors in humid environments as indicated.

2.6 SOURCE QUALITY CONTROL

A. Test motors in accordance with NEMA, IEEE and manufacturer procedures.
1. The test shall include but not necessarily be limited to the following:
   a. Routine test:
      1) No-load current and speed at rated voltage and frequency.
      2) Locked rotor current.
      3) Winding resistance.
      4) Vibration check.
      5) High potential.
   b. Complete test (in addition to the routine tests):
      1) Rated load temperature rise.
      2) Winding resistance.
      3) Slip test, measured in percent slip.
      4) Locked rotor amperes (3 PH, full voltage).
      5) Locked rotor torque.
      6) Breakdown torque.
      7) Efficiencies tabulated at 100, 75, and 50 PCT of full load.
      8) Power factor tabulated at 100, 75, and 50 PCT of full load.

B. Motors to be tested:
1. As indicated in the schedule.
2. All motors, at a minimum, to receive a routine test.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Ground all motors in accordance with Specification Section 26 05 26.

3.2 FIELD QUALITY CONTROL

A. Acceptance Testing: See Specification Section 01 61 03.

END OF SECTION

SECTION 26 05 19
WIRE AND CABLE - 600 VOLT AND BELOW

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Material and installation requirements for:
      a. Building wire.
      b. Power cable.
      c. Control cable.
      d. Instrumentation cable.
      e. Wire connectors.
      f. Insulating tape.
      g. Pulling lubricant.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 26 05 00 - Electrical: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Institute of Electrical and Electronics Engineers, Inc. (IEEE).
   2. Insulated Cable Engineers Association (ICEA):
      a. S-58-679, Standard for Control Cable Conductor Identification.
   3. National Electrical Manufacturers Association (NEMA):
      a. ICS 4, Industrial Control and Systems: Terminal Blocks.
   4. National Electrical Manufacturers Association/Insulated Cable Engineers Association (NEMA/ICEA):
      a. WC 57/S-73-532, Standard for Control Cables.
      b. WC 70/S-95-658, Non-Shielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.
   5. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
      b. 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
   6. Telecommunications Industry Association/Electronic Industries Alliance/American National Standards Institute (TIA/EIA/ANSI):
      a. 568, Commercial Building Telecommunications Cabling Standard.
   7. Underwriters Laboratories, Inc. (UL):
      a. 44, Standard for Safety Thermoset-Insulated Wires and Cables.
      b. 83, Standard for Safety Thermoplastic-Insulated Wires and Cables.
      c. 467, Standard for Safety Grounding and Bonding Equipment.
      d. 486A, Standard for Safety Wire Connectors and Soldering Lugs for use with Copper Conductors.
      e. 486C, Standard for Safety Splicing Wire Connections.
      f. 510, Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape.
      g. 1581, Standard for Safety Reference Standard for Electrical Wires, Cables, and Flexible Cords.

1.3 DEFINITIONS

A. Cable: Multi-conductor, insulated, with outer sheath containing either building wire or instrumentation wire.

B. Instrumentation Cable:
   1. Multiple conductor, insulated, twisted or untwisted, with outer sheath.
   2. The following are specific types of instrumentation cables:
      a. Analog signal cable:
         1) Used for the transmission of low current (e.g., 4-20mA DC) or low voltage (e.g., 0-10 VDC) signals, using No. 16 AWG and smaller conductors.
         2) Commonly used types are defined in the following:
            a) TSP: Twisted shielded pair.
            b) TST: Twisted shielded triad.
      b. Digital signal cable: Used for the transmission of digital signals between computers, PLC's, RTU's, etc.

C. Power Cable: Multi-conductor, insulated, with outer sheath containing building wire, No. 8 AWG and larger.

D. Control Cable: Multi-conductor, insulated, with outer sheath containing building wires, No. 14, No. 12 or No. 10 AWG.

E. Building Wire: Single conductor, insulated, with or without outer jacket depending upon type.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data:
      a. Provide submittal data for all products specified in PART 2 of this Specification Section except:
         1) Wire connectors.
         2) Insulating tape.
         3) Cable lubricant.
      b. See Specification Section 26 05 00 for additional requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. See Specification Section 26 05 00.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Building wire, power and control cable, and multiplex cable:
      a. Aetna Insulated Wire.
      b. Alphawire.
      c. Cerrowire.
      d. Encore Wire Corporation.
      e. General Cable.
      f. Okonite Company.
      g. Southwire Company.
   2. Instrumentation cable:
      a. Analog cable:
         1) Alphawire.
         2) Belden Inc.
         3) General Cable.
   3. Wire connectors:
      a. Burndy Corporation.
      b. Buchanan.

c. Ideal.
d. Ilsco.
e. 3M Co.
f. Teledyne Penn Union.
g. Thomas and Betts.
h. Phoenix Contact.

4. Insulating and color coding tape:
   a. 3M Co.
   b. Plymouth Bishop Tapes.
   c. Red Seal Electric Co.

2.2 MANUFACTURED UNITS

A. Building Wire:
1. Conductor shall be copper with 600 V rated insulation.
2. Conductors shall be stranded, except for conductors used in lighting and receptacle circuits which may be stranded or solid.
3. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
4. Conform to NEMA/ICEA WC 70/S-95-658 and UL 83 for type THHN/THWN and THHN/THWN-2 insulation.
5. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 for type XHHW-2 insulation.

B. Power Cable:
1. Conductor shall be copper with 600 V rated insulation.
2. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
3. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 and UL 1277 for type XHHW-2 insulation with an overall PVC jacket.
4. Number of conductors as required, including a bare ground conductor.
5. Individual conductor color coding:
   a. ICEA S-58-679, Method 4.
   b. See PART 3 of this Specification Section for additional requirements.
6. Conform to NFPA 70 Type TC and IEEE 1202 or CSA FT-4.

C. Control Cable:
1. Conductor shall be copper with 600 V rated insulation.
2. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
3. Conform to NEMA/ICEA WC 57/S-73-532 and UL 44 and UL 1277 for type XHHW-2 insulation with an overall PVC jacket.
4. Number of conductors as required, provided with or without bare ground conductor of the same AWG size.
   a. When a bare ground conductor is not provided, an additional insulated conductor shall be provided and used as the ground conductor (e.g., 6/c No. 14 w/g and 7/c No. 14 are equal).
5. Individual conductor color coding:
   a. ICEA S-58-679, Method 1, Table E-2.
   b. See PART 3 of this Specification Section for additional requirements.
6. Conform to NFPA 70 Type TC and IEEE 1202, CSA FT-4 or NFPA 262.

D. Electrical Equipment Control Wire:
1. Conductor shall be copper with 600 V rated insulation.
2. Conductors shall be stranded.
3. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
4. Conform to UL 44 for Type SIS insulation.
5. Conform to UL 83 for Type MTW insulation.

E. Instrumentation Cable:
   1. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
   2. Analog cable:
      a. Tinned copper conductors.
      b. 600 V PVC insulation with PVC jacket.
      c. Twisted with 100 PCT foil shield coverage with drain wire.
      d. Six (6) twists per foot minimum.
      e. Individual conductor color coding: ICEA S-58-679, Method 1, Table E-2.
      f. Conform to IEEE 1202 or CSA FT-4 or NFPA 262, UL 2250, UL 1581 and NFPA 70 Type ITC.
   3. Digital cable:
      a. As recommended by equipment (e.g., PLC, RTU) manufacturer.
      b. Horizontal voice and data cable:
         1) Category 6a per TIA/EIA/ANSI 568.
         2) Cable shall be label-verified.
         3) Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level.
         4) Conductors: No. 24 AWG solid untinned copper.
         5) Rated CMP per NFPA 70.
      c. Conform to IEEE 1202 or CSA FT-4 or NFPA 262 and NFPA 70 Type ITC.

F. Wire Connectors:
   1. Twist/screw on type:
      a. Insulated pressure or spring type solderless connector.
      b. 600 V rated.
      c. Ground conductors: Conform to UL 486C and/or UL 467 when required by local codes.
      d. Phase and neutral conductors: Conform to UL 486C.
   2. Compression and mechanical screw type:
      a. 600 V rated.
      b. Ground conductors: Conform to UL 467.
      c. Phase and neutral conductors: Conform to UL 486A.
   3. Terminal block type:
      a. High density, screw-post barrier-type with white center marker strip.
      b. 600 V and ampere rating as required, for power circuits.
      c. 600 V, 20 ampere rated for control circuits.
      d. 300 V, 15 ampere rated for instrumentation circuits.
      e. Conform to NEMA ICS 4 and UL 486A.

G. Insulating and Color Coding Tape:
   1. Pressure sensitive vinyl.
   2. Premium grade.
   3. Heat, cold, moisture, and sunlight resistant.
   4. Thickness, depending on use conditions: 7, 8.5, or 10 MIL.
   5. For cold weather or outdoor location, tape must also be all-weather.
   6. Color:
      a. Insulating tape: Black.
      b. Color coding tape: Fade-resistant color as specified herein.
   7. Comply with UL 510.

H. Pulling Lubricant: Cable manufacturer's standard containing no petroleum or other products which will deteriorate insulation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Permitted Usage of Insulation Types:
   1. Type XHHW-2:
      a. Building wire and power and control cable in architectural and non-architectural finished areas.
      b. Building wire and power and control cable in conduit in outdoor areas and below grade.
   2. Type SIS and MTW:
      a. For the wiring of control equipment within control panels and field wiring of control equipment within switchgear, switchboards, motor control centers.

B. Conductor Size Limitations:
   1. Feeder and branch power conductors shall not be smaller than No. 12 AWG unless otherwise indicated on the Drawings.
   2. Control conductors shall not be smaller than No. 14 AWG unless otherwise indicated on the Drawings.
   3. Instrumentation conductors shall not be smaller than No. 18 AWG unless otherwise indicated on the Drawings.

C. Color Code All Wiring as Follows:
   1. Building wire:

	240 V, 208 V, 240/120 V, 208/120 V	480 V, 480/277 V
Phase 1	Black	Brown
Phase 2	Red *	Orange
Phase 3	Blue	Yellow
Neutral	White	White or Gray
Ground	Green	Green

* Orange when it is a high leg of a 120/240 V Delta system.

      a. Conductors No. 6 AWG and smaller: Insulated phase, neutral and ground conductors shall be identified by a continuous colored outer finish along its entire length.
      b. Conductors larger than No. 6 AWG:
         1) Insulated phase and neutral conductors shall be identified by one (1) of the following methods:
            a) Continuous colored outer finish along its entire length.
            b) 3 IN of colored tape applied at the termination.
         2) Insulated grounding conductor shall be identified by one (1) of the following methods:
            a) Continuous green outer finish along its entire length.
            b) Stripping the insulation from the entire exposed length.
            c) Using green tape to cover the entire exposed length.
         3) The color coding shall be applied at all accessible locations, including but not limited to: Junction and pull boxes, wireways, manholes and handholes.
   2. Power cables ICEA S-58-679, Method 4 with:
      a. Phase and neutral conductors identified with 3 IN of colored tape, per the Table herein, applied at the terminations.
      b. Ground conductor: Bare.
   3. Control cables ICEA S-58-679, Method 1, Table E-2:
      a. When a bare ground is not provided, one (1) of the colored insulated conductors shall be re-identified by stripping the insulation from the entire exposed length or using green tape to cover the entire exposed length.

b. When used in power applications the colored insulated conductors used as phase and neutral conductors may have to be re-identified with 3 IN of colored tape, per the Table herein, applied at the terminations.

D. Install all wiring in raceway unless otherwise indicated on the Drawings.

E. Feeder, branch, control and instrumentation circuits shall not be combined in a raceway, cable tray, junction or pull box, except as permitted in the following:
   1. Where specifically indicated on the Drawings.
   2. Where field conditions dictate and written permission is obtained from the Engineer.
   3. Control circuits shall be isolated from feeder and branch power and instrumentation circuits but combining of control circuits is permitted.
      a. The combinations shall comply with the following:
         1) 12 VDC, 24 VDC and 48 VDC may be combined.
         2) 125 VDC shall be isolated from all other AC and DC circuits.
         3) AC control circuits shall be isolated from all DC circuits.
   4. Instrumentation circuits shall be isolated from feeder and branch power and control circuits but combining of instrumentation circuits is permitted.
      a. The combinations shall comply with the following:
         1) Analog signal circuits may be combined.
         2) Digital signal circuits may be combined but isolated from analog signal circuits.
   5. Multiple branch circuits for lighting, receptacle, and other 120Vac circuits are allowed to be combined into a common raceway.
      a. Contractor is responsible for making the required adjustments in conductor and raceway size, in accordance with all requirements of the NFPA 70, including but not limited to:
         1) Up sizing conductor size for required ampacity de-ratings for the number of current carrying conductors in the raceway.
         2) Up sizing raceway size for the size and quantity of conductors.

F. Ground the drain wire of shielded instrumentation cables at one (1) end only.
   1. The preferred grounding location is at the load (e.g., control panel), not at the source (e.g., field mounted instrument).

G. Splices and terminations for the following circuit types shall be made in the indicated enclosure type using the indicated method.
   1. Feeder and branch power circuits:
      a. Device outlet boxes:
         1) Twist/screw on type connectors.
      b. Junction and pull boxes and wireways:
         1) Twist/screw on type connectors for use on No. 8 and smaller wire.
         2) Compression, mechanical screw or terminal block or terminal strip type connectors for use on No. 6 AWG and larger wire.
      c. Motor terminal boxes:
         1) Twist/screw on type connectors for use on No. 10 AWG and smaller wire.
         2) Insulated mechanical screw type connectors for use on No. 8 AWG and larger wire.
   2. Control circuits:
      a. Junction and pull boxes: Terminal block type connector.
      b. Control panels and motor control centers: Terminal block or strips provided within the equipment or field installed within the equipment by the Contractor.
   3. Instrumentation circuits can be spliced where field conditions dictate and written permission is obtained from the Engineer.
      a. Maintain electrical continuity of the shield when splicing twisted shielded conductors.
      b. Junction and pull boxes: Terminal block type connector.
      c. Control panels and motor control centers: Terminal block or strip provided within the equipment or field installed within the equipment by the Contractor.

4. Non-insulated compression and mechanical screw type connectors shall be insulated with tape or hot or cold shrink type insulation to the insulation level of the conductors.

H. Insulating Tape Usage:
   1. For insulating connections of No. 8 AWG wire and smaller: 7 MIL vinyl tape.
   2. For insulating splices and taps of No. 6 AWG wire or larger: 10 MIL vinyl tape.
   3. For insulating connections made in cold weather or in outdoor locations: 8.5 MIL, all weather vinyl tape.

I. Color Coding Tape Usage: For color coding of conductors.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Material and installation requirements for grounding and bonding system(s).

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 10 14 00 - Identification Devices.
   4. Section 26 05 00 - Electrical - Basic Requirements.
   5. Section 26 05 19 - Wire and Cable - 600 Volt and Below.
   6. Section 26 05 33 - Raceways and Boxes.
   7. Section 26 08 13 - Acceptance Testing.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
   2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. 837, Standard for Qualifying Permanent Connections Used in Substation Grounding.
   3. National Fire Protection Association (NFPA):
      70, National Electrical Code (NEC).
   4. Underwriters Laboratories, Inc. (UL):
      a. 467, Grounding and Bonding Equipment.

B. Assure ground continuity is continuous throughout the entire Project.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data.
      a. Provide submittal data for all products specified in PART 2 of this Specification Section except:
         1) Grounding clamps, terminals and connectors.
         2) Exothermic welding system.
      b. See Specification Section 26 05 00 for additional requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Ground rods and bars and grounding clamps, connectors and terminals:
      a. ERICO by Pentair.
      b. Harger Lightning & Grounding.
      c. Heary Bros. Lightning Protection Co. Inc..
      d. Burndy by Hubbell.
      e. Robbins Lightning, Inc.

f. Blackburn by Thomas & Betts.
g. Thompson Lightning Protection, Inc.

2. Exothermic weld connections:
   a. ERICO by Pentair - Cadweld.
   b. Harger Lightning & Grounding - Ultraweld.
   c. Burndy by Hubbell - Thermoweld.
   d. FurseWELD by Thomas & Betts.

2.2 COMPONENTS

A. Wire and Cable:
   1. Bare conductors: Soft drawn stranded copper meeting ASTM B8.
   2. Insulated conductors: Color coded green, per Specification Section 26 05 19.

B. Conduit: As specified in Specification Section 26 05 33.

C. Ground Bars:
   1. Solid copper:
      a. 1/4 IN thick.
      b. 2 or 4 IN wide.
      c. 24 IN long minimum in main service entrance electrical rooms, 12 IN long elsewhere.
   2. Predrilled grounding lug mounting holes.
   3. Stainless steel or galvanized steel mounting brackets.
   4. Insulated standoffs.

D. Ground Rods:
   1. 3/4 IN x 10 FT.
   2. Copper-clad:
      a. Heavy uniform coating of electrolytic copper molecularly bonded to a rigid steel core.
      b. Corrosion resistant bond between the copper and steel.
      c. Hard drawn for a scar-resistant surface.

E. Grounding Clamps, Connectors and Terminals:
   1. Mechanical type:
      a. Standards: UL 467.
      b. High copper alloy content.
   2. Compression type for interior locations:
      a. Standards: UL 467.
      b. High copper alloy content.
      c. Non-reversible.
      d. Terminals for connection to bus bars shall have two bolt holes.
   3. Compression type suitable for direct burial in earth or concrete:
      a. Standards: UL 467, IEEE 837.
      b. High copper alloy content.
      c. Non-reversible.

F. Exothermic Weld Connections:
   1. Copper oxide reduction by aluminum process.
   2. Molds properly sized for each application.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. Install products in accordance with manufacturer's instructions.
   2. Size grounding conductors and bonding jumpers in accordance with NFPA 70, Article 250, except where larger sizes are indicated on the Drawings.

3. Remove paint, rust, or other non-conducting material from contact surfaces before making ground connections.
4. Where ground conductors pass through floor slabs or building walls provide nonmetallic sleeves.

5. Do not splice grounding electrode conductors except at ground rods.
6. Install ground rods and grounding electrode conductors in undisturbed, firm soil.
    a. Provide excavation required for installation of ground rods and conductors.
    b. Use driving studs or other suitable means to prevent damage to threaded ends of sectional rods.
    c. Unless otherwise specified, connect conductors to ground rods with compression type connectors or exothermic weld.
    d. Provide sufficient slack in conductor to prevent conductor breakage during backfill or due to ground movement.
    e. Backfill excavation completely, thoroughly tamping to provide good contact between backfill materials and ground rods and conductors.
7. Do not use exothermic welding if it will damage the structure the grounding conductor is being welded to.

B. Grounding Electrode System:
1. Provide a grounding electrode system in accordance with NFPA 70, Article 250 and as indicated on the Drawings.
2. Grounding electrode conductor terminations:
    a. Ground bars mounted on wall: Use compression type conductor terminal and bolt it to the ground bar with two bolts.
    b. Ground bars in electrical equipment: Use compression type conductor terminal and bolt it to the ground bar.
    c. Piping systems: Use mechanical type connections.
    d. Building steel, below grade and encased in concrete: Use compression type connector or exothermic weld.
    e. At all above grade terminations, the conductors shall be labeled as required.
3. Ground ring grounding system:
    a. Ground ring consists of ground rods and a grounding conductor looped around the structure.
    b. Placed at a minimum of 10 FT from the structure foundation and 2 FT-6 IN below grade.
    c. Provide a minimum of four (4) ground rods placed at the corners of the structure and additional rods so that the maximum distance between ground rods does not exceed 50 FT.
    d. Building/Structure grounding:
        1) Bond building/structure metal support columns to the ground ring at all corners of the structure.
    e. Grounding conductor: Bare conductor, size as indicated on the Drawings.
    f. Ground rod test stations: Provide where indicated on the Drawings.

C. Supplemental Grounding Electrode:
1. Provide the following grounding in addition to the equipment ground conductor supplied with the feeder conductors whether or not shown on the Drawings.

2. Metal light poles:
    a. Grounding conductor: Bare #6 AWG minimum.
3. Equipment support rack and pedestals mounted outdoors:
    a. Connect metallic structure to a ground rod.
    b. Grounding conductor: #6 AWG minimum.

D. Low Voltage Transformer Separately Derived Grounding System:

1. Install the System Bonding Jumper at the transformer. At the first disconnect, ensure the neutral is isolated from ground.
2. Structures with a single electrical room/area:
    a. Connect grounding electrode conductor to the Grounding Electrode System main ground bar.
3. Structures with multiple electrical rooms/areas:
    a. Provide a ground bar mounted in each electrical room/area.
    b. Interconnect all ground bars in a daisy chain or radial fashion to the main ground bar as indicated on the Drawings.
    c. Connect grounding electrode conductor to the electrical room/area ground bar.
4. See Grounding Electrode System paragraph for conductor termination requirements.

E. Raceway Bonding/Grounding:
1. Install all metallic raceway so that it is electrically continuous.
2. Provide an equipment grounding conductor in all raceways with insulation identical to the phase conductors, unless otherwise indicated on the Drawings.
3. NFPA 70 required grounding bushings shall be of the insulating type.
4. Provide double locknuts at all panels.
5. Bond all conduits, at entrance and exit of equipment, to the equipment ground bus or lug.
6. Provide bonding jumpers if conduits are installed in concentric knockouts.
7. Make all metallic raceway fittings and grounding clamps tight to ensure equipment grounding system will operate continuously at ground potential to provide low impedance current path for proper operation of overcurrent devices during possible ground fault conditions.

F. Equipment Grounding:
1. Ground all utilization equipment with an equipment grounding conductor.

G. Manhole and Handhole Grounding:
1. Provide a ground rod and ground bar, when indicated or as needed, in each manhole and handhole with exposed metal parts.
    a. Expose a minimum of 4 IN of the rod above the floor for field connections to the rod.
2. Connect all exposed metal parts (e.g., conduits and cable racks) to the ground rod.

3.2 FIELD QUALITY CONTROL

A. Leave grounding system uncovered until observed by Owner.

END OF SECTION

SECTION 26 05 33
RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Material and installation requirements for:
      a. Conduits.
      b. Conduit fittings.
      c. Conduit supports.
      d. Wireways.
      e. Outlet boxes.
      f. Pull and junction boxes.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 26 05 00 - Electrical - Basic Requirements.
   4. Section 26 05 43 - Electrical - Exterior Underground.
   5. Section 26 27 26 - Wiring Devices.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Iron and Steel Institute (AISI).
   2. ASTM International (ASTM):
      a. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
      b. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
      c. D2564, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
   3. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. RN 1, Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
      c. TC 2, Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
      d. TC 3, Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
   4. National Electrical Manufacturers Association/American National Standards Institute (NEMA/ANSI):
      a. C80.1, Electric Rigid Steel Conduit (ERSC).
      b. C80.3, Steel Electrical Metallic Tubing (EMT).
      c. OS 1, Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
   5. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   6. Underwriters Laboratories, Inc. (UL):
      a. 1, Standard for Flexible Metal Conduit.
      b. 6, Electrical Rigid Metal Conduit - Steel.
      c. 50, Enclosures for Electrical Equipment, Non-Environmental Considerations.
      d. 360, Standard for Liquid-Tight Flexible Metal Conduit.
      e. 467, Grounding and Bonding Equipment.
      f. 514A, Metallic Outlet Boxes.
      g. 514B, Conduit, Tubing, and Cable Fittings.
      h. 651, Standard for Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.
      i. 797, Electrical Metallic Tubing - Steel.

j. 870, Standard for Wireways, Auxiliary Gutters, and Associated Fittings.
k. 886, Standard for Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.

1.3 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Product technical data:
a. Provide submittal data for all products specified in PART 2 of this Specification Section except:
1) Conduit fittings.
2) Support systems.
b. See Specification Section 26 05 00 for additional requirements.
3. Fabrication and/or layout drawings:
a. Identify dimensional size of pull and junction boxes to be used.

1.4 DELIVERY, STORAGE, AND HANDLING

A. See Specification Section 26 05 00.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Rigid metal conduits:
a. Allied Tube and Conduit.
b. Western Tube and Conduit Corporation.
c. Wheatland Tube Company.
2. PVC coated rigid metal conduits:
a. Ocal by Thomas & Betts.
b. Robroy Industries.
3. Rigid nonmetallic conduit:
a. Prime Conduit.
b. Cantex, Inc.
c. Osburn Associates, Inc.
4. Flexible conduit:
a. AFC Cable Systems.
b. Anamet, Inc.
c. Electri-Flex Company.
d. International Metal Hose Company.
e. Southwire Company, LLC.
5. Wireway:
a. Hoffman Engineering.
b. Wiegmann by Hubbell.
c. Square D by Schneider Electric.
6. Conduit fittings and accessories:
a. Appleton by Emerson Electric Co.
b. Carlon by Thomas & Betts.
c. Cantex, Inc.
d. Crouse-Hinds by Eaton.
e. Killark by Hubbell.
f. Osburn Associates, Inc.
g. O-Z/Gedney by Emerson Electric Co.
h. Raco by Hubbell.

i. Steel City by Thomas & Betts.
j. Thomas & Betts.

7. Support systems:
   a. Unistrut by Atkore International, Inc.
   b. B-Line by Eaton.
   c. Kindorf by Thomas & Betts.
   d. Minerallac Company.
   e. CADDY by Pentair.
   f. Superstrut by Thomas & Betts.
8. Outlet, pull and junction boxes:
   a. Appleton by Emerson Electric Co.
   b. Crouse-Hinds by Eaton
   c. Killark by Hubbell.
   d. O-Z/Gedney by Emerson Electric Co.
   e. Steel City by Thomas & Betts.
   f. Raco by Hubbell
   g. Bell by Hubbell.
   h. Hoffman Engineering.
   i. Wiegmann by Hubbell.
   j. B-Line by Eaton.
   k. Adalet.
   l. RITTAL North America LLC.
   m. Stahlin by Robroy Enclosures.

2.2 RIGID METAL CONDUITS

A. Rigid Galvanized Steel Conduit (RGS):
   1. Mild steel with continuous welded seam.
   2. Metallic zinc applied by hot-dip galvanizing or electro-galvanizing.
   3. Threads galvanized after cutting.
   4. Internal coating: Baked lacquer, varnish or enamel for a smooth surface.
   5. Standards: NFPA 70 Type RMC, NEMA/ANSI C80.1, UL 6.

B. PVC-Coated Rigid Steel Conduit (PVC-RGS):
   1. Nominal 40 MIL Polyvinyl Chloride Exterior Coating:
      a. Coating: Bonded to hot-dipped galvanized rigid steel conduit conforming to NEMA/ANSI C80.1.
      b. The bond between the PVC coating and the conduit surface: Greater than the tensile strength of the coating.
   2. Nominal 2 mil, minimum, urethane interior coating.
   3. Urethane coating on threads.
   4. Conduit: Epoxy prime coated prior to application of PVC and urethane coatings.
   5. Female Ends:
      a. Have a plastic sleeve extending a minimum of 1 pipe diameter or 2 IN, whichever is less beyond the opening.
      b. The inside diameter of the sleeve shall be the same as the outside diameter of the conduit to be used with it.
   6. Standards: NFPA 70 Type RMC, NEMA/ANSI C80.1, UL 6, NEMA RN 1.

2.3 RIGID NONMETALLIC CONDUIT

A. Schedules 40 (PVC-40) and 80 (PVC-80):
   1. Polyvinyl-chloride (PVC) plastic compound which includes inert modifiers to improve weatherability and heat distribution.
   2. Rated for direct sunlight exposure.
   3. Fire retardant and low smoke emission.
   4. Shall be suitable for use with 90 DEGC wire and shall be marked "maximum 90 DEGC".
   5. Standards: NFPA 70 Type PVC, NEMA TC 2, UL 651.

2.4 FLEXIBLE CONDUIT

A. PVC-Coated Flexible Galvanized Steel (liquid-tight) Conduit (FLEX-LT):
   1. Core formed of continuous, spiral wound, hot-dip galvanized steel strip with successive convolutions securely interlocked.
   2. Extruded PVC outer jacket positively locked to the steel core.
   3. Liquid and vaportight.
   4. Standard: UL 360.

2.5 WIREWAY

A. General:
   1. Suitable for lay-in conductors.
   2. Designed for continuous grounding.
   3. Covers:
      a. Hinged or removable in accessible areas.
      b. Non-removable when passing through partitions.
   4. Finish: Rust inhibiting primer and manufacturer's standard paint inside and out except for stainless steel type.
   5. Standards: UL 870, NEMA 250.

B. General Purpose (NEMA 1 rated) Wireway:
   1. 14 or 16 gage steel without knockouts.
   2. Cover: Solid, non-gasketed and held in place by captive screws.

C. Raintight (NEMA 3R) Wiring Trough:
   1. 14 or 16 GA galvanized steel without knockouts.
   2. Cover: Non-gasketed and held in place by captive screws.

D. Watertight (NEMA 4X rated) Wireway:
   1. 14 GA Type 304 or 316 stainless steel bodies and covers without knockouts and 10 GA stainless steel flanges.
   2. Cover: Fully gasketed and held in place with captive clamp type latches.
   3. Flanges: Fully gasketed and bolted.

E. Dusttight (NEMA 12 rated) Wireway:
   1. 14 GA steel bodies and covers without knockouts and 10 GA steel flanges.
   2. Cover: Fully gasketed and held in place with captive clamp type latches.
   3. Flanges: Fully gasketed and bolted.

2.6 CONDUIT FITTINGS AND ACCESSORIES

A. Fittings for Use with RGS:
   1. General:
      a. In hazardous locations listed for use in Class I, Groups C and D locations.
   2. Locknuts:
      a. Threaded steel or malleable iron.
      b. Gasketed or non-gasketed.
      c. Grounding or non-grounding type.
   3. Bushings:
      a. Threaded, insulated metallic.
      b. Grounding or non-grounding type.
   4. Hubs: Threaded, insulated and gasketed metallic for raintight connection.
   5. Couplings:
      a. Threaded straight type: Same material and finish as the conduit with which they are used on.
      b. Threadless type: Gland compression or self-threading type, concrete tight.
   6. Unions: Threaded galvanized steel or zinc plated malleable iron.
   7. Conduit bodies (ells and tees):
      a. Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs.

b. Standard and mogul size.
c. Cover:
1) Clip-on type with stainless steel screws.
2) Gasketed or non-gasketed galvanized steel, zinc plated cast iron or cast copper free aluminum.

8. Conduit bodies (round):
a. Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs.
b. Cover: Threaded screw on type, gasketed, galvanized steel, zinc plated cast iron or cast copper free aluminum.

9. Sealing fittings:
a. Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs.
b. Standard and mogul size.
c. With or without drain and breather.
d. Fiber and sealing compound: UL listed for use with the sealing fitting.

10. Hazardous location flexible coupling (HAZ-FLEX):
a. Liquid tight and arc resistant.
b. Electrically conductive so no bonding jumper is required.
c. Dry and wet areas:
1) Bronze braided covering over flexible brass core.
2) Bronze end fittings.
3) Zinc-plated steel or malleable iron unions and nipples.
d. Corrosive areas:
1) Stainless steel braided covering over flexible stainless steel core.
2) Stainless steel end fittings.
3) Aluminum unions and nipples.

11. Service entrance head:
a. Malleable iron, galvanized steel or copper free aluminum.
b. Insulated knockout cover for use with a variety of sizes and number of conductors.

12. Expansion couplings:
a. 2 IN nominal straight-line conduit movement in either direction.
b. Galvanized steel with insulated bushing.
c. Gasketed for wet locations.
d. Internally or externally grounded.

13. Expansion/deflection couplings:
a. 3/4 IN nominal straight-line conduit movement in either direction.
b. 30-degree nominal deflection from the normal in all directions.
c. Metallic hubs, neoprene outer jacket and stainless steel jacket clamps.
d. Internally or externally grounded.
e. Watertight, raintight and concrete tight.

14. Standards: UL 467, UL 514B, UL 1203.

B. Fittings for Use with FLEX-LT:
1. Connector:
a. Straight or angle type.
b. Metal construction, insulated and gasketed.
c. Composed of locknut, grounding ferrule and gland compression nut.
d. Liquid tight.
2. Standards: UL 467, UL 514B.

C. Fittings for Use with Rigid Nonmetallic PVC Conduit:
1. Coupling, adapters and conduit bodies:
a. Same material, thickness, and construction as the conduits with which they are used.
b. Homogeneous plastic free from visible cracks, holes or foreign inclusions.
c. Bore smooth and free of blisters, nicks or other imperfections which could damage the conductor.
2. Solvent cement for welding fittings shall be supplied by the same manufacturer as the conduit and fittings.

3. Standards: ASTM D2564, NEMA TC 3, UL 651, UL 514B.

D. Weather and Corrosion Protection Tape:
   1. PVC based tape, 10 mils thick.
   2. Protection against moisture, acids, alkalis, salts and sewage and suitable for direct bury.
   3. Used with appropriate pipe primer.

2.7 ALL FITTINGS

A. Mark Products:
   1. Identify the nominal trade size on the product.
   2. Stamp with the name or trademark of the manufacturer.

2.8 OUTLET BOXES

A. Cast Outlet Boxes:
   1. Zinc plated cast iron or die-cast copper free aluminum with manufacturer's standard finish.
   2. Threaded hubs and grounding screw.
   3. Styles:
      a. "FS" or "FD".
      b. "Bell".
      c. Single or multiple gang and tandem.
      d. "EDS" or "EFS" for hazardous locations.
   4. Accessories: 40 MIL PVC exterior coating and 2 MIL urethane interior coating.
   5. Standards: UL 514A, UL 886.

B. See Specification Section 26 27 26 for wiring devices, wallplates and coverplates.

2.9 PULL AND JUNCTION BOXES

A. NEMA 1 Rated:
   1. Body and cover: 14 GA minimum, galvanized steel or 14 GA minimum, steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
   2. With or without concentric knockouts on four sides.
   3. Flat cover fastened with screws.

B. NEMA 4X Rated (metallic):
   1. Body and cover: 14 GA Type 304 or 316 stainless steel.
   2. Seams continuously welded and ground smooth.
   3. No knockouts.
   4. External mounting flanges.
   5. Hinged door and stainless steel screws and clamps.
   6. Door with oil-resistant gasket.

C. NEMA 4X Rated (Nonmetallic):
   1. Body and cover: Ultraviolet light protected fiberglass-reinforced polyester boxes.
   2. No knockouts.
   3. External mounting flanges.
   4. Hinged door with quick release latches and padlocking hasp.
   5. Door with oil resistant gasket.

D. NEMA 12 Rated:
   1. Body and cover:
      a. 14 GA steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
      b. Type 5052 H-32 aluminum, unpainted.
   2. Seams continuously welded and ground smooth.
   3. No knockouts.
   4. External mounting flanges.
   5. Non-hinged cover held closed with captivated cover screws threaded into sealed wells or hinged cover held closed with stainless steel screws and clamps.

6. Flat door with oil resistant gasket.

E. Miscellaneous Accessories:
   1. Rigid handles for covers larger than 9 SQFT or heavier than 25 LBS.
   2. Split covers when heavier than 25 LBS.
   3. Weldnuts for mounting optional panels and terminal kits.
   4. Terminal blocks: Screw-post barrier-type, rated 600 volt and 20 ampere minimum.

F. Standards: NEMA 250, UL 50.

2.10 SUPPORT SYSTEMS

A. Multi-conduit Surface or Trapeze Type Support and Pull or Junction Box Supports:
   1. Material requirements.
      a. Stainless steel: AISI Type 316.

B. Single Conduit and Outlet Box Support Fasteners:
   1. Material requirements:
      a. Stainless steel.
      b. Malleable iron.

2.11 OPENINGS AND PENETRATIONS IN WALLS AND FLOORS

A. Sleeves, smoke and fire stop fitting through walls and floors:
   1. See Specification Section 01 73 20.

PART 3 - EXECUTION

3.1 RACEWAY INSTALLATION - GENERAL

A. Shall be in accordance with the requirements of:
   1. NFPA 70.
   2. Manufacturer instructions.

B. Size of Raceways:
   1. Raceway sizes are shown on the Drawings, if not shown on the Drawings, then size in accordance with NFPA 70.
   2. Unless specifically indicated otherwise, the minimum raceway size shall be:
      a. Conduit: 3/4 IN.
      b. Wireway: 2-1/2 IN x 2-1/2 IN.

C. Field Bending and Cutting of Conduits:
   1. Utilize tools and equipment recommended by the manufacturer of the conduit, designed for the purpose and the conduit material to make all field bends and cuts.
   2. Do not reduce the internal diameter of the conduit when making conduit bends.
   3. Prepare tools and equipment to prevent damage to the PVC coating.
   4. Degrease threads after threading and apply a zinc rich paint.
   5. Debur interior and exterior after cutting.

D. Male threads of conduit systems shall be coated with an electrically conductive anti-seize compound.

E. The protective coating integrity of conduits, fittings, outlet, pull and junction boxes and accessories shall be maintained.
   1. Repair galvanized components utilizing a zinc rich paint.
   2. Repair painted components utilizing touch up paint provided by or approved by the manufacturer.
   3. Repair PVC coated components utilizing a patching compound, of the same material as the coating, provided by the manufacturer of the conduit; or a self-adhesive, highly conformable, cross-linked silicone composition strip, followed by a protective coating of vinyl tape.

a. Total nominal thickness: 40 MIL.

4. Repair surfaces which will be inaccessible after installation prior to installation.

F. Remove moisture and debris from conduit before wire is pulled into place.
1. Pull mandrel with diameter nominally 1/4 IN smaller than the interior of the conduit, to remove obstructions.
2. Swab conduit by pulling a clean, tight-fitting rag through the conduit.
3. Tightly plug ends of conduit with tapered wood plugs or plastic inserts until wire is pulled.

G. Only nylon or polyethylene rope shall be used to pull wire and cable in conduit systems.

H. Where portions of a raceway are subject to different temperatures and where condensation is known to be a problem, as in cold storage areas of buildings or where passing from the interior to the exterior of a building, the raceway shall be sealed to prevent circulation of warm air to colder section of the raceway.

I. Fill openings in walls, floors, and ceilings and finish flush with surface.
1. See Specification Section 01 73 20.

3.2 RACEWAY ROUTING

A. Raceways shall be routed in the field unless otherwise indicated.
1. Conduit and fittings shall be installed, as required, for a complete system that has a neat appearance and is in compliance with all applicable codes.
2. Run in straight lines parallel to or at right angles to building lines.
3. Do not route conduits:
a. Through areas of high ambient temperature or radiant heat.
b. In suspended concrete slabs.
c. In concrete members including slabs, slabs on grade, beams, walls, and columns unless specifically located and detailed on structural Drawings..
4. Locate sleeves or conduits penetrating floors, walls, and beams so as not to significantly impair the strength of the construction. Do not place conduit penetrations in columns.
5. Conduit shall not interfere with, or prevent access to, piping, valves, ductwork, or other equipment for operation, maintenance and repair.
6. Provide pull boxes or conduit bodies as needed so that there is a maximum of 360 DEG of bends in the conduit run or in long straight runs to limit pulling tensions.

B. All conduits within a structure shall be installed exposed except as follows:
1. As indicated on the Drawings.
2. Concealed above gypsum wall board or acoustical tile suspended ceilings.
3. Conduits in architecturally finished areas shall be concealed.

C. Maintain minimum spacing between parallel conduit and piping runs in accordance with the following when the runs are greater than 30 FT:
1. Between instrumentation and telecommunication: 1 IN.
2. Between instrumentation and 125 V, 48 V and 24 VDC, 2 IN.
3. Between instrumentation and 600 V and less AC power or control: 6 IN.
4. Between instrumentation and greater than 600 VAC power: 12 IN.
5. Between telecommunication and 125 V, 48 V and 24 VDC, 2 IN.
6. Between telecommunication and 600 V and less AC power or control: 6 IN.
7. Between telecommunication and greater than 600 VAC power: 12 IN.
8. Between 125 V, 48 V and 24 VDC and 600 V and less AC power or control: 2 IN.
9. Between 125 V, 48 V and 24 VDC and greater than 600 VAC power: 2 IN.
10. Between 600 V and less AC and greater than 600 VAC: 2 IN.
11. Between process, gas, air and water pipes: 6 IN.

D. Conduits shall be installed to eliminate moisture pockets.
1. Where water cannot drain to openings, provide drain fittings in the low spots of the conduit run.

E. Conduit shall not be routed on the exterior of structures except as specifically indicated on the Drawings.

F. Where sufficient room exists within the housing of roof-mounted equipment, the conduit shall be stubbed up inside the housing.

G. Provide all required openings in walls, floors, and ceilings for conduit penetration.
   1. See Specification Section 01 73 20.

3.3 RACEWAY APPLICATIONS

A. Permitted Raceway Types Per Wire or Cable Types:
   1. Power wire or cables: All raceway types.
   2. Control wire or cables: All raceway types.
   3. Instrumentation cables: Metallic raceway except nonmetallic may be used underground.
   4. Motor leads from a VFD: RGS, or shielded VFD cables in all other raceways.
   5. Telecommunication cables: All raceway types.

B. Permitted Raceway Types Per Area Designations:
   1. Dry areas:
      a. RGS.
   2. Wet areas:
      a. RGS.
   3. Corrosive areas:
      a. PVC-RGS.
   4. Highly corrosive areas:
      a. PVC-RGS.
      b. PVC-80.
   5. NFPA 70 hazardous areas:
      a. RGS.

C. Permitted Raceway Types Per Routing Locations:
   1. In stud framed walls:
      a. RGS.
   2. In concrete block or brick walls:
      a. PVC-40.
   3. Above acoustical tile ceilings:
      a. RGS.
      b. NEMA 1 rated wireway.
   4. Embedded in poured concrete walls and floors:
      a. PVC-40.
      b. PVC-RGS when emerging from concrete into areas designated as wet, corrosive or highly corrosive.
   5. Beneath floor slab-on-grade:
      a. PVC-40.
   6. Through floor penetrations, see Specification Section 01 73 20:
      a. PVC-RGS in areas designated as wet, corrosive or highly corrosive.
   7. Direct buried conduits and ductbanks:
      a. PVC-80.
      b. 90 DEG elbows for transitions to above grade:
         1) PVC-RGS.
      c. Long sweeping bends greater than 15 DEG:
         1) PVC-RGS.
   8. Concrete encased ductbanks:
      a. PVC-40.
      b. PVC-EB.
      c. 90 degree elbows for transitions to above grade:
         1) PVC-RGS.
      d. Long sweeping bends greater than 15 DEG:

1) RGS for sizes 2 IN and larger.

D. FLEX conduits shall be installed for connections to light fixtures, HVAC equipment and other similar devices above the ceilings.
   1. The maximum length shall not exceed:
      a. 6 FT to light fixtures.
      b. 3 FT to all other equipment.

E. FLEX-LT conduits shall be install as the final conduit connection to light fixtures, dry type transformers, motors, electrically operated valves, instrumentation primary elements, and other electrical equipment that is liable to vibrate.
   1. The maximum length shall not exceed:
      a. 6 FT to light fixtures.
      b. 3 FT to motors.
      c. 2 FT to all other equipment.

F. HAZ-FLEX coupling shall be installed as the final conduit to motors, electrically operated valves, instrumentation primary elements and electrical equipment that is liable to vibrate.
   1. The maximum length shall not exceed:
      a. 3 FT to motors.
      b. 2 FT to all other equipment.

G. NEMA 1 Rated Wireway:
   1. Surface mounted in electrical rooms.
   2. Surface mounted above removable ceilings tiles of an architecturally finished area.

H. NEMA 3R Wiring Trough:
   1. Surface mounted in exterior locations.

I. NEMA 4X Rated Wireway:
   1. Surface mounted in areas designated as wet and or corrosive.

J. NEMA 12 Rated Wireway:
   1. Surface mounted in areas designated as dry in architecturally and non-architecturally finished areas.

K. Underground Conduit: See Specification Section 26 05 43.

3.4 CONDUIT FITTINGS AND ACCESSORIES

A. Conduit Seals:
   1. Installed in conduit systems located in hazardous areas as required by the NFPA 70.
   2. Filler plug and drain shall be accessible.
   3. Pour the conduit seals in a two-step process.
      a. Pour the seal and leave cover off.
      b. After seal is dry, inspect for proper sealing, install cover and mark (for example, paint or permanent marker) as complete.

B. Rigid nonmetallic conduit and fittings shall be joined utilizing solvent cement.
   1. Immediately after installation of conduit and fitting, the fitting or conduit shall be rotated 1/4 turn to provide uniform contact.

C. Install Expansion Fittings:
   1. Where conduits are exposed to the sun and conduit run is greater than 200 FT.
   2. Elsewhere as identified on the Drawings.

D. Install Expansion/Deflection Fittings:
   1. Where conduits enter a structure.
      a. Except electrical manholes and handholes.
      b. Except where the ductbank is tied to the structure with rebar.
   2. Where conduits span structural expansions joints.
   3. Elsewhere as identified on the Drawings.

E. Threaded connections shall be made wrench-tight.

F. Conduit joints shall be watertight:
   1. Where subjected to possible submersion.
   2. In areas classified as wet.
   3. Underground.

G. Terminate Conduits:
   1. In metallic outlet boxes:
      a. RGS:
         1) Conduit hub and locknut.
         2) Insulated bushing and two locknuts.
         3) Use grounding type locknut or bushing when required by NFPA 70.
   2. In NEMA 1 rated enclosures:
      a. RGS:
         1) Conduit hub and locknut.
         2) Insulated bushing and two locknuts.
         3) Use grounding type locknut or bushing when required by NFPA 70.
   3. In NEMA 12 rated enclosures:
      a. Watertight, insulated and gasketed hub and locknut.
      b. Use grounding type locknut or bushing when required by NFPA 70.
   4. In NEMA 4 and NEMA 4X rated enclosures:
      a. Watertight, insulated and gasketed hub and locknut.
   5. When stubbed up through the floor into floor mount equipment:
      a. With an insulated grounding bushing on metallic conduits.
      b. With end bells on nonmetallic conduits.

H. Threadless couplings shall only be used to join new conduit to existing conduit when the existing conduit end is not threaded and it is not practical or possible to cut threads on the existing conduit with a pipe threader.

3.5 CONDUIT SUPPORT

A. Permitted multi-conduit surface or trapeze type support system per area designations and conduit types:
   1. Dry or wet and/or hazardous areas:
      a. Aluminum system consisting of: Aluminum channels, fittings and conduit clamps with stainless steel nuts and hardware.
   2. Corrosive areas:
      a. Aluminum system consisting of: Aluminum channels, fittings and conduit clamps with stainless steel nuts and hardware.
      b. PVC coated steel system consisting of: PVC coated galvanized steel channels and fittings and conduit clamps with stainless steel nuts and hardware.
   3. Highly corrosive areas:
      a. PVC coated steel system consisting of: PVC coated galvanized steel channels and fittings and conduit clamps with stainless steel nuts and hardware.
      b. Fiberglass system consisting of: Fiberglass channels and fittings, nuts and hardware and conduit clamps.
   4. Conduit type shall be compatible with the support system material.
      a. Stainless steel system may be used with RGS.
      b. PVC coated galvanized steel system may be used with PVC-40 and PVC-80.

B. Permitted single conduit support fasteners per area designations and conduit types:
   1. Dry or wet areas:
      a. Material: Zinc plated steel, stainless steel and malleable iron.
      b. Types of fasteners: Straps, hangers with bolts, clamps with bolts and bolt on beam clamps.
   2. Corrosive areas:
      a. Material: Stainless steel and PVC coat malleable iron or steel.

b. Types of fasteners: Straps, hangers with bolts, clamps with bolts and bolt on beam clamps.
c. .

3. Conduit type shall be compatible with the support fastener material.
   a. Stainless steel system may be used with RGS.
   b. PVC coated fasteners may be used with PVC-40 and PVC-80.
   c. Nonmetallic fasteners may be used with PVC-40 and PVC-80.

C. Conduit Support General Requirements:
1. Maximum spacing between conduit supports per NFPA 70.
2. Support conduit from the building structure.
3. Do not support conduit from process, gas, air or water piping; or from other conduits.
4. Provide hangers and brackets to limit the maximum uniform load on a single support to 25 LBS or to the maximum uniform load recommended by the manufacturer if the support is rated less than 25 LBS.
   a. Do not exceed maximum concentrated load recommended by the manufacturer on any support.
   b. Conduit hangers:
      1) Continuous threaded rods combined with struts or conduit clamps: Do not use perforated strap hangers and iron bailing wire.
   c. Hangers in metal roof decks:
      1) Utilize fender washers.
      2) Not extend above top of ribs.
      3) Not interfere with vapor barrier, insulation, or roofing.
5. Conduit support system fasteners:
   a. Use sleeve-type expansion anchors as fasteners in masonry wall construction.
   b. Do not use concrete nails and powder-driven fasteners.

3.6 OUTLET, PULL AND JUNCTION BOX INSTALLATION

A. General:
1. Install products in accordance with manufacturer's instructions.
2. See Specification Section 26 05 00 and the Drawings for area classifications.
3. Fill unused punched-out, tapped, or threaded hub openings with insert plugs.
4. Size boxes to accommodate quantity of conductors enclosed and quantity of conduits connected to the box.

B. Outlet Boxes:
1. Permitted uses of metallic outlet boxes:
   a. Housing of wiring devices:
      1) Recessed in all stud framed walls and ceilings.
      2) Recessed in poured concrete, concrete block and brick walls of architecturally finished areas and exterior building walls.
2. Permitted uses of cast outlet boxes:
   a. Housing of wiring devices surface mounted in non-architecturally finished dry, wet, corrosive, highly corrosive and hazardous areas.
   b. Pull and junction box surface mounted in non-architecturally finished dry, wet, corrosive and highly corrosive areas.
3. Mount device outlet boxes where indicated on the Drawings and at heights as scheduled in Specification Section 26 05 00.
4. Set device outlet boxes plumb and vertical to the floor.
5. Outlet boxes recessed in walls:
   a. Install with appropriate stud wall support brackets or adjustable bar hangers so that they are flush with the face of the wall.
   b. Locate in ungrouted cell of concrete block with bottom edge of box flush with bottom edge of block and flush with the face of the block.
6. Place barriers between switches in boxes with 277 V switches on opposite phases.
7. Back-to-back are not permitted.

8. When an outlet box is connected to a PVC coated conduit, the box shall also be PVC coated.

C. Pull and Junction Boxes:
   1. Install pull or junction boxes in conduit runs where indicated or required to facilitate pulling of wires or making connections.
      a. Make covers of boxes accessible.
   2. Permitted uses of NEMA 1 enclosure:
      a. Pull or junction box surface mounted above removable ceiling tiles of an architecturally finished area.
   3. Permitted uses of NEMA 4X metallic enclosure:
      a. Pull or junction box surface mounted in areas designated as wet and/or corrosive.
   4. Permitted uses of NEMA 12 enclosure:
      a. Pull or junction box surface mounted in areas designated as dry.

END OF SECTION

SECTION 26 05 43
ELECTRICAL - EXTERIOR UNDERGROUND

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Material and installation requirements for:
      a. Handhole.
      b. Underground conduits and ductbanks.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 31 23 33 - Trenching, Backfilling and Compacting for Utilities.
   4. Division 03 - Concrete.
   5. Section 10 14 00 - Identification Devices.
   6. Section 26 05 26 - Grounding.
   7. Section 26 05 33 - Raceways and Boxes.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Association of State Highway and Transportation Officials (AASHTO):
      a. HB-17, Standard Specifications for Highway Bridges.
   2. ASTM International (ASTM):
      a. A536, Standard Specification for Ductile Iron Castings.
   3. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   4. Society of Cable Telecommunications Engineers (SCTE):
      a. 77, Specifications for Underground Enclosure Integrity.

1.3 DEFINITIONS

A. Direct-Buried Conduit(s):
   1. Individual (single) underground conduit.
   2. Multiple underground conduits, arranged in one or more planes, in a common trench.

B. Concrete Encased Ductbank: An individual (single) or multiple conduit(s), arranged in one or more planes, encased in a common concrete envelope.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data:
      a. Provide submittal data for all products specified in PART 2 of this Specification Section.
   3. Fabrication and/or layout drawings:
      a. Provide dimensional drawings of each manhole indicating all specified accessories and conduit entry locations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Prefabricated composite handholes:
      a. Armorcast Products Company.
      b. Quazite by Hubbell.
      c. Synertech by Oldcastle Enclosure Solutions.
   2. Precast manholes and handholes:
      a. Lister Industries Ltd.
      b. Oldcastle Enclosure Solutions.
      c. Jensen Precast and Utility Concrete Products.
   3. Manhole and handhole and ductbank accessories:
      a. Cantex, Inc.
      b. Condux International, Inc.
      c. Neenah Enterprises, Inc.
      d. Prime Conduit.
      e. Thomas and Betts.
      f. Underground Devices, Inc.
      g. Unistrut by Atkore International, Inc.

2.2 HANDHOLES

A. Prefabricated Composite Material Handholes:
   1. Handhole body and cover: Fiberglass reinforced polymer concrete conforming to all test provisions of SCTE 77.
   2. Minimum load ratings: SCTE 77 Tier 15.
   3. Open bottom.
   4. Stackable design as required for specified depth.
   5. Cover:
      a. Engraved legend of "ELECTRIC" or "COMMUNICATIONS".
      b. Non-gasketed bolt down with stainless steel penta head bolts.
      c. Lay-in non-bolt down, when cover is over 100 LBS.
      d. One or multiple sections so the maximum weight of a section is 125 LBS.
   6. Cover lifting hook: 24 IN minimum in length.

B. Precast Handholes:
   1. Fiberglass reinforced polymer concrete or steel reinforced cement concrete structures:
   2. AASHTO live load rating: H-20 for full deliberate vehicle traffic.
   3. Mating edges: Tongue and groove type.
   4. Gasketed removable top slab with lifting eyes and cast in frame for cover.
   5. Cable pulling eyes opposite all conduit entrances.
      a. Coordinate exact location with installation contractor.

2.3 CONCRETE HANDHOLE ACCESSORIES

A. Cover and Frame:
   1. Cast ductile iron: ASTM A536.
   2. AASHTO live load rating: H-20.
   3. Diameter: 30 IN.
   4. Cast the legend "ELECTRICAL" or "COMMUNICATIONS" into manhole and handhole covers.

B. Cable Racks and Hooks:
   1. Material: Heavy-duty nonmetallic (glass reinforced nylon).
   2. Hook loading capacity: 400 LBS minimum.
   3. Rack loading capacity: Four hooks maximum.
   4. Hook deflection: 0.25 IN maximum.

5. Hooks: Length, as required, with positive locking device to prevent upward movement.
6. Mounding hardware: Stainless steel.

C. Cable Pulling Irons:
1. 7/8 IN DIA hot-dipped galvanized steel.
2. 6000 LB minimum pulling load.

D. Ground Rods and Grounding Equipment: See Specification Section 26 05 26.

2.4 UNDERGROUND CONDUIT AND ACCESSORIES

A. Concrete: Comply with Division 03.

B. Conduit: See Specification Section 26 05 33.

C. Duct Spacers/Supports:
1. High density polyethylene or high impact polystyrene.
2. Interlocking web or mesh design.
3. Provide 2 IN minimum spacing between conduits.
4. Accessories, as required:
a. Hold down bars.
b. Ductbank strapping.

PART 3 - EXECUTION

3.1 GENERAL

A. Drawings indicate the intended location of handholes and routing of ductbanks and direct buried conduit.
1. Field conditions may affect actual routing.

B. Handhole Locations:
1. Approximately where shown on the Drawings.
2. As required for pulling distances.
3. As required to keep pulling tensions under allowable cable tensions.
4. As required for number of bends in ductbank routing.
5. Shall not be installed in a swale or ditch.
6. Determine the exact locations after careful consideration has been given to the location of other utilities, grading, and paving.
7. Locations are to be approved by the Engineer prior to excavation and placement or construction of manholes and handholes.

C. Install products in accordance with manufacturer's instructions.

D. Install manholes and handholes in conduit runs where indicated or as required to facilitate pulling of wires or making connections.

E. Comply with Specification Section 31 23 33 for trenching, backfilling and compacting.

3.2 HANDHOLES

A. Prefabricated Composite Material Handholes:
1. For use in areas subjected to occasional non-deliberate vehicular traffic.
2. Place handhole on a foundation of compacted 1/4 to 1/2 IN crushed rock or gravel a minimum of 8 IN thick and 6 IN larger than handholes footprint on all sides.
3. Install so that the surrounding grade is 1 IN lower than the top of the handhole.
4. Size: As indicated on the Drawings or as required for the number and size of conduits.
5. Provide cable rails and pulling eyes as needed.

B. Precast Handholes:
1. For use in vehicular and non-vehicular traffic areas.
2. Construction:

a. Grout or seal all joints, per manufacturer's instructions.
b. Support cables on walls by cable racks:
1) Provide a minimum of two racks, install symmetrically on each wall of handholes.
a) Provide additional cable racks, as required, so that both ends of cable splices will be supported horizontally.
2) Equip cable racks with adjustable hooks: Quantity of cable hooks as required by the number of conductors to be supported.
c. In each handhole, drive 3/4 IN x 10 FT long copper clad ground rod into the earth with approximately 6 IN exposed above finished floor.
1) Connect all metallic components to ground rod by means of #8 AWG minimum copper wire and approved grounding clamps.
2) Utilize a ground bar in the handhole if the quantity of ground wires exceeds three.
a) Connect ground bar to ground rod with a #2/0 AWG minimum copper wire.
3. Place handhole on a foundation of compacted 1/4 to 1/2 IN crushed rock or gravel a minimum of 8 IN thick and 6 IN larger than handholes footprint on all sides.
4. Install so that the top of cover is 1 IN above finished grade.
a. Where existing grades are higher than finished grades, install sufficient number of courses of curved segmented concrete block between top of handhole frame to temporarily elevate manhole cover to existing grade level.
5. After installation is complete, backfill and compact soil around handholes.
6. Handhole size:
a. As indicated on the Drawings or as required for the number and size of conduits entering or as indicated on the Drawings.
b. Minimum floor dimension of 4 FT x 4 FT and minimum depth of 4 FT.

3.3 UNDERGROUND CONDUITS

A. General Installation Requirements:
1. Ductbank types per location:
a. Concrete encased ductbank:
1) Under roads.
2) Pad mounted transformer secondaries.
3) Plant process equipment feeders and controls.
b. Direct-buried conduit(s):
1) Area/Roadway lighting.
2. Do not place concrete or soil until conduits have been observed by the Engineer.
3. Ductbanks shall be sloped a minimum of 4 IN per 100 FT or as detailed on the Drawings.
a. Low points shall be at handholes.
4. During construction and after conduit installation is complete, plug the ends of all conduits.
5. Provide conduit supports and spacers.
a. Place supports and spacers for rigid nonmetallic conduit on maximum centers as indicated for the following trade sizes:
1) 1 IN and less: 3 FT.
2) 1-1/4 to 3 IN: 5 FT.
3) 3-1/2 to 6 IN: 7 FT.
b. Place supports and spacers for rigid steel conduit on maximum centers as indicated for the following trade sizes:
1) 1 IN and less: 10 FT.
2) 1-1/4 to 2-1/2 IN: 14 FT.
3) 3 IN and larger: 20 FT.
c. Securely anchor conduits to supports and spacers to prevent movement during placement of concrete or soil.
6. Stagger conduit joints at intervals of 6 IN vertically.
7. Make conduit joints watertight and in accordance with manufacturer's recommendations.
8. Accomplish changes in direction of runs exceeding a total of 15 DEG by long sweep bends having a minimum radius of 25 FT.

a. Sweep bends may be made up of one or more curved or straight sections or combinations thereof.

9. Furnish manufactured bends at end of runs.
    a. Minimum radius of 18 IN for conduits less than 3 IN trade size and 36 IN for conduits 3 IN trade size and larger.
10. Field cuts requiring tapers shall be made with the proper tools and shall match factory tapers.
11. After the conduit run has been completed:
    a. Prove joint integrity and test for out-of-round duct by pulling a test mandrel through each conduit.
        1) Test mandrel:
            a) Length: Not less than 12 IN.
            b) Diameter: Approximately 1/4 IN less than the inside diameter of the conduit.
    b. Clean the conduit by pulling a heavy duty wire brush mandrel followed by a rubber duct swab through each conduit.
12. Pneumatic rodding may be used to draw in lead wire.
    a. Install a heavy nylon cord free of kinks and splices in all unused new ducts.
    b. Extend cord 3 FT beyond ends of conduit.
13. Transition from rigid nonmetallic conduit to rigid metallic conduit, per Specification Section 26 05 33, prior to entering a structure or going above ground.
    a. Except rigid nonmetallic conduit may be extended directly to handholes, pad mounted transformer boxes and other exterior pad mounted electrical equipment where the conduit is concealed within the enclosure.
    b. Terminate rigid PVC conduits with end bells.
    c. Terminate steel conduits with insulated bushings.
14. Place warning tape in trench directly over ductbanks, direct-buried conduit, and direct-buried wire and cable in accordance with Specification Section 10 14 00. Warning tape shall be 6" detectable type tape.
15. Placement of conduits stubbing into handholes shall be located to allow for proper bending radiuses of the cables.

B. Concrete Encased Ductbank:
1. Ductbank system consists of conduits completely encased in minimum 2 IN of concrete and with separations between different cabling types as required in Specification Section 26 05 33 or as detailed on the Drawings.
2. Install so that top of concrete encased duct, at any point:
    a. Is not less than 24 IN below grade.
    b. Is below pavement sub-grading.
3. Conduit supports shall provide a uniform minimum clearance of 2 IN between the bottom of the trench and the bottom row of conduit.
4. Conduit separators shall provide a uniform minimum clearance of 2 IN between conduits or as required in Specification Section 26 05 33 for different cabling types.

C. Direct-Buried Conduit(s):
1. Install so that the top of the uppermost conduit, at any point:
    a. Is not less than 30 IN below grade.
    b. Is below pavement sub-grading.

END OF SECTION

SECTION 26 05 48
ELECTRICAL SEISMIC RESTRAINT SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. The design and installation of seismic bracing and anchorage required for electrical equipment, conduit, cable tray, and bus ducts.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Civil Engineers (ASCE):
      a. 7, Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
   2. ASTM International (ASTM):
      a. A36/A36M, Standard Specification for Carbon Structural Steel.
      b. A307, Standard Specification Carbon Steel Bolts, Studs, and Threaded Rod, 60,000 PSI Tensile Strength.
      c. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
      d. A588/A588M, Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 KSI (345 MPa) Minimum Yield Point, with Atmospheric Corrosion Resistance.
      e. A992/A992M, Standard Specification for Structural Steel Shapes.
      f. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105 KSI Yield Strength.
   3. State of California Earthquake Regulations:
      a. Title 24, Section T22-94215.
   4. Building code:
      a. International Code Council (ICC):
         1) California Building Code and associated standards, 2019 Edition including all amendments, referred to herein as Building Code.
      b. International Building Code (IBC) - 2018 Edition including all State of California and local amendments.

1.3 SYSTEM DESCRIPTION

A. Contractor is responsible for design and installation of seismic bracing and anchorage systems.

B. Description of Systems:
   1. Transverse and longitudinal bracing for seismic forces on suspended electrical systems including conduit, cable tray, bus duct, and equipment.
   2. Anchorage of floor and roof mounted electrical equipment.

C. Seismic Design Requirements:
   1. Seismic design criteria: Provide bracing and anchoring for equipment, conduit, cable tray, bust duct, designed, constructed, and installed to resist stresses produced by lateral forces.

D. Design and install seismic anchorage and bracing for all floor or roof mounted equipment weighing 400 LBS or more and all suspended or wall mounted equipment weighing 20 LBS or more.

E. The following components are exempt from the requirements of this Specification Section:
   1. Electrical components in structures assigned to Seismic Design Category C provided that the importance factor (I_p) is equal to 1.0.
   2. Electrical components in Seismic Design Categories D, E, and F where I_p = 1.0 and flexible connections between the components and associated conduit are provided and that are mounted at 4 FT (1.22 M) or less above a floor level and weigh 400 LBS (1780 N)or less.
   3. Electrical components in Seismic Design Categories D, E, and F weighing 20 LBS (95 N) or less where I_p = 1.0 and flexible connections between the components and conduit are provided, or for distribution systems, weighing 5 LBS/FT (7 N/M) or less.

F. Seismic forces shall be presumed to act through the center of mass of the equipment in a direction that will produce the largest single anchor force.

G. Deferred Approval items: provide designand details of anchorages or restraints conforming to title 24, section T22-94215 Earthquake Regulations; prepared and signed by a structural engineer licensed in the State of California.

H. Installation Inspection:
   1. Certifythat seismic bracing system installed is in accordance with approved Shop drawings.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data:
      a. Seismic control devices.
   3. Fabrication and/or layout drawings:
      a. Layout and mounting detail drawings showing system and proposed brace locations for all systems including pre-engineered systems.
      b. The specific detail for each type of brace or anchor must be referenced on a plan that identifies the required location.
         1) Supplying a book of details without referencing the proper detail to a specific location on a plan is not acceptable.
      c. Structural calculations for required lateral force level for each component.
      d. All submittals, including pre-approved systems, shall be signed and sealed by a licensed engineer, licensed in the state in which the project is located.
   4. Certifications:
      a. Certificate that seismic bracing system installed is in accordance with approved Shop Drawings.
   5. Contract Closeout Infpromation:
      a. Operation and Maintenance Data:
         1) See Specification Section 01 33 04 for rquirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

1.5 PROJECT CONDITIONS

A. Seismic (Earthquake) Loads:
   1. Seismic use group: II.
   2. S_s: 1.5.
   3. S_1: 0.6.
   4. S_{DS}: 1.2
   5. S_{D1}: 0.8
   6. Site Class: E.
   7. Seismic design category: D.
   8. Risk Category: III.
   9. Component Importance Factor, Ip: 1.5.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Pre-engineered suspended bracing systems:
      a. International Seismic Application Technology (ISAT) “Engineered Seismic Bracing of Suspended Utilities”.
      b. Unistrut by Atkore International, Inc.
      c. TOLCO by Eaton.
      d. B-Line by Eaton.
      e. Or equal.
   2. Custom engineered systems designed using specified criteria and common building materials.

A. For “or equal” manufacturers submit requested information in accordance with Specification Section 01 25 13.

2.2 EQUIPMENT ANCHORS AND SUPPORTS

A. Drilled-in-place concrete anchors shall have an approved ICBO Evaluation Services Report.

B. Cast-in-place anchors shall comply with ASTM A36, ASTM A307, or ASTM F1554, 36 ksi.

C. Anchors permanently exposed to weather or corrosive environments shall be stainless steel or hot-dipped galvanized.

D. Structural steel for supports: ASTM A36, A588, A992 or A500.

E. Cold formed metal and connection material: Unistrut, or equal.

F. Any details provided are based on assumed equipment and arrangement.
   1. The Contractor shall be responsible for design and acquiring approval for support and anchorage of equipment and arrangement which varies from equipment and arrangement assumed in detail provided.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Every run which requires bracing shall have a minimum of two transverse braces and one longitudinal brace.
   1. A "run" is defined as suspended pipe, conduit, cable tray, bus ductor trapeze rack having a minimum 10 FT straight run length.

B. Brace spacing shall not exceed the maximum allowable brace spacing as engineered by the manufacturer or custom bracing designer.

C. Bracing may be omitted from conduit, cable tray and bus duct runs less than 10 FT in length.

D. Bracing may be omitted from conduit, cable tray and bus duct runs where rod hung supports of less than 12 IN. (305 MM) in length are required.
   1. All unbraced suspended utility systems having 2 IN conduit and larger or systems weighing more then 5 LBS/FT shall be installed with a minimum 6 IN clearance to suspended ceiling vertical hanger wires.
   2. The conduit, cable tray, or bus duct shall be installed such that the lateral motion of the members will not cause damaging impact with other systems or structural members or loss of vertical support.

E. A longitudinal brace at a 90 DEG change in direction may act as a transverse brace if it is located within 2 FT of the change in direction.

F. A transverse brace may act as a longitudinal brace if it is located within 2 FT of a change in direction and if the brace arm and anchorage have been sized to meet or exceed the requirements of the longitudinal brace.

G. When bracing equipment or a utility system that is suspended from an overhead deck, brace back to the overhead deck or to the supporting structure supporting the deck.
   1. Do not brace to another element of the structure which may respond differently during a seismic event.

H. Obtain approval from the Structural Engineer prior to attaching any brace elements to structural steel or wood framing.

I. When utilizing cable bracing, tension the cable to remove slack without inducing uplift of the suspended element.
   1. Tension seismic bracing system prior to system start-up and adjust if necessary after equipment start-up.

J. As a general rule, do not mix rigid bracing with cable bracing in the same run.
   1. However, once bracing has transitioned a 90 DEG change in run direction, the bracing may switch from rigid to cable or vice versa if required due to a significant change in overhead deck elevation or to provide an implementable bracing scheme in a congested area.

K. Install brace members at an angle of 45 DEG from horizontal within a tolerance of +2-1/2 DEG or -45 DEG provided the brace length is accounted for in design.
   1. Brace angle may be increased to 60 DEG provided the brace spacing is reduced to 1/2 that required for a 45 DEG brace.

L. Seismic bracing may not pass through a building separation joint.
   1. Utility systems that pass through a separation joint must be seismically restrained no greater than 5 FT from the point of connection.
   2. Any hardware designed to accommodate seismic movement across the span of the separation joint shall be installed per manufacturer's installation and listing instructions.

M. With approval of the Structural Engineer, utility systems that are suspended from the overhead deck may be braced to load bearing concrete or CMU (concrete masonry) walls provided that the walls and the overhead decks will respond similarly during a seismic event.

N. Each layer of a multiple layer trapeze rack shall be braced individually based on the weight of the individual layer.

O. Conduit, cable tray, or bus duct constructed of non ductile material (plastic or fiberglass), shall have brace spacing reduced to 1/2 of the spacing allowed for ductile materials.

P. Where brace elements are through-bolted, the mounting hole in the element is to be no more than 1/16 IN in diameter larger then the bolt or threaded rod.

Q. Seismic braces shall directly brace the support and not the hanger.

3.2 SUSPENDED ELECTRICAL SYSTEMS

A. Install seismic bracing for all conduit 2-1/2 IN trade size or greater.

B. All trapeze assemblies supporting conduits, cable trays or bus ducts shall be braced considering the total weight of the elements on the trapeze.
   1. For the purposes of calculating weight, all conduits are to be treated as full.

C. Brace all trapeze racks which support conduit 2-1/2 IN trade size or larger.
   1. Brace all other conduit rack, cable tray or bus duct trapezes having a minimum weight in excess of 10 LBS/LF.
   2. Include a minimum 10 PCT additional capacity for future additions.

D. Seismic bracing may be omitted from cable trays, conduit and bus ducts suspended by rod hung supports 12 IN or less in length form the top of the element to the bottom of the structural

attachment of the hanger provided lateral motion will not cause damaging impacts to other systems or loss of system vertical support.

E. For steel and aluminum bus ducts, conduit and cable trays:
   1. Provide transverse bracing at 40 FT maximum spacing unless otherwise noted.
   2. Provide longitudinal bracing at 80 FT maximum spacing unless otherwise noted.

F. All vertical risers involving conduit 2-1/2 IN in diameter or larger shall include lateral restraint at maximum 30 FT intervals and at the top and bottom of the riser.

G. Make provisions to eliminate seismic impact between components.

3.3 FLOOR OR ROOF MOUNTED EQUIMENT

A. Provide one anchor on each leg or corner.
   1. Support with a minimum of three 3/8 IN DIA anchors.

B. Friction shall be neglected when designing anchors for shear.

C. Vertical seismic forces, when required, shall be presumed to act concurrently with horizontal seismic forces.

D. Batteries on racks or for generators shall have wrap around restrains to ensure that the batteries will not slide laterally. Spacers shall be used between the restraints and cases to prevent damage to the cases.

E. Electrical cabinet design shall comply with the applicable NEMA standards. Cutouts in the lower shear panel that have not been made by the manufacturer and reduce significantly the strength of the cabinet shall be specifically evaluated.

END OF SECTION

SECTION 26 05 73

ELECTRICAL POWER SYSTEM STUDIES

PART 1 - GENERAL

1.1 SUMMARY

A. Contractor shall be responsible to obtain information on existing electrical equipment and existing electrical power system studies if available. Field work will be required to verify actual installation from point of Pacific Gas And Electric (PG&E) connection to first piece of new electrical equipment connected to the electrical system.

B. Contractor shall be responsible for the activities required to perform all analyses including, but not limited to: data collection, system modeling, and model verification, using industry approved modeling software (ETAP, SKM).

C. Analysis shall include Protective device coordination study, Short Circuit study, Fault and Device Duty evaluation, Load Flow study, Transient Motor Starting (TMS) Study and Arc Flash Hazard Assessment. Project deliverables shall include a detailed report of the findings and recommendations.

D. Contractor will adjust all relays and adjustable trip circuit breakers to settings determined by the Power system study.

E. Contractor shall provide and attach new Arc Flash labels to new and existing electrical equipment as required by National Fire Protection Agency (NFPA) 70E.

F. Contractor to obtain all source information from PG&E and utilize the updated information in the power system study and arc flash study.

1.2 SUBMITTALS

A. Completed electrical power system studies shall be bound and submitted to Engineer.

B. Contractor is responsible for completing an electrical power system study. Contractor shall provide a table containing the settings of all relays and adjustable trip circuit breakers rated over 100A.

C. Contractor shall perform an electrical power system study to determine the final settings of the relays and adjustable trip circuit breakers over 100A per the final “As-Built” installation. The study shall be included in the switchgear O&M manual. This submittal will contain the following:
   1. Complete input data report, including computer generated protected device settings report.
   2. Load Flow Study.
   3. Load Flow, Short Circuit and Arc Flash analyzer reports in MS Excel format.
   4. Short Circuit and Arc Flash result analyzer reports shall indicate worst case scenario conditions and associated results.
   5. Coordination Study Report including computer generated Time-current Characteristic Curves (TCC).
   6. Arc Flash Hazard Assessment Report and Personal Protective Equipment Label.
   7. Electronic copy of computer software (project) model including update to existing model if available.

D. Power system study and arc flash study shall include the following plant system operating conditions:
   1. Utility only.
   2. Generator only. Perform study with hypothetical portable generator, sized at 300KVA.

   Provide scenarios for each operation condition in the final submittal and report.

1.3 REFERENCES

A. Institute of Electrical and Electronics Engineers (IEEE)
   1. IEEE C2 National Electric Safety Code
   2. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems (Red Book)
   3. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings
   4. IEEE 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (Buff Book).
   5. IEEE 315 - Standards Electrical and Electronics Graphic and Letter Symbols and Reference Designations.
   6. IEEE 399 Recommended Practice for Industrial and Commercial Power Systems Analysis (Brown Book).
   7. 902 - IEEE Guide for Maintenance, Operation and Safety on Industrial and Commercial Power Systems (Yellow Book).
   8. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems - Corrigendum 1 (Blue Book).
   9. 7. IEEE 1584– Guide for Performing Arc Flash Hazard Calculations

B. American National Standards Institute (ANSI)
   1. ANSI C57.12.01 – Standard General Requirements for Dry-Type Distribution, Power Transformers
   2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
   3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
   4. ANSI C37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories

C. National Fire and Protection Association (NFPA):
   1. NFPA 70 – National Electrical Code (NEC)
   2. NFPA 70E – Standard for Electrical Safety in the Workplace

1.4 SYSTEM DESCRIPTION

A. General study requirements:
   1. Scope:
      a. The load flow, transient motor starting, short-circuit fault analysis, protective device coordination and arc-flash hazard studies shall include all equipment in the power distribution system including but not limited to:
         1) Utility equipment.
         2) MCCs.
         3) Transformers:
            a) Including all dry-type transformers.
         4) Disconnect Switches.
         5) Motors.
         6) Panelboards: Including all 240 and 208 volt systems
         7) Vendor Control Panels.
      b. Study Scenarios:
         1) The studies shall include all possible electrical system configurations, for example:
            a) Operation on normal (utility) source.
            b) Operation on generator source.
   2. Obtain, for all equipment, the required data for preparation of the study, including, but not limited to:
      a. Transformer kilovolt-ampere and impedances.
      b. Generator impedances.
      c. Generator decrement curves.
      d. Bus withstand ratings.
      e. Cable and bus data.

f. Protective device taps, time dials, instantaneous pickups, and time delay settings.

3. Obtain the Electric Utility information on the minimum and maximum available fault current, minimum and maximum utility impedances, utility protective device settings including manufacturer and model number, interrupting ratings, X/R ratios, and model information one level above the point of connection:
   a. Utility tolerances and voltage variations.
4. The individual performing the studies shall visit the site and collect all necessary field data in order to perform and complete comprehensive electrical system studies.
   a. Coordinate with client to obtain prior system coordination and arc flash studies.
5. Obtain equipment layouts and configurations from the manufacturer's final submittal requirements and Contract Drawings as required.
6. Bus and conductor data:
   a. Use impedances of the actual installed or specified conductors, unless otherwise indicated.
   b. Use cable and bus impedances calculated at 25 degrees Celsius, unless otherwise indicated.
   c. Use 600-volt cable reactance based on typical dimensions of actual installed or specified conductors, unless otherwise indicated.
   d. Use bus withstand values for all equipment having buses.
   e. Use medium voltage cable reactances based on typical dimensions of shielded cables with 133 percent insulation levels, unless otherwise indicated.
7. Motors:
   a. Each motor shall be individually modeled:
      1) Grouping of motors for fault contribution current is not acceptable.
   b. Motors with variable frequency drives may be assumed to have no contribution to fault current.
8. Use the equipment, bus, and device designations as indicated on the Drawings for all studies.

B. Short-circuit fault analysis study additional requirements:
1. The short-circuit fault analysis shall be performed and submitted in 2 phases:
   a. Initial short-circuit fault analysis:
      1) Based on the Contract Documents and Electric Utility information.
      2) The initial short-circuit fault analysis report shall indicate the estimated available short-circuit current at the line side terminals of each piece of equipment covered by the scope of the study.
      3) Provide a list of assumptions used in the initial study.
   b. Final short-circuit analysis:
      1) The final short-circuit fault analysis shall modify the initial analysis as follows:
         a) Utilize the actual equipment provided on the project.
         b) Utilize conductor lengths based on installation.
2. Calculate 3-phase bolted fault, line-to-line fault, and line-to-ground fault short circuit current values at each piece of equipment in the distribution system.
3. Evaluate bus bracing, short circuit ratings, fuse interrupting capacity and circuit breaker adjusted interrupting capacities against the fault currents, and calculate X/R values:
   a. Identify and document all devices and equipment as either inadequate or acceptable.
4. Calculate line-to-ground momentary short circuit values at all buses having ground fault devices.
5. Provide calculation methods, assumptions, one-line diagrams, and source impedance data, including Utility X/R ratios, typical values, recommendations, and areas of concern.

C. Protective device coordination study additional requirements:
1. Furnish protective device settings for all functions indicated on the Drawings, including, but not limited to:
   a. Current.
   b. Voltage:

1) Provide settings for all voltage relays based upon actual Utility and generator tolerances and specifications.

c. Frequency:
1) Provide settings for all frequency relays based upon actual Utility and generator tolerances and specifications.

d. Machine protection functions:
1) Provide settings for all motor and generator protective relays based on the manufacturer's recommended protection requirements.

2. Provide log-log form time-current curves (TCCs) graphically indicating the coordination proposed for the system:
a. Include with each TCC a complete title and one-line diagram with legend identifying the specific portion of the system covered by the particular TCC:
1) Typical time-current curves for identical portions of the system, such as motor circuits, are acceptable as allowed by the ENGINEER.

b. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics:
1) These details can be included on the TCC.

c. Include a detailed description of each protective device tap, time dial, pickup, instantaneous, and time delay settings:
1) These details can be included in the TCC.

3. TCCs shall include all equipment in the power distribution system where required to demonstrate coordination. Include Utility relay and fuse characteristics, medium voltage equipment protective relay and fuse characteristics, low-voltage equipment circuit breaker trip device characteristics, transformer characteristics, motor and generator characteristics, and characteristics of other system load protective devices:
a. Include all devices down to the largest branch circuit and largest feeder circuit breaker in each motor control center, main breaker in branch panelboards and fused disconnect switches.
b. Provide ground fault TCCs with all adjustable settings for ground fault protective devices.
c. Include manufacturing tolerances and damage bands in plotted fuse and circuit breaker characteristics.
d. On the TCCs show transformer full load currents, transformer magnetizing inrush, ANSI transformer withstand parameters and transformer damage curves.
e. Cable damage curves.
f. Terminate device characteristic curves at a point reflecting the maximum symmetrical or asymmetrical fault current to which the device is exposed based on the short-circuit fault analysis study.
g. Coordinate time interval medium-voltage relay characteristics with upstream and downstream device to avoid nuisance tripping.

4. Suggest modifications or additions to equipment rating or settings in a tabulated form.

D. Arc-Flash Hazard Study Additional Requirements:
1. Include the calculated arc-flash boundary and incident energy (calories/square centimeter) at each piece of equipment in the distribution system:
a. Perform Arc-flash calculations for both the line side and load side of switchgear, switchboard, motor control center, and panelboard main breakers.
b. Perform arc-flash calculations for all short-circuit scenarios with all motors on for 3 to 5 cycles and with all motors off.
c. Protective device clearing time shall be limited to 2 seconds, maximum.

2. Provide executive summary of the study results.
3. Provide a detailed written discussion and explanation of the tabulated outputs.
4. Provide alternative device settings to allow the Engineer to select the desired functionality of the system:
a. Minimize the arc-flash energy by selective trip and time settings for equipment maintenance purposes.

b. Identify the arc-flash energy based upon the criteria of maintaining coordination and selectivity of the protective devices.

5. Perform the arc flash study calculations using both IEEE 1584 and NFPA 70E. Provide both studies in the final report. Provide summary based upon worst case results between IEEE 1584 and NFPA 70E.

E. Electrical system study meetings:
1. The individual conducting the load flow, transient motor starting, short circuit analysis, protective device coordination, and the arc-flash hazard studies shall meet with the Engineer 3 times.
2. The purpose of the 3 meetings is as follows:
a. Initial meeting:
1) Meet with the Engineer to discuss the scope of the studies.
2) Discuss the Engineer's operational requirements for both normal operation and maintenance.
b. Preliminary results meeting:
1) This meeting will be held after the studies have been completed, reviewed, and accepted by the Engineer.
2) The purpose of this meeting is to inform the Engineer of the results of the study and impacts on normal operation and maintenance including:
a) Load flow results and its potential impact on operations.
b) Transient Motor Starting results and recommended solutions for optimal timing.
c) Protective device coordination problems and recommended solutions.
d) Explanation of the arc-flash study results and its potential impact on operations.
e) Recommendations for reduction of arc-flash category levels including reduction of protective device settings or changes in operational practices.
c. Final meeting:
1) Discuss changes to the reports based on the previous meeting.
2) Discuss with the Engineer how changes to the electrical system may change the arc-flash hazard category.
3) Deliver the final electrical system studies report.
3. The meetings will be at the Engineer's facility:
a. Provide a minimum of 3 weeks notice to the Engineer in advance of the projected meeting date.
b. Submit a draft of the meeting agenda when each meeting is requested.
4. Meeting materials:
a. Prepare and provide the following materials:
1) Meeting agenda. Include at a minimum the scope of the meeting, estimated time length for the meeting and meeting goals.
2) Six copies of the project one-line diagrams for the initial meeting.
3) Six copies of the studies of the submitted study.

F. By virtue of the fact that this is a professional study, the Engineer reserves the right to modify the requirements of the study to comply with its operational requirements. The protective device coordination study and the arc-flash study shall be modified based on the results of the meetings with the Engineer.

1.5 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00.

B. Initial Studies and Reports:
1. Include the following in the initial short circuit current report:
a. List of all devices included in the studies.
b. A description of all operating scenarios.
c. Form and format of arc flash labels.

C. Final Studies and Reports:
   1. Format and Quantity:
      a. Provide 6 bound copies of all final reports.
      b. Provide 3 complete sets of electronic files on memory card media, including the electrical system model(s), configuration files, custom libraries, and any other files used to perform the studies and produce the reports. Also provide an electronic version of the bound reports in PDF format.
   2. Include the sections below in the final report:
      a. Copies of correspondence and data obtained from the Electric Utility Company.
      b. Letter certifying the inspection and verification of existing equipment.
      c. One-line diagrams:
         1) The following information shall be included at a minimum:
            a) Motor horsepower.
            b) Transformer data:
               (1) KVA
               (2) Configuration
            c) Cable Data:
               (1) Insulation.
               (2) Size.
               (3) Length.
         2) One-line diagrams shall be fully legible at 11-inch by 17-inch size.
      d. Include in the load flow study:
         1) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.
         2) Modeling of utility and generator equivalent impedance calculated from short circuit duty.
         3) Modeling of motor and non-motor loads.
         4) Reporting of bus voltage, voltage angle, and voltage drop at each bus, and branch voltage drop, branch loss, and total system losses.
      e. Include in the transient motor starting study:
         1) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.
         2) Simulation of all pump motor scenarios dynamically modeled throughout starting, stopping or reacting to load changes. Simulations to be run from utility and generator power.
         3) Voltage dip impact on motor starting and motor accelerating times.
         4) Evaluation of interaction between multiple motors during starting conditions, motor starting heating problems, application of reduced voltage starters.
         5) Optimal timing of staggered motor starting and re acceleration schemes.
         6) Time related output data including bus voltage, motor speed, motor slip, motor torque, load torque, accelerating torque, stator voltage, stator current, input power, VARs, power factor, and rotor current.
      f. Include in the short-circuit fault analysis study:
         1) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.
         2) Normal system connections and those, which result in maximum fault conditions.
         3) Tabulation of circuit breaker, fuse, and other protective device ratings compared to maximum calculated short circuit duties.
         4) Fault current calculations for the cases run including a definition of terms and guide for interpretation of computer software printouts.
      g. Protective device coordination study shall include:
         1) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.
         2) List all requirements used in the selection and setting criteria for any protective devices.

3) Manufacturer's time-current curves for circuit breakers, fuses, motor circuit protectors, and other protective devices for all new equipment.
4) Time-current curves (TCCs) graphically indicating the coordination proposed for the system on log-log graphs. At least 3 of the copies shall be in color.
5) Tabulation of relay, fuse, circuit breaker, and other protective devices in graphical form with a one-line diagram to display area coordination.
6) Where coordination could not be achieved, an explanation shall be included in the report to support the statement along with recommendations to improve coordination. Recommended equipment modifications or settings shall be in a tabulated form.

h. Include in the arc-flash study:
1) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.
2) Normal system connections and those, which result in maximum arc-flash conditions.
3) Arc-flash raw data, calculations, and assumptions.
4) Arc-flash label data:
a) Identifying the content of each label.
b) Identifying the location of each label.

D. Certification:
1. Submit written certification, sealed, and signed by the professional engineer conducting the study, equipment supplier, and electrical subcontractor stating that the data used in the study is correct.

E. Submit the credentials of the individual(s) performing the study and the individual in responsible charge of the study.

F. The Engineer will review all studies and reports. After review, the Engineer will make recommendations and/or require changes to be made to the short-circuit analysis, protective device coordination or arc-flash studies. These changes shall be provided as part of the scope of work.

1.6 QUALITY ASSURANCE

A. Qualifications of the entity responsible for electrical system studies:
1. The studies shall be performed, stamped, and signed by a Professional Engineer registered in the state where the project is located.
2. A minimum of 5 years' experience in power system analysis is required for the individual in responsible charge of the studies.
3. The short-circuit analysis, protective device coordination, and arc-flash hazard studies shall be performed with the aid of a digital computer program:
a. Point-to-point calculations are not acceptable.

B. The study shall be performed by an independent firm.

1.7 SEQUENCING

A. Site visit to gather data on the existing facility systems for all studies:
1. Make multiple trips as required to obtain all data for the short-circuit, protection device coordination and arc flash study.

B. Submit the initial short-circuit analysis study before submittal of any electrical equipment.

C. Submit the final short-circuit analysis and protective device coordination studies.

D. Initial arc-flash meeting.

E. Submit the arc-flash hazard study.

F. Second arc-flash meeting for preliminary results.

G. Final arc-flash meeting and final reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Electrical system study software:
   1. Powertools by SKM Systems Analysis, or equal.

2.2 COMPONENTS

A. Arc-Flash Hazard Labels:
   1. Dimensions:
      a. Minimum 5 inches by 3.5 inches.
   2. Materials:
      a. Polyester with polyvinyl polymer over-laminate.
      b. Self-adhesive.
      c. Resistant to:
         1) UV.
         2) Chemicals and common cleaning solvent resistant.
         3) Scuffing.
         4) Wide temperature changes.
   3. Contents:
      a. Short-circuit bus identification.
      b. Calculated incident energy (calories/square centimeter) range.
      c. Arc-flash protection boundary.
      d. Shock Hazard Boundary:
         1) The Contactor may provide separate labels for indication of the shock hazard boundary.
   4. Color Scheme:
      a. For locations above 40 calories/square centimeter:
         1) White label with red “DANGER” strip across the top.
         2) Black lettering.
      b. For locations below 40 calories/square centimeter:
         1) White label with orange “WARNING” strip across the top.
         2) Black lettering.

2.3 SITE VISIT

A. Review safety procedures, and facility conditions prior to site visit.

B. Request available short circuit current and X/R ratio from Pacific Gas and Electric (PG&E) at PG&E point of connection. Indicate available short circuit at all substations and switchboards between the PG&E point of connection and the last piece of equipment which shall require Arc Flash label. Record the settings of all relays and adjustable trip circuit breakers 100A or above between PG&E feed point and the last piece of equipment requiring Arc Flash label. Incorporate the recorded information in all electrical system studies.

C. If the above data is not available state the reason that the information could not be located and the method used to determine the assumed settings.

PART 3 - EXECUTION

3.1 ELECTRICAL POWER SYSTEM STUDIES

A. A one line diagram shall be provided with all equipment and material that is part of the electrical system studies. The device numbers and names shall match those shown on the existing ‘As-Built’ Drawings or Contract Drawings for new equipment. The following data shall be collected for the study.

1. Product Data for overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
    a. Circuit-breaker and fuse-current ratings and types.
    b. Generator kilovolt amperes, size, voltage, and source impedance
    c. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
    d. Motor horsepower and code letter designation according to NEMA MG 1.
3. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
    a. Special load considerations such as cranes, including starting inrush currents, regeneration and frequent starting and stopping
    b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability
    c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
    d. Ratings, types, and settings of utility company's overcurrent protective device
    e. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers
    f. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays
    g. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical

3.2 SHORT CIRCUIT STUDY

A. Short circuit study will be performed to ensure that all electrical equipment and protective devices can withstand the maximum available short circuit current.
    1. Calculate the maximum available short circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit. Calculate momentary and interrupting duties on the basis of maximum available fault current at each of the following:
        a. Switchgear, switchboard, busways, bus duct, motor control centers, unit substations, transformers, panelboards, automatic transfer switches and other significant locations throughout the system.
    2. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions
    3. Protective Device Time-Current Coordination Analysis
        a. The time-current coordination analysis shall be performed with the aid of computer software program, SKM or equal, and will include the determination of settings, ratings, or types for the overcurrent protective devices supplied.
        b. A sufficient number of computer generated Time-current Characteristic Curves (TCC) log-log plots shall be provided to indicate the degree of system protection and coordination by displaying the time-current characteristics of connected overcurrent devices and other pertinent system parameters.
        c. Computer printouts shall accompany the log-log plots and will contain descriptions for each of the devices shown, settings of the adjustable devices, the short-circuit current availability at the device location and device identification numbers to aid in locating the devices on the log-log plots and the system one-line diagram.

d. When equipment is directly connected to Pacific Gas and Electric (PG&E), Contractor shall work with PG&E and ensure that all relay settings or adjustable trip breaker coordinate with PG&E.
e. The study shall include a separate, table containing the suggested device setting of all relays and adjustable overcurrent protective devices; indicate the equipment where the device is located, and the device number corresponding to the device on the system one-line diagram.
f. A computer generated system one-line diagram shall be provided which clearly identifies individual equipment buses, bus numbers, device identification numbers and the maximum available short-circuit current at each bus. These identifications must be in accordance with Contract Documents and identical to what is shown in Contract Documents.
g. A discussion section which evaluates the degree of system protection and service continuity with overcurrent devices, along with recommendations as required for addressing system protection or device coordination deficiencies.

4. Significant deficiencies in protection and/or coordination shall be called to the attention of the Engineer and recommendations made for improvements as soon as they are identified.

3.3 LOAD FLOW STUDY

A. Load flow study shall be performed to evaluate the system's capability to adequately supply the connected load and prevent overloading of equipment.

B. Compare equipment (transformers, cables, breakers, fuses) operating values against manufacturer's specified maximum capability ratings whenever available.

C. Provide a computer generated Alert View list/report which lists all equipment that is overloaded

D. Voltage drop calculations shall be performed on all circuits to determine the worst case voltage drop. Feeder voltage drop shall be limited to 3% and combined feeder and branch circuit shall be less than 5%. The voltage drop results shall be shown individually on the single line diagram

E. Provide a computer generated load flow analysis report that provides a summarized comparison of power flow results between the different scenarios being evaluated.

3.4 ARC FLASH HAZZARD ANAYSIS

A. All requirements shall be from the latest edition of the referenced code or standard. Arc Flash warning labels shall be provided on all electrical equipment as required by the NEC, IEEE-1584, IEEE C2 and NFPA 70E. In case of any conflict the more stringent requirement shall be used.
1. The Arc Flash Hazard Analysis shall be performed with the aid of a digital computer in order to calculate Arc Flash Incident Energy (AFIE) levels and arc flash protection boundary distances.
2. The Arc Flash Hazard Analysis shall be performed in conjunction with a short-circuit analysis and a time-current coordination analysis.
3. Results of the Arc Flash Hazard Analysis shall be submitted in tabular form, and shall include device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, personal-protective equipment classes and AFIE levels.
4. The Arc Flash Hazard Analysis shall be performed by a registered professional electrical engineer.
5. The Arc Flash Hazard Analysis shall be performed in compliance with IEEE Standard 1584, the IEEE Guide for Performing Arc Flash Calculations.
6. The Arc Flash Hazard Analysis shall include recommendations for reducing AFIE levels and enhancing worker safety.
7. The Arc Flash Hazard Analysis shall report incident energy values based on the existing incident energy values at all buses within the scope of the study in addition to incident energy values based on the recommended overcurrent device setting changes.

B. Calculations shall be performed to determine the following and all calculations must be submitted for each piece of equipment. The minimum information required in an Arc Flash hazard protection analysis are:
   1. HAZARD RISK CATEGORY (HRC): A general classification of hazard involved in performing specified tasks. Typically ranges from 0 to 4. The NFPA provides a recommended list of PPE for each HRC in table 130.7 of NFPA 70E.
   2. INCIDENT ENERGY (cal/cm2) at 18 inches: This is the energy per unit area for a potential arc flash 18 inches from the source of the arc.
   3. ARC FLASH BOUNDARY: This is the distance from the arc flash source for which a person is likely to receive a second degree burn. Second degree burns typically occur at an energy level of 1.2 cal/cm2
   4. SHOCK HAZARD PROTECTION INFORMATION: The minimum information required in a Shock Hazard protection analysis are:
      a. Limited Approach Boundary: This boundary may only be crossed by a qualified person, or an unqualified person wearing appropriate PPE and accompanied by a qualified person.
      b. Restricted Approach Boundary: This boundary may only be crosses by authorized management using adequate shock prevention equipment and techniques.
      c. Prohibited Approach Boundary: This boundary may only be crossed by a qualified person that has the same level of protection required for direct contact with live parts.
      d. A Copy of the calculations and label shall be submitted for Arc Flash Labels
      e. A discussion section which evaluates the degree of system protection and service continuity with overcurrent devices, along with recommendations to lower available Arc Fault currents.

EXAMPLE OF LABEL TO BE USED

(3.5 INCH X 5 INCH THERMAL TRANSFER TYPE LABEL OF HIGH ADHESION POLYESTER)

Example of information provided in the final analysis.

	BUS NAME		
	100 T-920A	**101 PNL PCA**	**102 TD-304**
Protective Device Name	004 Dual	101 PCA Main	101 PCA - 10
KV	0.48	0.48	0.48
Bus Bolted Fault (kA)	14.81	14031	7.51
Protective Device Bolted Fault (kA)	13.65	13.15	7.51
Arcing Fault (kA)	8.45	8.19	5.14
Time / Delay Trip (sec)	1.451	0.04	0.0017
Breaker Opening Time (sec)	0	0	0
GND	Yes	Yes	Yes
Equipment Type	Panel	Panel	Panel
GAP (mm)	25	25	25
Arc Flash Boundary (in)	145	18	7
Working Distance (in)	18	18	18
Incident Energy (cal/cm²)	36.8	1.17	0.27
Hazard / Risk Category Number	4	0	0

3.5 FINAL REQUIREMENTS

A. The Final Study performed by the Contractor shall be generated based on the final electrical equipment submittals and final pulled conductor lengths.

B. Based on the findings of the final report the Contractor shall have a third party Contractor set the relays and circuit breakers prior to final acceptance and functional testing

C. The Final Report will be reviewed by, signed and stamped by a registered professional Electrical Engineer.

D. Provide arc flash labels with the two main operating scenarios, Utility and Generator. Labels to show arc flash data for the plant running on Utility and running on the standby generators.

END OF SECTION

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SECTION 26 08 13
ACCEPTANCE TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Basic requirements for acceptance testing.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 01 61 03 - Equipment - Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. InterNational Electrical Testing Association (NETA):
      a. ATS, Standard for Acceptance Testing Specifications for Electric Power Equipment and Systems.
   2. Nationally Recognized Testing Laboratory (NRTL).
   3. Telecommunications Industry Association/Electronic Industries Alliance/American National Standards Institute (TIA/EIA/ANSI):
      a. 455-78-B, Optical Fibres - PART 1-40: Measurement Methods and Test Procedures - Attenuation.

B. Qualifications:
   1. Testing firm qualifications: See Specification Section 01 61 03.
   2. Field personnel:
      a. See Specification Section 01 61 03.
      b. As an alternative, supervising technician may be certified by the equipment manufacturer.
   3. Analysis personnel:
      a. See Specification Section 01 61 03
         As an alternative, supervising technician may be certified by the equipment manufacturer.

C. Phasing Diagram:
   1. Coordinate with Utility Company for phase rotations and Phase A, B and C markings.
      a. Create a phasing diagram showing the coordinated phase rotations with generators and motors through the transformers.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 61 03 for electrical equipment and connection testing plan submittal requirements.

B. Informational Submittals:
   1. Prior to energizing equipment:
      a. Coordinated phasing diagram.
      b. Photocopies of all continuity tests.
   2. Within two weeks after successful completion of Demonstration Period (Commissioning Period):
      a. Single report containing information including:
         1) Summary of Project.
         2) Information from pre-energization testing.
         3) See testing and monitoring reporting requirements in Specification Section 01 61 03.

PART 2 - PRODUCTS

2.1 FACTORY QUALITY CONTROL

A. Provide Electrical equipment with all factory tests required by the applicable industry standards or NRTL.

B. Factory testing will not be accepted in lieu of field acceptance testing requirements specified in this Specification Section and Specification Section 01 61 03.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. General:
   1. See Specification Section 01 61 03.
   2. Complete electrical testing in three phases:
      a. Pre-energization testing phase.
      b. Equipment energized with no load.
      c. Equipment energized under load.
   3. Perform testing in accordance with this Specification Section and NETA ATS.
   4. Provide field setting and programming of all adjustable protective devices and meters to settings as determined by the approved coordination study.

B. Equipment Monitoring and Testing Plan: See Specification Section 01 61 03.

C. Instruments Used in Equipment and Connections Quality Control Testing: See Specification Section 01 61 03.

D. Testing and Monitoring Program Documentation: See Specification Section 01 61 03.

E. Electrical Equipment and Connections Testing Program:
   1. See Specification Section 01 61 03.
   2. See individual Division 26 Specification Sections for equipment specific testing requirements.
   3. Test all electrical equipment.
      a. Perform all required NETA testing.
      b. Perform all required NETA testing plus the optional testing identified with each specific type of equipment in Article 3.2 of this Specification Section.

3.2 SPECIFIC EQUIPMENT TESTING REQUIREMENTS

A. Switchgear and Switchboards:
   1. Perform inspections and tests per NETA ATS 7.1.
   2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.

B. Transformers - Small Dry Type:
   1. Perform inspections and tests per NETA ATS 7.2.1.1.
   2. Perform the following additional tests:
      a. Record phase-to-phase, phase-to-neutral, and neutral-to-ground voltages at no load after energizing, and at operating load after startup.
   3. Adjust tap connections as required to provide secondary voltage within 2-1/2% of nominal under normal load after approval of Engineer.
   4. Record as-left tap connections.

C. Transformers - Large Dry Type:
   1. Perform inspections and tests per NETA ATS 7.2.1.2.
   2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.
   3. Perform the following additional tests:

a. Record phase-to-phase, phase-to-neutral, and neutral-to-ground voltages at no load after energizing, and at operating load after start-up.
4. Adjust tap connections as required to provide secondary voltage within 2-1/2% of nominal under normal load.
5. Record as-left tap connections.

D. Cable - Low Voltage:
1. Perform inspections and tests per NETA ATS 7.3.2.

E. Cable - Medium Voltage:
1. Perform inspections and tests per NETA ATS 7.3.3.
2. Perform Dielectric Withstand Test.
3. Perform tan delta or partial discharge Baseline Diagnostic Tests.
1)

F. Low Voltage Power Circuit Breakers:
1. Perform inspections and tests per NETA ATS 7.6.1.2.
a. Tests shall include primary current injection testing of all breakers at final settings.
b. Where short-time or instantaneous settings on large frame breakers are beyond the current capability of field testing, primary injection tests at reduced currents shall be permitted if combined with secondary injection calibration test of trip unit at final settings.
2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.
3. Perform the following additional tests:
a. Shunt trip devices minimum tripping voltage.
4. Record as-left settings.

G. Low Voltage Molded Case Circuit Breakers:
1. Perform inspections and tests per NETA ATS 7.6.1.1.
2. Components:
a. Test all components per applicable paragraphs of this Specification Section and NETA ATS.
b. Thermal magnetic breakers: Visual and mechanical inspection per NETA ATS only.
c. Solid state trip type: Visual and mechanical inspection and electrical tests per NETA ATS.
3. Record as-left settings.

H. Network Protectors:
1. Perform inspections and tests per NETA ATS 7.8.
2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.
3. Perform all tests identified as optional per NETA ATS:

I. Protective Relays:
1. Perform inspections and tests per NETA ATS 7.9.
a. Tests to be performed using secondary injection of 3 PH current and potential at final settings.
b. Test at manufacturer's recommended test points and critical timing points identified on relay setting sheet.
2. Perform all tests identified as optional per NETA ATS.
3. Perform the following additional tests:
a. Verification of direct trip of associated lockout relay or circuit breaker(s) by using relay test function or shorting trip contact at relay case.
b. Microprocessor-based relays:
1) Complete commissioning procedure per manufacturer's instructions, followed by tests of each relay element at final settings.
2) Verification of all internally-programmed logic.
c. Verification of all auxiliary input and output signals.

d. Verification of power supply/self-diagnostic alarm contact and remote annunciation.

4. Record as-left settings.

J. Metering:
   1. Perform inspections and tests per NETA ATS 7.11.
   2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.

K. Grounding:
   1. Perform inspections and tests per NETA ATS 7.13.
   2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.

L. Ground Fault Protection:
   1. Perform inspections and tests per NETA ATS 7.14.
   2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.
   3. Perform the following optional tests per NETA ATS:
      a. Control wiring insulation resistance.
   4. Perform the following additional tests for four-wire systems:
      a. Primary current injection into switchgear bus with test set configured to simulate transformer source and high current jumper used to simulate unbalanced load and ground fault conditions.
      b. Verify no tripping for unbalanced load on each feeder and each main breaker.
      c. Verify no tripping for unbalanced load across tie breaker for dual-source schemes.
      d. Verify tripping for ground fault on load side of feeder each feeder and on each main bus.
      e. Verify tripping for ground fault on a single feeder and on each main bus through tie breaker(s) for multiple-source schemes.

M. Motors:
   1. Perform inspections and tests per NETA ATS 7.15.
   2. See Specification Section 01 61 03.

N. Motor Controllers:
   1. Perform inspections and tests per NETA ATS 7.16.
   2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.

O. Control System Functional Test:
   1. Perform test upon completion of equipment acceptance tests.
   2. The test is to prove the correct interaction of all sensing, processing and action devices.
   3. Develop a test plan and parameters for the purpose of evaluating the performance of the system.
   4. Perform the following tests:
      a. Verify the correct operation of all interlock safety devices for fail-safe functions in addition to design function.
      b. Verify the correct operation of all sensing devices, alarms and indicating devices.

END OF SECTION

SECTION 26 09 16
CONTROL EQUIPMENT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Operator control devices (selector switches, pushbuttons, indicator lights, etc.).
   2. Control devices (timers, relays, contactors, etc.).
   3. Operator Control Stations.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 26 05 00 - Electrical - Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. ICS 2, Industrial Control and System Controllers, Contactors and Overload Relays Rated 600 Volts.
      c. ICS 5, Control Circuit and Pilot Devices.
   2. Underwriters Laboratories, Inc. (UL):
      a. 508, Standard for Safety Industrial Control Equipment.
      b. 508A, Standard for Industrial Control Panels.
      c. 698A, Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations.

1.3 SYSTEM DESCRIPTION

A. This Specification specifies components used within other equipment as referenced in other technical specifications.

B. This Specification is used to specify the components and construction of Operator Control Stations.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data:
      a. Provide submittal data for all products specified in PART 2 of this Specification:
         1) When components are used within equipment specified in another Section, submittal data for components specified herein shall be included with the submittal for the equipment the components are used in.
      b. Control Station bill of material.
      c. See Section 26 05 00 for additional requirements.
   3. Fabrication and/or layout drawings.
      a. Operator Control Station:
         1) Interior (if applicable) and exterior layout.
         2) Wiring/connection diagrams.
      b. Associate Industrial Control Panel and Operator Control Stations with associated equipment name and tagging.

B. Informational Submittals:

1. See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Functional Test Plan.

C. Contract Closeout Information:
1. Operation and Maintenance Data:
a. See Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
b. Content of Operation and Maintenance Manual:
1) Product technical data of components used within Industrial Control Panels and Operator Control Stations.
2) As-constructed wiring/connection diagrams for Industrial Control Panels and Operator Control Stations.
3) Operating instructions for time clocks.
4) Functional Test Report.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Pilot devices, relays, contactors, and termination equipment:
a. Allen-Bradley by Rockwell Automation, Inc.
b. ASCO by Emerson Electric Co.
c. Eaton.
d. General Electric.
e. IDEC Corporation.
f. Phoenix Contact.
g. Schneider Electric.
h. Time Mark Corporation.
2. Photocells and time clocks:
a. Grasslin by Intermatic.
b. Tork by NSi Industries.
c. Intermatic.
d. Paragon Auto Control.
3. Alarm devices:
a. Edwards Signaling by United Technologies Corp.
b. Federal Signal Corporation.
4. Enclosures:
a. Hoffman Engineering.
b. Wiegmann by Hubbell.
c. B-Line by Eaton.
d. Adalet.
e. Stahlin by Robroy Enclosures.

2.2 PILOT DEVICES

A. General Requirements:
1. Standards: NEMA ICS 5, UL 508.
2. Heavy-duty NEMA 4/13 watertight/oiltight.
3. Heavy-duty NEMA 4/4X corrosion resistant.
4. Heavy-duty factory sealed, explosion-proof and dust ignition-proof (Class I and II).
5. Mounting hole: 30.5 MM.
6. Contact blocks: 10 amp, NEMA A600 rated, number as required to fulfill functions shown or specified.
7. Legend plate marked as indicated on Drawings or specified.

B. Selector Switches:
   1. Two, three- or four-position rotary switch as required to fulfill functions shown or specified.
   2. Maintained contact type.
   3. Knob or lever type operators.

C. Pushbuttons:
   1. Non-illuminated type:
      a. Protective boot.
      b. Momentary contact.
      c. Standard flush and mushroom operators.
      d. Green colored buttons for START or ON and red color for STOP or OFF.
      e. Emergency stop pushbuttons: Mushroom head operator and maintained contact.
   2. Illuminating type:
      a. Protective boot.
      b. Momentary contact.
      c. Standard flush operator.
      d. Serves as both pushbutton control and indicating light.
      e. Green colored lenses: START or ON.
      f. Red colored lenses: STOP or OFF.
      g. Resistor-type full voltage light unit with lens and panel gasket.

D. Indicating Lights:
   1. Allowing replacement of bulb without removal from control panel.
   2. Lamp: LED, 120 V or 24 V as required.
   3. Full voltage type.
   4. Push-to-test indicating lights.
   5. Plastic lens.
   6. Color code lights as follows:
      a. Green: ON or running; valve open.
      b. Amber: Standby; auto mode; ready, fail
      c. Red: OFF or stopped; valve closed.

2.3 RELAYS

A. General Requirements:
   1. Standards: NEMA ICS 5, UL 508.

B. Control Relays:
   1. General purpose (ice cube) type:
      a. Plug-in housing.
      b. Clear polycarbonate dust cover with clip fastener.
      c. Coil voltage: 120 VAC or as required.
      d. Contacts:
         1) 10 amp continuous.
         2) Silver cadmium oxide.
         3) Minimum of 3 SPDT contacts.
      e. Sockets: DIN rail mounted.
      f. Internal neon or LED indicator is lit when coil is energized.
      g. Manual operator switch.
   2. Industrial type:
      a. Coil voltage: 120 VAC or as required.
      b. Contacts:
         1) 10 amp, NEMA A600 rated.
         2) Double break, silver alloy.
         3) Convertible from normally open to normally closed or vice versa, without removing any wiring.
         4) Expandable from 2 poles to 12 poles.
      c. Provide contacts for all required control plus two spares.

C. Time Delay Relays:
1. General purpose type:
a. Timing modes: On and Off delay, interval, one shot and repeat cycle.
b. Plug-in housing.
c. Polycarbonate dust cover with clip fastener.
d. Coil voltage: 120 VAC or as required.
e. Contacts:
1) 10 amp continuous.
2) Silver cadmium oxide.
3) Two normally open and two normally closed DPDT contacts.
f. Sockets: DIN rail mounted.
g. External timing adjustment knob.
h. Timing ranges: 0.05 seconds to 16.65 HRS.
i. Repeat accuracy: +1 PCT.
2. Solid State industrial type:
a. Timing modes: On and Off delay and repeat cycle.
b. Industrial housing.
c. Coil voltage: 120 VAC or as required.
d. Contacts:
1) 5 amp, NEMA B150 rated.
2) Silver alloy.
3) Convertible On Delay and Off Delay contacts.
4) One normally open and one normally closed timed contacts.
5) One normally open and one normally closed instantaneous contacts.
e. Furnish with "on" and "timing out" indicators.
f. External timing adjustment knob.
g. Timing ranges: 0.05 seconds to 10 HRS.
h. Repeat accuracy: +1 PCT.
3. Mechanical industrial type:
a. Timing modes: On and Off delay.
b. Coil voltage: 120 VAC or as required.
c. Contacts:
1) 10 amp, NEMA A600 rated.
2) Double break, silver alloy.
3) Convertible On Delay and Off Delay contacts.
4) Convertible normally open and normally closed timed contacts.
5) Convertible normally open instantaneous contacts.
d. External timing adjustment knob.
e. Timing ranges: 0.2 - 60 seconds or 5 - 180 seconds.
f. Repeat accuracy: Greater than +10 PCT.

2.4 CONTACTORS

A. General Requirements:
1. Standards: NEMA ICS 2, UL 508.

B. Lighting and Remote Control Switches:
1. Electrically operated, electrically held.
2. Coil voltage: 120 VAC or as required.
3. Contacts: Totally enclosed, double-break silver-cadmium-oxide.
4. Rated for ballasted lighting, tungsten and general use loads.
5. Number of poles, continuous ampere rating and voltage, as indicated on Drawings or as specified.
6. Auxiliary control relays, as indicated on Drawings or as specified.
7. Auxiliary contacts, as indicated on Drawings or as specified.

C. Definite Purpose:
1. Coil voltage: 120 VAC or as required.

2. Contacts: Totally enclosed, double-break silver-cadmium-oxide.
3. Resistive load and horsepower rated.
4. Number of poles, continuous ampere rating and voltage, as indicated on Drawings or as specified.
5. Auxiliary contacts, as indicated on Drawings or as specified.

2.5 PHOTOCELLS AND TIME CLOCKS

A. Photocells:
1. Weatherproof enclosure.
2. Adjustable turn-on range, initially set at 1.0 foot-candles.
   a. Turn-off level approximately three times turn-on.
3. Provide time delay device to eliminate nuisance switching.
4. Voltage, amperage and/or wattage ratings as required for the application.

B. General Requirements for Time Clocks:
1. Separate manual on-off operation without disturbing automatic settings.
2. Enclosure:
   a. NEMA 1 for indoor locations.
   b. Stand alone or DIN rail for mounting in control panel.
   c. NEMA 3R or 4 for exterior locations.
3. Voltage, amperage and/or wattage ratings as required for the application.

C. Electromechanical:
1. 24 HR dial powered by a self-starting synchronous motor.
2. Minimum of 16 HR carryover power utilizing a spring-driven reserve with automatic rewind or rechargeable battery.
3. Minimum of 12 pairs of on-off trippers and a skip-a-day device.

D. Electromechanical:
1. Seven day dial powered by a self-starting synchronous motor.
2. Minimum of 24 HR carryover power utilizing a spring-driven reserve with automatic rewind or rechargeable battery.
3. Minimum of one pair of on-off trippers per day.

E. Electronic:
1. 24 HR and seven day programmable using solid state technology.
2. Minimum of 72 HR carryover power utilizing rechargeable battery or capacitor.
3. Minimum of seven on and seven off set points.

F. Electronic:
1. 365 day programmable using solid state technology with block programming.
2. Minimum of 72 HR carryover power utilizing rechargeable battery or capacitor.
3. Minimum of 48 events per week, 16 individual holiday overrides, daylight savings or standard time selectable, automatic leap year correction.

2.6 ALARM DEVICES

A. Alarm Horns:
1. Vibrating horn type.
2. PLC compatible as required.
3. Heavy-duty die cast housing with corrosion resistant finish.
4. Adjustable volume: 78 to 103 dB at 10 FT.
5. Voltage: 120 VAC or as required.
6. Enclosures/mountings:
   a. Flush wall or panel mounting in dry areas.
   b. NEMA 4X panel mounting in wet areas.
   c. Surface mounting in dry areas.
   d. NEMA 4X surface mounting in wet areas.
   e. NEMA 4X, hazardous location surface mounting in wet and hazardous areas.

1) Fixed volume: 97 dB at 10 FT.

B. Alarm Lights:
1. Panel mounted:
a. Strobe type.
b. Shatter resistant polycarbonate lens and base.
c. Lens color as indicated on Drawings.
d. NEMA 4X enclosure.
e. PLC compatible.
f. Voltage: 120 VAC.
2. Wall mounted:
a. Heavy-duty strobe type.
b. Weatherproof shatter resistant polycarbonate lens and cast base.
c. Optically designed fresnel lens with color as indicated on Drawings.
d. Immune to shock and vibration, no moving parts.
e. Xenon flash tube providing a minimum of 65 single flashes per minute.
f. Mounting: Wall or corner wall brackets.
3. Hazardous and corrosive locations:
a. Heavy-duty strobe type.
b. Weatherproof and rated for the indicated hazardous location.
c. Body: Zinc plated cast iron or cast copper free aluminum and/or coated with 20 mils of PVC.
d. High impact glass dome with guard.
e. Shatter resistant polycarbonate lens with color as indicated on Drawings.
f. Immune to shock and vibration, no moving parts.
g. Xenon flash tube providing a minimum of 65 single flashes per minute.
h. Mounting: Wall bracket or pendant.

2.7 TERMINATION EQUIPMENT

A. General Requirements:
1. Modular type with screw compression clamp.
2. Screws: Stainless steel.
3. Current bar: Nickel-plated copper alloy.
4. Thermoplastic insulation rated for -40 to +90 DEGC.
5. Wire insertion area: Funnel-shaped to guide all conductor strands into terminal.
6. End sections and end stops at each end of terminal strip.
7. Machine-printed terminal markers on both sides of block.
8. Spacing: 6 MM.
9. Wire size: 22-12 AWG.
10. Rated voltage: 600 V.
11. DIN rail mounting.

B. Standard-Type Block:
1. Rated current: 30 A.
2. Color: Gray body.

C. Bladed-Type Disconnect Block:
1. Terminal block with knife blade disconnect which connects or isolated the two sides of the block.
2. Rated current: 10 A.
3. Color:
a. Panel control voltage leaves enclosure - normal: Gray body, orange switch.
b. Foreign voltage entering enclosure: Orange body, orange switch.

D. Grounded-Type Block:
1. Electrically grounded to mounting rail.
2. Terminal ground wires and analog cable shields.
3. Color: Green and yellow body.

E. Fuse Holders:
   1. Blocks can be ganged for multi-pole operation.
   2. Spacing: 9.1 MM.
   3. Wire size: 30-12 AWG.
   4. Rated voltage: 300 V.
   5. Rated current: 12 A.
   6. Fuse size: 1/4 x 1-1/4.
   7. Blown fuse indication.
   8. DIN rail mounting.

2.8 ENCLOSURES

A. Industrial Control Panels:
   1. NEMA 4 rated:
      a. Seams continuously welded and ground smooth.
      b. No knockouts.
      c. External mounting flanges.
      d. Hinged or non-hinged cover held closed with stainless steel screws and clamps.
      e. Cover with oil resistant gasket.
   2. NEMA 4X rated:
      a. Body and cover: 14 GA Type 316 stainless steel.
      b. Seams continuously welded and ground smooth.
      c. No knockouts.
      d. External mounting flanges.
      e. Hinged door and stainless steel screws and clamps.
      f. Door with oil-resistant gasket.
   3. NEMA 12 enclosure:
      a. Body and cover: 14 GA steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
      b. No knockouts.
      c. External mounting flanges.
      d. Non-hinged stainless steel cover held closed with captivated cover screws threaded into sealed wells or hinged cover held closed with stainless steel screws and clamps.
      e. Flat door with oil resistant gasket.
   4. Control panel miscellaneous accessories:
      a. Back plane mounting panels: Steel with white enamel finish or Type 316 stainless steel.
      b. Interiors shall be white or light gray in color.
      c. Wire management duct:
         1) Bodies: PVC with side holes.
         2) Cover: PVC snap-on.
         3) Size as required.
      d. Rigid handles for covers larger than 9 SQFT or heavier than 25 LBS.
      e. Split covers when heavier than 25 LBS.
      f. Floor stand kits made of same material as the enclosure.
      g. Weldnuts for mounting optional panels and terminal kits.
      h. Ground bonding jumper from door, across hinge, to enclosure body.
   5. Standards: NEMA 250, UL 508.

B. Operator Control Stations:
   1. NEMA 4/13 rated:
      a. Die cast aluminum body with manufacturer's standard finish.
      b. Gasketed die cast aluminum cover with manufacturer's standard finish.
      c. Number of device mounting holes as required.
   2. NEMA 4X rated:
      a. Type 316 stainless steel body.
      b. Gasketed Type 316 stainless steel cover.

c. Number of device mounting holes as required.

2.9 FABRICATION

A. Supplier of Industrial Control Panels shall build control panel under the provisions of UL 508A or UL 698A.
   1. Entire assembly shall be affixed with a UL 508A or UL 698A label "Listed Enclosed Industrial Control Panel" prior to shipment to the jobsite.
   2. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
      a. Determine the SCCR rating by one of the following methods:
         1) Method 1: SCCR rating meets or exceeds the available fault current of the source equipment when indicated on the Drawings.
         2) Method 2: SCCR rating meets or exceeds the source equipment's Amp Interrupting Current (AIC) rating as indicated on the Drawings.
         3) Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.
      b. The source equipment is the switchboard, panelboard, motor control center or similar equipment where the control panel circuit originates.
   3. For Method 3, provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install as indicated and in accordance with manufacturer's recommendations and instructions.

B. Control Panels:
   1. Size as required to mount the equipment.
   2. Permitted uses of NEMA 4 enclosure:
      a. Surface mounted in areas designated as wet.
   3. Permitted uses of NEMA 4X enclosure:
      a. Surface mounted in areas designated as wet and/or corrosive or highly corrosive.
   4. Permitted uses of NEMA 12 enclosure:
      a. Surface mounted in areas designated as dry and/or dusty architecturally or non-architecturally finished areas.

C. Operator Control Stations:
   1. Permitted uses of NEMA 4/13 enclosure:
      a. Surface mounted in areas designated as dry and/or dusty architecturally or non-architecturally finished areas and wet.
   2. Permitted uses of NEMA 4X enclosure:
      a. Surface mounted in areas designated as wet and/or corrosive or highly corrosive.

3.2 FIELD QUALITY CONTROL

A. See Section 26 05 00.

B. Industrial Control Panel(s) and Operator Control Station Functional Test:
   1. The test is to prove the correct interaction of all sensing, processing and action devices.
   2. Develop a test plan and parameters for the purpose of evaluating the performance of the system.
      a. Plan shall have witness signature lines for the contractor and owner and submitted when system pass the test.
   3. Perform the following tests:
      a. Verify functionality of all control states.
      b. Verify the correct operation of all interlock safety devices for fail-safe functions
      c. Verify the correct operation of all sensing devices, alarms and indicating devices.

3.3 TRAINING

A. A qualified supplier representative shall provide the Owner with on-site training in the operation and maintenance of the Industrial Control Panel(s) and its components.

END OF SECTION

SECTION 26 22 13
DRY-TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Dry-type transformers, 1000 kVA and less.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 26 05 00 - Electrical - Basic Requirements.
   4. Section 26 05 26 - Grounding.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Department of Energy (DOE):
      a. 10 CFR 431, Energy Conservation Program: Energy Conservation Standards for Distribution Transformers.
   2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. C57.96, Guide for Loading Dry-Type Distribution and Power Transformers.
   3. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. ST 20, Dry Type Transformers for General Applications.
   4. Underwriters Laboratories, Inc. (UL):
      a. 506, Standard for Specialty Transformers.
      b. 1561, Standard for Dry-Type General Purpose and Power Transformers.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data:
      a. Provide submittal data for all products specified in PART 2 of this Specification Section.
      b. See Specification Section 26 05 00 for additional requirements.
   3. Fabrication and/or layout drawings.
      a. Nameplate drawing.
   4. Certifications:
      a. Sound level certifications.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Eaton.
   2. General Electric.

3. Square D by Schneider Electric.
4. Siemens.
5. SolaHD by Emerson Electric Co.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 GENERAL PURPOSE DRY-TYPE TRANSFORMERS

A. Ventilated or non-ventilated, air cooled, two winding type.

B. Cores:
1. High grade, non-aging silicon steel with high magnetic permeability, and low hysteresis and eddy current losses.
2. Magnetic flux densities are to be kept well below the saturation point.

C. Coils: Continuous wound with electrical grade aluminum.

D. Ventilated Units:
1. Core and coils assembly impregnated with non-hygroscopic, thermosetting varnish and cured to reduce hot spots and seal out moisture and completely isolated from the enclosure by means of vibration dampening pads.
2. Dripproof, NEMA 1, steel enclosure finished with a weather-resistant enamel and ventilation openings protected from falling dirt.

E. Furnish Taps for Transformers as follows:
1. 1 PH, 2 kVA and below: None.
2. 1 PH, 3 to 25 kVA: Two, 5 PCT FCBN.
3. 1 PH, 25 kVA and above: Two, 2.5 PCT FCAN and four, 2.5 PCT FCBN.
4. 3 PH, 3 to 15 kVA: Two, 5 PCT FCBN.
5. 3 PH, 15 kVA and above: Two, 2.5 PCT FCAN and four, 2.5 PCT FCBN.

F. Sound Levels:
1. Manufacturer shall guarantee not to exceed the following:
   a. Up to 9 kVA: 40 dB.
   b. 10 to 50 kVA: 45 dB.
   c. 51 to 150 kVA: 50 dB.
   d. 151 to 300 kVA: 55 dB.

G. Efficiency (minimum):
1. Ventilated:
   a. 1 PH, 15 - 333 kVA: DOE 2016 Efficiency.
   b. 3 PH, 15 - 1000 kVA: DOE 2016 Efficiency.

H. Insulating Material (600 V and below):
1. 3 to 15 kVA units: 185 DEGC insulation system with a 115 DEGC rise.
2. 15 kVA and above units: 220 DEGC insulation system with a 150 DEGC rise.

I. Ratings: 60 Hz, voltage, KVA and phase, as indicated on the Drawings.

J. Finish: Rust inhibited primer and manufacturers standard paint inside and out.

K. Standards: IEEE C57.96, NEMA ST 20, UL 506, UL 1561.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Indoor Locations:
1. Provide ventilated type for 15 kVA units and above.
2. Provide non-ventilated type for 9 kVA units and below and were indicated on the Drawings.
3. Mount 9 kVA units and below on wall.

4. Mount 15 kVA units and above on chamfered 4 IN high concrete housekeeping pad or from wall and/or ceiling, at 7 FT above finished floor, using equipment support brackets per Section 26 05 00.
5. Provide rubber vibrations isolation pads.

C. Enclosures: Painted steel in all areas except stainless steel in highly corrosive areas.

D. Ground in accordance with Section 26 05 26.

END OF SECTION

SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Lighting and appliance panelboards.
   2. Power distribution panelboards.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 26 05 00 - Electrical - Basic Requirements.
   4. Section 26 28 00 - Overcurrent and Short Circuit Protective Devices.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. PB 1, Panelboards.
   2. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   3. Underwriters Laboratories, Inc. (UL):
      a. 50, Enclosures for Electrical Equipment, Non-Environmental Considerations.
      b. 67, Standard for Panelboards.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data.
      a. Provide submittal data for all products specified in PART 2 of this Specification Section.
      b. See Specification Section 26 05 00 for additional requirements.
   3. Fabrication and/or layout drawings:
      a. Panelboard layout with alphanumeric designation, branch circuit breakers size and type, as indicated in the panelboard schedules.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
   2. Panelboard schedules with as-built conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Eaton.
   2. General Electric.
   3. Square D by Schneider Electric.
   4. Siemens Corporation.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MANUFACTURED UNITS

A. Standards: NEMA PB 1, NFPA 70, UL 50, UL 67.

B. Ratings:
   1. Current, voltage, number of phases, number of wires as indicated on the Drawings.
   2. Panelboards rated 240 VAC or less: 10,000 AMP minimum short circuit rating or as indicated in the schedule.
   3. Panelboards rated 480 VAC: 14,000 AMP minimum short circuit rating or as indicated in the schedule.

C. Construction:
   1. Interiors factory assembled and designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.
   2. Multi-section panelboards: Feed-through or sub-feed lugs.
   3. Main lugs: Solderless type approved for copper and aluminum wire.

D. Bus Bars:
   1. Main bus bars:
      a. Plated aluminum or copper sized to limit temperature rise to a maximum of 65 DEGC above an ambient of 40 DEGC.
      b. Drilled and tapped and arranged for sequence phasing of the branch circuit devices.
   2. Ground bus and isolated ground bus, when indicated on the Drawings: Solderless mechanical type connectors.
   3. Neutral bus bars: Insulated 100 PCT rated or 200 PCT rated, when indicated on the Drawings and with solderless mechanical type connectors.

E. Enclosure:
   1. Boxes: Code gage galvanized steel, furnish without knockouts.
   2. Trim assembly: Code gage steel finished with rust inhibited primer and manufacturers standard paint inside and out.
   3. Lighting and appliance panelboard:
      a. Trims supplied with hinged door over all circuit breaker handles.
      b. Trims for surface mounted panelboards, same size as box.
      c. Trims for flush mounted panelboards, overlap the box by 3/4 IN on all sides.
      d. Doors lockable with corrosion resistant chrome-plated combination lock and catch, all locks keyed alike.
      e. Nominal 20 IN wide and 5-3/4 IN deep with gutter space in accordance with NFPA 70.
      f. Clear plastic cover for directory card mounted on the inside of each door.
      g. NEMA 12 rated: Door gasketed.
   4. Power distribution panelboard:
      a. Trims cover all live parts with switching device handles accessible.
      b. Less than or equal to 12 IN deep with gutter space in accordance with NFPA 70.
      c. Clear plastic cover for directory card mounted front of enclosure.
      d. NEMA 12 rated: Doors gasketed and lockable with corrosion resistant chrome-plated combination lock and catch, all locks keyed alike.

F. Overcurrent and Short Circuit Protective Devices:
   1. Main overcurrent protective device:
      a. Molded case circuit breaker.
   2. Branch overcurrent protective devices:
      a. Mounted molded case circuit breaker.
   3. See Section 26 28 00 for overcurrent and short circuit protective device requirements.
   4. Factory installed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install as indicated on the Drawings, in accordance with the NFPA 70, and in accordance with manufacturer's instructions.

B. Support panelboard enclosures from wall studs or modular channels support structure, per Specification Section 26 05 00.

C. Provide NEMA 12 rated enclosure as indicated on the Drawings.

D. Provide each panelboard with a typed directory:
   1. Identify all circuit locations in each panelboard with the load type and location served.
   2. Mechanical equipment shall be identified by Owner-furnished designation if different than designation indicated on the Drawings.
   3. Room names and numbers shall be final building room names and numbers as identified by the Owner if different than designation indicated on the Drawings.

END OF SECTION

SECTION 26 24 19
MOTOR CONTROL EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Motor control centers.
   2. Separately mounted motor starters (including those supplied with equipment).
   3. Manual motor starters.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 26 05 00 - Electrical - Basic Requirements.
   4. Section 26 08 13 - Acceptance Testing.
   5. Section 26 28 00 - Overcurrent and Short Circuit Protective Devices.
   6. Section 26 43 13 - Low Voltage Surge Protective Devices (SPD).

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. International Electrotechnical Commission (IEC).
   2. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volt Maximum).
      b. ICS 2, Controllers, Contactors and Overload Relays Rated 600 V.
      c. ICS 18, Motor Control Centers.
   3. Underwriters Laboratories, Inc. (UL):
      a. 508, Standard for Industrial Control Equipment.
      b. 845, Motor Control Centers.

B. Miscellaneous:
   1. Verify motor horsepower loads, other equipment loads, and controls from approved shop drawings and notify Engineer of any discrepancies.
   2. Verify the required instrumentation and control wiring for a complete system and notify Engineer of any discrepancies.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data:
      a. Provide submittal data for all products specified in PART 2 of this Specification Section.
      b. See Specification Section 26 05 00 for additional requirements.
   3. Fabrication and/or layout drawings:
      a. Motor control center:
         1) Elevation drawing with overall dimensions.
         2) Starter and component schedule.
         3) Identification of units and their location in the MCC.
         4) Location of incoming line terminals.
         5) Mounting dimensions.
         6) Available conduit entrance areas.
         7) Nameplate schedule.
         8) One line diagram.

9) Assembly ratings (amps, volts, short circuit, etc.).
10) Unit ladder logic wiring for each unit depicting electrical interlocking and wiring between units (NEMA ICS 18 Class II) and identification of terminals where field devices or remote control signals are to be terminated (NEMA ICS 18 Class II-S) including industry standard symbology of the field devices as indicated on the Drawings, product specification and/or loop descriptions. Drawings indicate basic control functionality, provide diagrams for the manufacturer's product(s) meeting the required functionality.

b. Separately mounted combination starters:
1) Unit ladder logic wiring for each unit depicting electrical wiring and identification of terminals where field devices or remote control signals are to be terminated including industry standard symbology of the field devices as indicated on the Drawings, specification and/or loop descriptions. Drawings indicate basic control functionality, provide diagrams for the manufacturer's product(s) meeting the required functionality.
2) Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70, include any required calculations.

B. Contract Closeout Information:
1. Operation and Maintenance Data:
a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
b. Fabrication and/or layout drawings updated with as-built conditions.

C. Informational Submittals:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Service equipment marking and documentation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Allen-Bradley by Rockwell Automation, Inc.
2. Eaton.
3. General Electric.
4. Square D by Schneider Electric.
5. Siemens Corporation.
6. Or equal.

2.2 MOTOR CONTROL CENTERS

A. Ratings:
1. 600 V class, 3 PH, 60 Hz with operating voltage and number of wires as indicated on the Drawings.
2. Assembly short circuit current and interrupting device rating as indicated on the Drawings.
3. Service Entrance Equipment rated when indicated on the Drawings.

B. Construction:
1. Standards: UL 845.
2. Totally enclosed, dead front, free standing assemblies, bolted together to form a single assembly.
3. Fabricate of not less than 14 GA steel with 16 GA steel doors in standardized units.
4. Nominal size per section: 20 IN wide, 20 or 21 IN deep, and 90 IN high.
5. Enclosure:
a. NEMA 1 gasketed.

b. NEMA 12:
    1) Dust-tight and drip-proof.
    2) Gasketed material round all doors, door cutouts, cover plates, side, top and back sheets.
    3) Gasketed bottom plate.
c. NEMA 3R non-walk-in:
    1) Rainproof and sleet resistant.
    2) NEMA 1 gasketed enclosure with an outdoor house erected around it.

6. Horizontal wireways:
    a. At the top, isolated from the main bus
    b. At the bottom.
    c. Easily accessible.
    d. Full length of the MCC.
7. Vertical wireway:
    a. Located in each MCC section that accepts plug-in units.
    b. Connect to top and bottom wireways.
    c. Isolated from the unit interiors.
    d. Accessible through a separate hinged door.
    e. Cable tie supports to hold wiring in place.
8. Unit doors:
    a. Formed round corners and rolled edges.
    b. Minimum of two heavy-duty hinges or continuous piano hinge.
    c. Held closed by means of captive fasteners.
    d. Fabricate to be a part of the structure and not part of the starter.
9. Unit cubicles:
    a. Draw-out type for motor starters through NEMA Size 5.
    b. Guide rails for supporting and aligning starters.
    c. Operating handle:
        1) With the unit stabs engaged and door closed the handle mechanism allows complete ON/OFF control of the unit disconnect and clear indication of the disconnect status.
        2) Circuit breaker and MCP operators includes a separate TRIPPED position.
        3) Mechanical interlock to prevent the opening of the door when the disconnect is in the ON position with a defeater mechanism.
        4) Mechanical interlock to prevent the placement of the disconnect in the ON position with the door open with a defeater mechanism.
        5) Non-defeatable interlock to prevent the installation or removal of a unit unless the disconnect is in the OFF position.
        6) Padlockable in the OFF position.
    d. Control panel:
        1) Provide control devices (selector switch, indicating devices, etc.) as indicated on the Drawings per Specification Section 26 09 16.
    e. Control power:
        1) Control power transformer:
            a) 120 V secondary.
            b) Fused on primary and secondary side.
            c) Sized for 140 PCT of required load.
    f. Minimum of one full size space unit (12 IN) for any combination magnetic motor starter or starter without overload relay.
    g. One-half full size space unit (6 IN) for circuit breakers 100 A and less.
    h. Effectively baffled to isolate any ionized gases which may occur within unit starter.
10. Externally mounted overload relay pushbutton.
11. Assemblies effectively ventilated to allow relocation of starters and other components:
    a. Within the assembly and with the same load.
    b. Without having to compensate for changes in location.
12. Finish: Rust inhibited primer and manufacturer's standard paint inside and out.

13. Provide ample unrestricted space for conduit entry from the bottom.
14. Wiring: NEMA ICS 18 Class II, Type B-D.

C. Buses:
   1. Material: Tin-plated copper.
   2. Main horizontal bus:
      a. 600 A unless otherwise indicated on the Drawings.
      b. Extend the full-length of the MCC with provisions for splicing additional sections to either end.
   3. Vertical buses:
      a. 300 A minimum.
      b. Securely bolted to the horizontal main bus with joint easily accessible for maintenance.
      c. Completely isolated and insulated by means of a barrier.
      d. Extended full length of vertical section to distribute incoming power to each circuit breaker and starter in structure.
         1) Starters NEMA Size 5 and larger and certain other components may be cable connected to the main bus with the approval of the Engineer.
      e. Extend Vertical bus to spaces provided for future equipment.
   4. Ground bus:
      a. Extend the full-length of the MCC with provisions for splicing additional sections to either end.
      b. 300 A tin-plated copper.
      c. Solidly grounded to each structure.
      d. Locate near bottom of structure.
      e. Provide for lug connection of equipment ground wires.

D. Overcurrent and Short Circuit Protective Devices:
   1. Main device:
      a. Molded case circuit breaker.
      b. Fusible switch.
   2. Feeder devices:
      a. Molded case circuit breaker.
      b. Fusible switch.
   3. Motor protection with full voltage starters:
      a. Motor circuit protector.
      b. Molded case circuit breaker.
      c. Class RK-1 fuse.
   4. Motor protection with reduced voltage starters:
      a. Molded case circuit breaker.
      b. Motor circuit protector.
      c. Class RK-1 fuse.
   5. See Specification Section 26 28 00 for overcurrent and short circuit protective device requirements.
   6. Factory installed.

E. Motor Starters: See requirements within this Specification Section.

F. Surge Protective Device: Integrally mounted, see Specification Section 26 43 13.

G. Power Monitor Metering:
   1. Separate compartment.

H. Utility Metering:
   1. Coordinate with Utility for meter, meter socket, and test block requirements.

I. Transfer Switch: Integrally mounted in MCC lineup.
   1. Manual transfer switches:
      a. Automatic Switch Company.
      b. Eaton.

c. Square D Company.
d. Siemens.
e. ABB Zenith.

2. Double throw load break rated with:
   a. Quick-make/quick-break operating mechanism.
   b. Deionizating arc chutes.
   c. Double-break rotary action shaft and switchblade shall be manufactured as one common component.
   d. Clear line shields to prevent accidental contact with line terminals.
3. Operating handle: Easily recognizable and padlockable in both positions.
4. Wiring configuration to allow single load to be supplied by a normal or alternate source.
5. Ratings: Voltage and amperage: As indicated on Drawings.
6. Short circuit withstand: Equal to or greater than the upstream equipment.
7. Enclosure:NEMA 1 rated:
   a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
   b. With or without knockouts, hinged and lockable door.

J. Miscellaneous:
1. See Drawings for items provided by other but factory installed (e.g., submersible motor temperature/leak controller, control system gateways or switches).

2.3 SEPARATELY MOUNTED COMBINATION STARTERS

A. Standards:
1. NEMA 250, NEMA ICS 2.
2. UL 508.

B. Enclosure:
1. NEMA 4X rated:
   a. Body and cover: Type 304 or 316 stainless steel.
   b. No knockouts, external mounting flanges, hinged and gasketed door.
2. NEMA 12 rated:
   a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturer's standard paint inside and out.
   b. No knockouts, external mounting flanges, hinged and gasketed door.

C. Operating Handle:
1. With the door closed the handle mechanism allows complete ON/OFF control of the unit disconnect and clear indication of the disconnect status.
2. Circuit breaker and MCP operators includes a separate TRIPPED position.
3. Mechanical interlock to prevent to prevent the opening of the door when the disconnect is in the ON position with a defeater mechanism for use by authorized personnel.
4. Mechanical interlock to prevent the placement of the disconnect in the ON position with the door open with a defeater mechanism for use by authorized personnel.
5. Padlockable in the OFF position.

D. External mounted overload relay pushbutton.

E. Control Devices:
1. Provide control devices as indicated on the Drawings per Specification Section 26 09 16.
2. Devices will be accessible with the door closed.

F. Control Power Transformer:
1. 120V secondary.
2. Fused on primary and secondary side.
3. Sized for 140 PCT of required load.

G. Fault Current Withstand Rating: Equal to the rating of the electrical gear from which it is fed.

H. Motor Starters: See requirements within this Specification Section.

I. Disconnect Switch, Overcurrent and Short Circuit Protective Devices:
   1. Motor circuit protector.
   2. See Specification Section 26 28 00 for overcurrent and short circuit protective device requirements.
   3. Factory installed.

2.4 MOTOR STARTERS

A. Standards:
   1. NEMA ICS 2.
   2. UL 508.

B. Full Voltage Non-Reversing (FVNR) Magnetic Starters:
   1. NEMA full size rated contactor.
      a. NEMA half sizes and IEC contactors are not permitted.
   2. Double-break silver alloy contacts.
   3. Overload relays:
      a. Ambient insensitive, adjustable solid-state type with phase loss protection, phase imbalance protection and manual reset.
   4. Interlock and auxiliary contacts, wired to terminal blocks:
      a. Holding circuit contact, normally open.
      b. Overload alarm contact, normally open.
      c. Normally open auxiliary contact, for remote run status.
      d. Additional field replaceable auxiliary contacts as required per the Sequence of Operation.
      e. Two additional normally open spare field replaceable auxiliary contacts.

2.5 MANUAL MOTOR STARTERS

A. Standards:
   1. NEMA 250, NEMA ICS 2.
   2. UL 508.

B. Quick-make, quick-break toggle mechanism that is lockable in the OFF position.

C. Types:
   1. Horsepower rated, for ON/OFF control.
   2. Horsepower rated, for ON/OFF control and thermal overload protection.
      a. Switch to clearly indicate ON, OFF, and TRIPPED position.

D. Voltage and current ratings and number of poles as required for the connected motor.

E. Enclosures:
   1. NEMA 1 rated:
      a. Galvanized steel or steel finished with rust inhibiting primer and manufacturer's standard paint inside and out.
      b. With or without concentric knockouts.
   2. NEMA 4X rated:
      a. Type 304 or 316 stainless steel.
      b. No knockouts, external mounting flanges.
   3. NEMA 12 rated:
      a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturer's standard paint inside and out.
      b. No knockouts, external mounting flanges.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install as indicated on the Drawings and in accordance with manufacturer's recommendations and instructions.

B. Mounting height for surface mounted equipment: See Specification Section 26 05 00.

C. Mount MCC on 4 IN high concrete pad:
   1. Install two, 4 IN wide channel sills flush in pads to support and maintain alignment of the MCC.
   2. Align front of MCC with top edge of pad chamfer.

D. Service Equipment Marking and Documentation:
   1. Provide service rated equipment with available fault current and arc-flash hazard warning labels as required by NFPA 70 and other applicable codes.
   2. Provide documentation of the calculations made for compliance with the marking requirements.
   3. Provide labels in accordance with Section 10 14 00.

E. Provide separately mounted combination starters with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
   1. Determine the SCCR rating by one of the following methods:
      a. Method 1: SCCR rating meets or exceeds the available fault current of the source equipment when indicated on the Drawings.
      b. Method 2: SCCR rating meets or exceeds the source equipment's Amp Interrupting Current (AIC) rating as indicated on the Drawings.
      c. Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.
   2. The source equipment is the switchboard, panelboard, motor control center or similar equipment where the equipment or control panel circuit originates.
   3. For Method 3, provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.

F. Overload Heaters:
   1. Size for actual motor full load current of the connected motor.
   2. For motors with power factor correction capacitors, size to compensate for the capacitors effect on load current.

G. Combination and Manual Starter Enclosures:
   1. Permitted uses of NEMA 1 enclosure:
      a. Surface or flush mounted in architecturally finished areas.
      b. Surface mounted above 10 FT in areas designated as dry in architecturally and non-architecturally finished areas.
   2. Permitted uses of NEMA 4X enclosure:
      a. Surface mounted in areas designated as wet and/or corrosive.
   3. Permitted uses of NEMA 12 enclosure:
      a. Surface mounted in areas designated as dry.

END OF SECTION

SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Material and installation requirements for:
      a. Wall switches.
      b. Receptacles.
      c. Device wallplates and coverplates.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 26 05 00 - Electrical: Basic Requirements.
   4. Section 26 05 33 - Raceways and Boxes.
   5. Section 26 24 19 - Motor Control Equipment.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. WD 1, General Color Requirements for Wiring Devices.
      c. WD 6, Wiring Devices - Dimensional Requirements.
   2. Underwriters Laboratories, Inc. (UL):
      a. 20, General-Use Snap Switches.
      b. 498, Standard for Attachment Plugs and Receptacles.
      c. 514A, Metallic Outlet Boxes.
      d. 894, Standard for Switches for Use in Hazardous (Classified) Locations.
      e. 943, Ground-Fault Circuit-Interrupters.
      f. 1310, Standard for Class 2 Power Units.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data:
      a. Provide submittal data for all products specified in PART 2 of this Specification Section.
      b. See Specification Section 26 05 00 for additional requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Wall switches and receptacles:
      a. Bryant Electric.
      b. Cooper Wiring Devices by Eaton.
      c. Hubbell Incorporated Wiring Device-Kellems.
      d. Leviton Manufacturing Company.
      e. Legrand/Pass & Seymour.

f. Eaton Crouse-Hinds.
g. Appleton Electric Co.
h. Hubbell Killark.

2.2 WALL SWITCHES

A. Basic requirements unless modified in specific requirements paragraph of switches per designated areas or types:
1. Industrial Specification Grade.
2. Quiet action, snap switch.
3. Self-grounding with grounding terminal.
4. Back and side wired.
5. Solid silver cadmium oxide contacts.
6. Rugged thermoplastic and/or nylon housing and one-piece switch arm.
7. Ratings: 20 A, 120/277 VAC.
8. Switch handle type: Toggle.
9. Switch handle color: Gray .
10. Types as indicated on the Drawings:
a. Single-pole.
b. Double-pole.
c. 3-way.
d. 4-way.
11. Standards: UL 20, UL 514A, NEMA WD 6.

B. Dry and Dusty Non-Architecturally Finished Area Specific Requirements:
1. Coverplate:
a. Cast iron alloy, gasketed, stainless steel hardware, galvanized and factory painted finish.
b. Cast aluminum, gasketed, stainless steel hardware, natural, lacquer, or factory painted finish.
c. Operator type:
1) Side mounted rocker type handle to operate snap switch.
2) Front mounted lever type handle to operate snap switch.
3) Push/pull operator to operate snap switch.
4) Spring type door to cover snap switch.
d. Single or multiple gang as required.

C. Wet or Damp Non-Architecturally Finished or Exterior Area Specific Requirements:
1. Coverplate:
a. Cast iron alloy, gasketed, stainless steel hardware, galvanized and factory painted finish.
b. Cast aluminum, gasketed, stainless steel hardware, natural, lacquer, or factory painted finish.
c. Operator type:
1) Side mounted rocker type handle to operate snap switch.
2) Front mounted lever type handle to operate snap switch.
3) Push/pull operator to operate snap switch.
4) Spring type door to cover snap switch.
d. Wet location rated.
e. Single or multiple gang as required.

D. Corrosive and Wet or Damp Area Specific Requirements:
1. Corrosion resistant nickel plated metal parts.
2. Coverplate for use on metallic outlet boxes:
a. Cast iron alloy, gasketed, stainless steel hardware, galvanized and factory painted finish.
b. Cast aluminum, gasketed, stainless steel hardware, natural, lacquer, or factory painted finish.

c. Operator type:
    1) Front mounted lever to operate snap switch.
    2) Push/pull operator to operate snap switch.
    3) Spring type door to cover snap switch.
d. Wet location rated.
e. Single or multiple gang as required.

3. Coverplate for use on non-metallic outlet boxes:
    a. High impact thermoplastic, gasketed, stainless steel screws.
        1) Front mounted lever to operate snap switch.
        2) Spring type door to cover snap switch.
    b. Wet location rated.
    c. Single or multiple gang as required.

2.3 RECEPTACLES

A. Basic requirements unless modified in specific requirements paragraph of receptacles and per designated areas:
    1. Industrial Specification Grade.
    2. Straight blade.
    3. Brass triple wipe line contacts.
    4. One-piece grounding system with double wipe brass grounding contacts and self-grounding strap with grounding terminal.
    5. Back and side wired.
    6. Rating: 20 A, 125 VAC.
    7. High impact nylon body.
    8. Receptacle body color:
        a. Normal power: Gray .
        b. Generator or UPS power: Red.
    9. Duplex or simplex as indicated on the Drawings.
    10. Configuration: NEMA 5-20R.
    11. Standards: UL 498, UL 514A, NEMA WD 1, NEMA WD 6.

B. Dry and Dusty Non-Architecturally Finished Areas Specific Requirements:
    1. Coverplate:
        a. Cast iron alloy, gasketed, self-closing cover, stainless steel hardware, galvanized and factory painted finish.
        b. Cast aluminum, gasketed, self-closing cover, stainless steel hardware, natural, lacquer or factory painted finish.
        c. Single or multiple gang, as required.

C. Corrosive and Wet or Damp Area Specific Requirements:
    1. Corrosion resistant nickel plated metal parts.
    2. Receptacle body color: Gray.
    3. Weather-resistant.
        a. Identification: Letters “WR” on face of receptacle.
    4. Coverplate for use on metallic outlet boxes:
        a. Extra-duty rated, weatherproof (NEMA 3R) while in use, gasketed, stainless steel hardware, copper-free aluminum, 3.2 IN minimum cover depth for #12 AWG cord.
    5. Coverplate for use on non-metallic outlet boxes:
        a. Extra-duty rated, weatherproof (NEMA 3R) while in use, gasketed, stainless steel hardware, flame retardant, UV stabilized polycarbonate, 3.2 IN minimum cover depth for #12 AWG cords.

2.4 MISCELLANEOUS WIRING DEVICES

A. Manual Motor Starters: Horsepower rated with or without thermal overloads, see Specification Section 26 24 19.

2.5 OCCUPANCY SENSORS

A. Low Voltage Passive Infrared Ceiling Sensor per the Drawings:
   1. Detection of changes in the infrared energy: Sensor to respond only to those signals caused by human motion.
   2. Analog and digital processing to provide immunity to RFI and EMI.
   3. Temperature compensated, dual element sensor and a multi-element lens with a minimum field of view of 110 DEG.
   4. Daylight filter or compensation for short wavelength infrared wave from the sun.
   5. Cover up to 300 SQ FT at normal mounting heights.
   6. System voltage: 24 VDC through power pack.
   7. Load ON-OFF control through power pack.
   8. Adjustable time delay set at 30 minutes.
   9. Adjustable sensitivity set at maximum.
   10. Adjustments and mounting hardware under a removable cover.
   11. Parallel wiring of multiple sensors to allow coverage of large areas.

B. Passive Infrared Wall Switch:
   1. Self-contained control system that replaces a standard toggle switch.
      a. Latching air gap relay switching mechanism, compatible with electronic ballasts, compact fluorescent and inductive loads.
   2. Detection of changes in the infrared energy: Sensor to respond only to those signals caused by human motion.
   3. Analog and digital processing to provide immunity to RFI and EMI.
   4. Temperature compensated, dual element sensor and a multi-element Fresnel lens.
   5. Cover up to 300 SQ FT for walking motion, with a field of view of 180 DEG.
   6. System voltage: 120 VAC or 277 VAC.
   7. No minimum load.
      a. 0 to 500 watts incandescent, 0 to 800 watts fluorescent or 1/6 HP at 120 VAC, 60 Hz.
      b. 0 to 1200 watts fluorescent or 1/3 HP at 277 VAC, 60 Hz.
   8. DIP switch to control the following functions:
      a. Built-in light level feature adjustable from 8 to 180 FT candles.
      b. AUTOMATIC-ON or MANUAL-ON operation.
      c. Time delay adjustable from 30 seconds to 30 minutes.
      d. High/low sensitivity adjustments.
   9. Adjustments and mounting hardware under a removable, tamper resistant cover.
   10. Normal operation: OFF and AUTO.

C. Ultrasonic Ceiling Sensor:
   1. Detection of Doppler shifts in transmitted ultrasound.
   2. Ultrasonic sensing is volumetric in coverage with a frequency of 32 kHz and automatically adjust the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled areas.
   3. Temperature and humidity resistant, 32 kHz tuned ultrasonic receivers.
      a. Receivers have less than a 6 dB shift in the humidity range of 10 PCT to 90 PCT and less than a 10 dB shift in the temperature range of -20 to 60 DEGC.
   4. DIP switch to control the following functions:
      a. Override-ON function for use in the event of failure.
      b. Time delay adjustable from 15 seconds to 30 minutes.
      c. High/low sensitivity adjustments.
   5. Cover 360 DEG and hallway and corridor sensors shall cover up to 90 linear feet.
   6. Additional single-pole, double-throw isolated relay with normally open, normally closed, and common outputs rated at 1 amp for 24 VDC.
      a. The isolated relay is for use with HVAC control, data logging and other control options.

D. Power Pack:
   1. Self-contained transformer and relay module.
   2. Dry contacts capable of switching:

a. 20 amp ballast load, 13 amp incandescent, 1 HP at 120 VAC, 60 Hz.
b. 20 amp ballast at 277 VAC, 60 Hz.

3. 24 VDC, 100 mA output.
4. Capable of parallel wiring without regard to AC phases on primary.
5. Used as a standalone, low voltage switch or wired to sensor for auto control.
6. Low voltage Teflon coated leads, rated for 300 V, suitable for use in plenum applications.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Mount devices where indicated on the Drawings and as scheduled in Specification Section 26 05 00.

C. See Specification Section 26 05 33 for device outlet box requirements.

D. Where more than one (1) receptacle is installed in a room, they shall be symmetrically arranged.

E. Provide blank plates for empty outlets.

END OF SECTION

SECTION 26 28 00
OVERCURRENT AND SHORT CIRCUIT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Low voltage circuit breakers.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 26 05 00 - Electrical: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. C37.13, Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures.
      b. C37.16, Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements, and Application Recommendations.
      c. C37.17, Trip Devices for AC and General Purpose DC Low Voltage Power Circuit Breakers.
   2. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   3. Underwriters Laboratories, Inc. (UL):
      a. 489, Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
      b. 943, Standard for Safety for Ground-Fault Circuit-Interrupters.
      c. 1066, Standard for Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Provide submittal data for all products specified in PART 2 of this Specification Section.
      b. See Specification Section 26 05 00 for additional requirements.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

C. Informational Submittals:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Reports:
      a. As-left condition of all circuit breakers that have adjustable settings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Circuit breakers:
      a. Eaton.
      b. General Electric Company.
      c. Square D Company.
      d. Siemens.

2.2 CIRCUIT BREAKERS

A. Molded Case Type:
   1. General:
      a. Standards: UL 489.
      b. Unit construction.
      c. Over-center, toggle handle operated.
      d. Quick-make, quick-break, independent of toggle handle operation.
      e. Manual and automatic operation.
      f. All poles open and close simultaneously.
      g. Three (3) position handle: On, off and tripped.
      h. Molded-in ON and OFF markings on breaker cover.
      i. One-, two- or three-pole as indicated on the Drawings.
      j. Current and interrupting ratings as indicated on the Drawings.
      k. Bolt on type.
   2. Thermal magnetic type:
      a. Inverse time overload and instantaneous short circuit protection by means of a thermal magnetic element.
      b. Frame size 150 amp and below:
         1) Non-interchangeable, non-adjustable thermal magnetic trip units.
      c. Frame sizes 225 to 400 amp (trip settings less than 400A):
         1) Interchangeable and adjustable instantaneous thermal magnetic trip units.
      d. Ground Fault Circuit Interrupter (GFCI) Listed:
         1) Standard: UL 943.
         2) One- or two-pole as indicated on the Drawings.
         3) Class A ground fault circuit.
         4) Trip on 5 mA ground fault (4-6 mA range).
   3. Solid state trip type:
      a. Inverse time overload, instantaneous short circuit and ground fault protection by means of a solid state trip element, associated current monitors and flux shunt trip mechanism.
      b. Frame size 400 amp to 1200 amp (trip settings between 400 and 1200A):
         1) Standard rating.
         2) Interchangeable current sensor or rating plug.
         3) Adjustable long time pick-up setting.
            a) Adjustable from 50 to 100 PCT of the current sensor or rating plug.
         4) Adjustable short time pick-up setting.
         5) Adjustable instantaneous pick-up.
         6) Fixed ground fault pick-up, when indicated on the Drawings.
      c. Frame size 1600 amp and above:
         1) 100 PCT rated.
         2) Interchangeable current sensor or rating plug.
         3) Adjustable long time pick-up setting.
            a) Adjustable from 50 to 100 PCT of the current sensor or rating plug.
         4) Adjustable long time delay setting.
         5) Adjustable short time pick-up setting.
         6) Adjustable instantaneous pick-up setting.

7) Adjustable ground fault pick-up setting, when indicated on the Drawings.
8) Adjustable ground fault delay setting, when indicated on the Drawings.

4. Motor circuit protector:
   a. Adjustable instantaneous short circuit protection by means of a magnetic or solid state trip element.
   b. Sized for the connected motor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Current and interrupting ratings as indicated on the Drawings.

B. Series rated systems not acceptable.

C. Devices shall be ambient temperature compensated.

D. Circuit Breakers:
   1. Molded case circuit breakers shall incorporate the following, unless indicated otherwise on the Drawings:
      a. Frame sizes 400 amp and less with trip setting less than 400A shall be thermal magnetic type.
      b. Frame sizes 450 amp and larger shall be solid state trip type.
      c. Motor circuit protectors sized for the connected motor.

3.2 FIELD QUALITY CONTROL

A. Adjustable Circuit Breakers:
   1. Set all circuit breaker adjustable taps as defined on the Drawings, except adjust motor circuit protectors per the motor nameplate and NFPA 70 requirements.

B. Ground Fault Protection System:
   1. Single source system:
      a. Main breaker using the residual sensing method system coordinated with individual feeder breakers using the residual sensing method.
      b. Main and feeder breakers: Utilize four (4) individual current sensors; the phase sensors are integral to the circuit breaker and the neutral sensor is external to the circuit breaker.

C. Testing:
   1. Test and verify all circuit breakers trip functions as intended.

END OF SECTION

SECTION 26 28 16
SAFETY SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Safety switches.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 26 05 00 - Electrical - Basic Requirements.
   4. Section 26 28 00 - Overcurrent and Short Circuit Protective Devices.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. KS 1, Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).
   2. Underwriters Laboratories, Inc. (UL):
      a. 98, Enclosed and Dead-Front Switches.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data:
      a. Provide submittal data for all products specified in PART 2 of this Specification Section.
      b. Provide a Summary Table or use Exhibit A that associates the safety switch features with connected equipment tag number. Exhibit A indicates minimum data required.
      c. See Specification Section 26 05 00 for additional requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following safety switch manufacturers are acceptable:
   1. Eaton.
   2. General Electric.
   3. Square D by Schneider Electric.
   4. Siemens Corporation.
   5. Appleton by Emerson Electric Co.
   6. Crouse-Hinds by Eaton.
   7. Killark by Hubbell.

2.2 SAFETY SWITCHES

A. General:
   1. Non-fusible or fusible as indicated on the Drawings.
   2. Suitable for service entrance when required.
   3. NEMA Type HD heavy-duty construction.
   4. Switch blades will be fully visible in the OFF position with the enclosure door open.

5. Quick-make/quick-break operating mechanism.
6. Deionizating arc chutes.
7. Manufacture double-break rotary action shaft and switchblade as one common component.
8. Clear line shields to prevent accidental contact with line terminals.
9. Operating handle:
    a. Red and easily recognizable.
    b. Padlockable in the OFF position.
    c. Interlocked to prevent door from opening when the switch is in the ON position with a defeater mechanism.

B. Ratings:
1. Horsepower rated of connected motor.
2. Voltage and amperage: As indicated on the Drawings.
3. Short circuit withstand:
    a. Non-fused: 10,000A.
    b. Fused: 200,000A.

C. Accessories, when indicated in PART 3 of this Specification Section or on the Drawings:
1. Neutral kits.
2. Ground lug kits.
3. Auxiliary contact kits:
    a. Opens before main switch.
    b. Rated 10A at 125/250 VAC.
    c. One N.O. and one N.C. contact.

D. Enclosures:
1. NEMA 4X rated (metallic):
    a. Body and cover: Type 304 or 316 stainless steel.
    b. No knockouts, external mounting flanges, hinged and gasketed door.
2. NEMA 4X rated (nonmetallic):
    a. Body and cover: Ultraviolet light protected fiberglass-reinforced polyester boxes.
    b. No knockouts, external mounting flanges, hinged, gasketed and lockable door.
3. NEMA 12 rated:
    a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
    b. No knockouts, external mounting flanges, hinged and gasketed door.

E. Overcurrent and short circuit protective devices:
1. Fuses.
2. See Specification Section 26 28 00 for overcurrent and short circuit protective device requirements.

F. Standards: NEMA KS 1, UL 98.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install as indicated and in accordance with manufacturer's instructions and recommendations.

B. Install switches adjacent to the equipment they are intended to serve unless otherwise indicated on the Drawings.

C. Provide auxiliary contact kit on local safety switches for motors being controlled by a variable frequency drive.
1. The VFD is to be disabled when the switch is in the open position.

D. Permitted uses of NEMA 4X metallic enclosure:
1. Surface mounted in areas designated as wet and/or corrosive.

E. Permitted uses of NEMA 4X nonmetallic enclosure:
   1. Surface mounted in areas designated as corrosive.
   2. Surface mounted in areas designated as highly corrosive.

F. Permitted uses of NEMA 12 enclosure:
   1. Surface mounted in areas designated as dry in non-architecturally finished areas.

END OF SECTION

SECTION 26 43 13
LOW VOLTAGE SURGE PROTECTION DEVICES (SPD)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Type 1 SPD - High exposure locations (switchboard or panelboard or motor control center), integrally mounted.
   2. Type 2 SPD - High exposure locations (switchboard or panelboard or motor control center), externally mounted.
   3. Type 3 SPD - Medium or low exposure locations at individual equipment locations, external, parallel connection.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
      b. C62.41.1, Guide on the Surge Environment in Low-Voltage (1000V and Less) AC Power Circuits.
      c. C62.41.2, Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.
      d. C62.45, Recommended Practice on Surge Testing For Equipment Connected to Low-Voltage (1000V and Less) AC Power Circuits.
   2. Military Standard:
      a. MIL-STD-220B, Method of Insertion Loss Measurement.
   3. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   4. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   5. Underwriters Laboratories, Inc. (UL):
      a. 1283, Standard for Electromagnetic Interference Filters.
      b. 1449, Standard for Surge Protective Devices.

B. Qualifications:
   1. Provide devices from a manufacturer who has been regularly engaged in the development, design, testing, listing and manufacturing of SPDs of the types and ratings required for a period of 10 years or more and whose products have been in satisfactory use in similar service.
      a. Upon request, suppliers or manufacturers shall provide a list of not less than three customer references showing satisfactory operation.

1.3 DEFINITIONS

A. Clamping Voltage:
   1. The applied surge shall be induced at the 90 DEG phase angle of the applied system frequency voltage.
   2. The voltage measured at the end of the 6 IN output leads of the SPD and from the zero voltage reference to the peak of the surge.

B. Let-Through Voltage:

1. The applied surge shall be induced at the 90 DEG phase angle of the applied system frequency voltage.
2. The voltage measured at the end of the 6 IN output leads of the SPD and from the system peak voltage to the peak of the surge.

C. Maximum Continuous Operating Voltage (MCOV): The maximum steady state voltage at which the SPD device can operate and meet its specification within its rated temperature.

D. Maximum Surge Current:
1. The maximum 8 x 20 microsecond surge current pulse the SPD device is capable of surviving on a single-impulse basis without suffering either performance degradation or more than 10 PCT deviation of clamping voltage at a specified surge current.
2. Listed by mode, since number and type of components in any SPD may very by mode.

E. MCC: Motor Control Center.

F. Protection Modes: This parameter identifies the modes for which the SPD has directly connected protection elements, i.e., line-to-neutral (L-N), line-to-line (L-L), line-to-ground (L-G), neutral-to-ground (N-G).

G. Surge Current per Phase:
1. The per phase rating is the total surge current capacity connected to a given phase conductor.
   a. For example, a wye system surge current per phase would equal L-N plus L-G; a delta system surge current per phase would equal L-L plus L-G.
   b. The N-G mode is not included in the per phase calculation.

H. System Peak Voltage: The electrical equipment supply voltage sine wave peak (i.e., for a 480/277 V system the L-L peak voltage is 679V and the L-N peak voltage is 392 V).

1.4 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Product technical data including:
   a. Manufacturer's qualifications.
   b. Standard catalog cut sheet.
   c. Electrical and mechanical drawing showing unit dimensions, weights, mounting provisions, connection details and layout diagram of the unit.
   d. Testing procedures and testing equipment data.
   e. Create a Product Data Sheet for each different model number of SPD provided (i.e., Model XYZ with disconnect and Model XYZ without disconnect, each require a Product Data Sheet).
      1) Data in the Product Data Sheet heading:
         a) SPD Type Number per PART 2 of the Specification.
         b) Manufacturer’s Name.
         c) Product model number.
      2) Data in the Product Data Sheet body:
         a) Column one: Specified value/feature of every paragraph of PART 2 of the Specification.
         b) Column two: Manufacturer’s certified value confirming the product meets the specified value/feature.
         c) Name of the nationally recognized testing laboratory that preformed the tests.
         d) Warranty information.
      3) Data in the Product Data Sheet closing:
         a) Signature of the manufacturer’s official (printed and signed).
         b) Title of the official.
      4) Date of signature.

B. Operation and Maintenance Manuals:
   1. See Specification Section 01 33 04 for requirements for:
      a. The mechanics and administration of submittal process.
      b. The content of the Operation and Maintenance Manuals.
   2. Warranty.

1.5 WARRANTY

A. Minimum of a five year Warranty from date of shipment against failure when installed in compliance with applicable national/local electrical codes and the manufacturer's installation, operation and maintenance instructions.

PART 2 - PRODUCTS

2.1 GENERAL

A. Standards: IEEE C62.41.1, IEEE C62.41.2, IEEE C62.45, MIL-STD 220B, UL 1283, UL 1449.

2.2 TYPE 1 SPD

A. Product:
   1. Integrally mounted in MCCs.
   2. Hybrid solid-state high performance suppression system.
      a. Do not use a suppression system with gas tubes, spark gaps or other components which might short or crowbar the line resulting in interruption of normal power flow to connected loads.
   3. Do not connect multiple SPD modules in series to achieve the specified performance.
   4. Designed for parallel connection.
   5. Field connection: Use mechanical or compression lugs for each phase, neutral and ground that will accept bus bar or #10 through #1/0 conductors.
   6. Device monitor:
      a. Long-life, solid state, externally visible indicators and Form C dry contact(s) that monitors the on-line status of each mode of the units suppression filter system and power loss in any of the phases.
      b. A fuse status only monitor system is not acceptable.

B. Operating Voltage: The nominal unit operating voltage and configuration as indicated on Drawings.

C. Modes of Protection: All modes.
   1. Three phase (delta): L-L, L-G.
   2. Three phase (wye): L-N, L-L, L-G and N-G.
   3. Single phase (2 pole): L-L, L-N, L-G and N-G.
   4. Single phase: L-N, L-G and N-G.

D. Maximum Continuous Operating Voltage: Less than 130 PCT of system peak voltage.

E. Operating Frequency: 45 to 65 Hz.

F. Short Circuit Rating: Equal to or greater than rating of equipment SPD is connected to.

G. Maximum Surge Current: 240,000 A per phase, 120,000 A per mode minimum.

H. Minimum Repetitive Surge Current Capacity: 4000 IEEE C High waveform impulses with no degradation greater than 10 PCT deviation of the clamping voltage.

I. SPD Protection:
   1. Integral unit level and/or component level overcurrent fuses and sustained overvoltage thermal cutout device.
   2. An IEEE C High waveforms shall not cause the fuse to open and render the SPD inoperable.

J. Maximum Clamping Voltages: Dynamic test at the 90 degree phase angle including 6 IN lead length and measured from the zero voltage reference:

System Voltage	Test Mode	IEEE C62.41		UL 1449
		C High V & I Wave	B Combination Wave	
L-L < 250 V **L-N < 150 V**	L-L	1470 V	1000 V	800 V
	L-N	850 V	600 V	500 V
	L-G	1150 V	800 V	600 V
	N-G	1150 V	800 V	600 V
L-L > 250 V **L-N > 150 V**	L-L	2700 V	2000 V	1800 V
	L-N	1500 V	1150 V	1000 V
	L-G	2000 V	1550 V	1200 V
	N-G	2000 V	1550 V	1200 V

K. EMI-RFI Noise Rejection: Attenuation greater than 30 dB for frequencies between 100 kHz and 100 MHz.

2.3 TYPE 2 SPD

A. Product:
1. Externally mounted next to MCCs.
2. Hybrid solid-state high performance suppression system.
   a. Do not use suppression system with gas tubes, spark gaps or other components which might short or crowbar the line resulting in interruption of normal power flow to connected loads.
3. Do not connect multiple SPD modules in series to achieve the specified performance.
4. Designed for parallel connection.
5. Enclosure:
   a. Metallic NEMA 4 or 12 for interior locations.
   b. Metallic NEMA 4 or 4X for exterior locations.
6. Field connection:
   a. Mechanical or compression lugs for each phase, neutral and ground that will accept #10 through #1/0 conductors. OR
   b. Preinstalled lead conductors: Size per manufacturer, length as required with a maximum of 5 FT.
7. Device monitor:
   a. Long-life, solid state, externally visible indicators and Form C dry contact(s) that monitor the on-line status of each mode of the units suppression filter system or power loss in any of the phase.
   b. A fuse status only monitor system is not acceptable.
8. Accessories (when specifically specified): Unit mounted disconnect switch.

B. Operating Voltage: Nominal unit operating voltage and configuration as indicated on the Drawings.

C. Modes of Protection: All modes.
1. Three phase (delta): L-L, L-G.
2. Three phase (wye): L-N, L-L, L-G and N-G.
3. Single phase (2 pole): L-L, L-N, L-G and N-G.
4. Single phase: L-N, L-G and N-G.

D. Maximum Continuous Operating Voltage: Less than 130 PCT of system peak voltage.

E. Operating Frequency: 45 to 65 Hz.

F. Short Circuit Rating: Equal to or greater than rating of equipment SPD is connected to.

G. Maximum Surge Current: 240,000 A per phase, 120,000 A per mode minimum.

H. Minimum Repetitive Surge Current Capacity: 4000 IEEE C High waveform impulses with no degradation of more than 10 PCT deviation of the clamping voltage.

I. SPD Protection:
   1. Integral unit level and/or component level overcurrent fuses and sustained overvoltage thermal cutout device.
   2. An IEEE C High waveforms shall not cause the fuse to open and render the SPD inoperable.

J. Maximum Clamping Voltages: Dynamic test at the 90 DEG phase angle including 6 IN lead length and measured from the zero voltage reference:

System Voltage	Test Mode	IEEE C62.41		UL 1449
		C High V & I Wave	B Combination Wave	
L-L < 250 V **L-N < 150 V**	L-L	1470 V	1000 V	800 V
	L-N	850 V	600 V	500 V
	L-G	1150 V	800 V	600 V
	N-G	1150 V	800 V	600 V
L-L > 250 V **L-N > 150 V**	L-L	2700 V	2000 V	1800 V
	L-N	1500 V	1150 V	1000 V
	L-G	2000 V	1550 V	1200 V
	N-G	2000 V	1550 V	1200 V

K. EMI-RFI Noise Rejection: Attenuation greater than 30 dB for frequencies between 100 kHz and 100 MHz.

2.4 TYPE 3 SPD

A. Product:
   1. Externally mounted next to equipment or internally to control panel for point-of-use loads.
   2. Hybrid solid state high performance suppression system.
      a. Do not use gas tubes, spark gaps or other suppression system components which might short or crowbar the line resulting in interruption of normal power flow to connected loads.
   3. Designed for parallel connection.
   4. Enclosure:
      a. Metallic NEMA 4 or 12 for interior locations.
      b. Metallic NEMA 4 or 4X for exterior locations.
   5. Field connection:
      a. Mechanical or compression lugs for each phase, neutral and ground that will accept #10 through #1/0 conductors. OR
      b. Preinstalled lead conductors: Size per manufacturer, length as required with a maximum of 2 FT.
   6. Device monitor:
      a. Long-life, solid state, externally visible indicators and Form C dry contact(s) that monitor the on-line status of each mode of the units suppression filter system or power loss in any of the phase.
      b. A fuse status only monitor system is not acceptable.

7. Accessories (when specifically specified): Unit mounted disconnect switch.

B. Operating Voltage: Nominal unit operating voltage and configuration as indicated on the Drawings.

C. Modes of Protection: All modes.
   1. Three phase (delta): L-L, L-G.
   2. Three phase (wye): L-N, L-L, L-G and N-G.
   3. Single phase (2 pole): L-L, L-N, L-G and N-G.
   4. Single phase: L-N, L-G and N-G.

D. Maximum Continuous Operating Voltage: Less than 130 PCT of system peak voltage.

E. Operating Frequency: 45 to 65 Hz.

F. Short Circuit Rating: Equal to or greater than rating of equipment SPD is connected to.

G. Maximum Surge Current: 120,000 A per phase, 60,000 A per mode minimum.

H. Minimum Repetitive Surge Current Capacity: 4000 IEEE C High or B combination waveform impulses with no degradation of more than 10 PCT deviation of the clamping voltage.

I. SPD Protection:
   1. Integral unit level and/or component level overcurrent fuses and sustained overvoltage thermal cutout device.
   2. An IEEE B combination wave shall not cause the fuse to open and render the SPD inoperable.

J. Maximum Clamping Voltages: Dynamic test at the 90 DEG phase angle including 6 IN lead length and measured from the zero voltage reference:

System Voltage	Test Mode	IEEE C62.41		UL 1449
		B Comb. Wave	B Ring Wave	
L-L < 250 V **L-N < 150 V**	L-L	1000 V	700 V	800 V
	L-N	600 V	400 V	500 V
	L-G	800 V	550 V	600 V
	N-G	800 V	550 V	600 V
L-L > 250 V **L-N > 150 V**	L-L	2000 V	1400 V	1800 V
	L-N	1150 V	8000 V	1000 V
	L-G	1550 V	1000 V	1200 V
	N-G	1550 V	1000 V	1200 V

K. EMI-RFI Noise Rejection: Attenuation greater than 30 dB for frequencies between 100 kHz and 100 MHz.

2.5 SOURCE QUALITY CONTROL

A. SPD approvals and ratings shall be obtained by manufacturers from nationally recognized testing laboratories.

B. The SPD are to be tested as a complete SPD system including:
   1. Integral unit level and/or component level fusing.
   2. Neutral and ground shall not be bonded during testing.
   3. 6 IN lead lengths.
   4. Integral disconnect switch when provided.

C. The “as installed” SPD system including the manufacturers recommended circuit breaker, the SPD is connected to, will not open when tested with a IEEE C3 combination waveform.

D. Tests to be performed in accordance with IEEE C62.45:
   1. Clamping voltage performance testing using IEEE C62.41 Category waveforms.
   2. Single pulse surge current capacity test.
   3. Repetitive surge current capacity testing.
   4. Spectrum analysis for EMI-RFI noise rejection.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Type 1 SPD:
   1. Connected in parallel to the equipment.
   2. Install in dedicated electrical equipment compartment, bucket or panelboard box at the factory before shipment.
   3. Provide leads that are as short and straight as possible.
   4. Maximum lead length: 12 IN.
   5. Minimum lead size: #2 stranded AWG or bus bar.
   6. Connect leads to the equipment to be protected by one of the following means:
      a. Through a circuit breaker or molded case switch mounted in the equipment.
      b. Use manufacturer recommended circuit breaker size.
      c. Circuit breaker or switch to be operable from the equipment exterior or from behind a hinged door.

C. Type 2 and 3 SPD:
   1. Mounting options:
      a. On wall or support structure adjacent to the equipment to be protected with leads routed through conduit. OR
      b. Nipple connection directly to the equipment to be protected.
   2. Install leads as short and straight as possible.
   3. Maximum lead length: 5 FT.
   4. Minimum lead size:
      a. Type 2 SPD: #2 stranded AWG.
      b. Type 3 SPD: #10 stranded AWG.
   5. When conduit connection is used, provide a minimum of four twists per foot in the lead conductors and install in NFPA 70 sized conduit.
   6. Connect leads to the equipment to be protected by one of the following means:
      a. Through a circuit breaker or molded case switch mounted in the equipment.
         1) Use manufacturer recommended circuit breaker size.
      b. Directly to the protected equipment bus, when SPD has integral disconnect switch.
      c. To the load side of field mounted equipment’s local disconnect switch.
         1) Provide taps or lugs as required to provide a UL and NFPA 70 compliant connection.

END OF SECTION

SECTION 26 50 00
INTERIOR AND EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Material and installation requirements for:
      a. Interior building and exterior building mounted luminaires.
      b. Exterior and site luminaires.
      c. Lamps and LEDs.
      d. Lighting control.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Division 03 - Concrete.
   4. Section 26 05 00 - Electrical - Basic Requirements.
   5. Section 26 05 19 - Wire and Cable - 600 Volt and Below.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI):
      a. C78.377, Specification for the Chromaticity of Solid-State Lighting Products.
   2. Federal Communications Commission (FCC):
      a. Code of Federal Regulations (CFR), 47 CFR 18, Industrial, Scientific and Medical Equipment.
   3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
   4. Illuminating Engineering Society of North America (IESNA):
      a. LM-79, Electrical and Photometric Measurements of Solid-State Lighting Products.
      b. LM-80, Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules.
   5. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. 410, Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts.
      c. LE 4, Recessed Luminaires, Ceiling Compatibility.
   6. National Electrical Manufacturers Association/American National Standards Institute (NEMA/ANSI):
      a. SSL 1, Electronic Drivers for LED Devices, Arrays or Systems.
   7. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
      b. 101, Life Safety Code.
   8. Underwriters Laboratories, Inc. (UL):
      a. 248-4, Low-Voltage Fuses - Part 4: Class CC Fuses.
      b. 844, Standard for Luminaires for Use in Hazardous (Classified) Locations.
      c. 924, Standard for Emergency Lighting and Power Equipment.
      d. 1012, Power Units Other Than Class 2.
      e. 1310, Standard for Class 2 Power Units.
      f. 1598, Luminaires.
      g. 8750, Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products.
   9. United States Department of Energy (USDOE):

a. EPAct, the National Energy Policy Act.

1.3 DEFINITIONS

A. Useful Life for LED luminaire light sources:
   1. The operating hours before reaching 70 PCT of the initial rated lumen output (L70) with no catastrophic failures under normal operating conditions.
   2. This is also known as 70 PCT "Rated Lumen Maintenance Life" as defined in IESNA LM-80.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data:
      a. Provide submittal data for all products specified in PART 2 of this Specification Section.
      b. Identify luminaire by Luminaire Schedule designation.
      c. Luminaire data sheet:
         1) Name of manufacturer.
         2) Complete order information (catalog number).
         3) Description of construction and optics.
         4) Total input wattage.
         5) Luminous efficacy (lumens/Watt).
         6) Photometric performance data including candlepower distribution and coefficient of utilization (CU) table.
         7) Dimensional size.
         8) Weight.
         9) UL nameplate data for luminaires used in Class 1, Division 1 and 2 areas.
         10) Effective Projected Areas (EPA) for pole mounted luminaires.
      d. Solid state Luminaire additional data:
         1) Voltage.
         2) Initial and IES L70 lumens.
         3) Luminous efficacy (lumens/Watt).
         4) Correlated Color Temperature (CCT).
         5) Color Rendering Index (CRI).
         6) Total Harmonic Distortion (THD).
         7) Lamp life.
         8) Driver manufacturer and model number.
         9) Driver life.
         10) Driver type (0-10V, constant voltage, constant current).
         11) Dimming range and control device compatibility.
         12) Remote driver: Maximum wire length to luminaire.
         13) Emergency battery driver:
            a) Compatibility with lighting module.
            b) Lumen output of lighting module in emergency operation.
            c) Battery life.
            d) Description of testing.
            e) Ambient operating temperature.
         14) Toxicity Characteristic Leaching Procedure (TCLP) compliance.
         15) DesignLights Consortium (DLC) Listing.
         16) Warranty information.
      e. Luminaire lamp data sheet:
         1) Name of manufacturer.
         2) Complete order information (catalog number).
         3) Wattage.
         4) Initial and mean lumens.

5) Luminous efficacy (lumens/Watt).
6) Correlated Color Temperature (CCT).
7) Color Rendering Index (CRI).
8) Lamp life.
9) Base configuration.
10) Toxicity Characteristic Leaching Procedure (TCLP) compliance.
11) Warranty information.

3. Test Reports:
   a. IESNA LM-79 Test Report for Solid-State Luminaire.
   b. IESNA LM-80 Test Report Solid-State Light Source.
4. Certifications: Solid-state Luminaire Useful Life Certificate.

B. Contract Closeout Information:
1. Operation and Maintenance Data:
   a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
   b. Submittal data for each component covered by warranty.
   c. Warranty.

1.5 WARRANTY

A. Minimum of a five-year Warranty from date of manufacture against failure for solid-state luminaire including LED arrays, LED drivers and integral control devices. The solid-state product is considered defective if more than 15 PCT of the individual light emitting diodes fail to illuminate.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Luminaires: Per Luminaire Schedule or equal.
2. Lamps:
   a. General Electric.
   b. Osram Sylvania.
   c. Philips Lighting Company.
   d. Venture Lighting.
3. Solid State Light Sources:
   a. Cree.
   b. Xicato.
   c. Luminaire manufacturer’s proprietary system.
4. LED Driver: Luminaire manufacturer's standard.
5. Emergency ballasts:
   a. Iota Engineering.
   b. Philips Bodine.
6. Emergency transfer devices: Philips Bodine.
7. Poles: Luminaire manufacturer's standard.

2.2 GENERAL REQUIREMENTS

A. Luminaires complete with lamps and ballasts or LED modules and drivers.

B. Provide all recessed luminaires with gaskets of rubber, fiberglass, or equivalent material to prevent light leaks around flush trim.
1. Provide recessed luminaires with trim gaskets cemented in proper position.

C. Provide standard plaster frame for all recessed luminaires installed in plaster walls or ceilings.
1. Design, finish and fabricate material to preclude possibility of rust stain in plaster.

D. Coordinate luminaire mounting where recessed into building canopies prior to Submitting Shop Drawings. Confirm clearances and luminaire flange compatibility with construction.

E. Electrical components of recessed luminaires shall be accessible and removable through luminaire without having to remove luminaire from ceiling.

F. No live parts normally exposed to contact.

G. When intended for use in wet areas: Mark luminaire "Suitable for wet locations."

H. When intended for use in damp areas: Mark luminaire "Suitable for damp locations" or "Suitable for wet locations."

2.3 LUMINAIRES

A. Standards and Listings:
   1. DesignLights Consortium (DLC).
   2. UL 1598.
   3. UL 844 for hazardous locations.
   4. NEMA LE 4 for recessed locations.

B. Housings:
   1. As indicated in the Luminaire Schedule:

C. Castings:
   1. As indicated in the Luminaire Schedule and the following:
      a. Uniform quality, free from imperfections affecting strength and appearance.
      b. Exterior surfaces, if not receiving a finish coat, shall be smooth and match adjacent surfaces. At least one coat of clear methacrylate lacquer shall be applied unless a painted finish is specified.

D. Fasteners:
   1. As indicated in the Luminaire Schedule and the following:
      a. Aluminum or steel luminaires: Cadmium-plated or an equivalent.
      b. Stainless steel luminaires: Stainless steel.
      c. Bronze luminaires: Bronze or stainless steel.
      d. Non-metallic luminaires: Stainless steel.

E. Finishes:
   1. As indicated in the Luminaire Schedule and the following:
      a. Painted surfaces:
         1) Manufacturer's standard metal pretreatment and baked or air-dried, light-stabilized enamel finish; acrylic, alkyd, epoxy, polyester, or polyurethane.
         2) White finishes shall have minimum 85 PCT reflectance.
      b. Unpainted surfaces:
         1) Interior: Clear anodic coating, satin finish.
         2) Exterior: Clear anodic coating.

F. Lens/Louver Frames:
   1. As indicated in the Luminaire Schedule and the following:
      a. Extruded aluminum with mitered corners.
      b. Hinging or other normal motion shall not cause lens or louver to drop out.
      c. No light leak between frame and housing.

G. Lenses:
   1. As Indicated in the Luminaire Schedule and the Following:
      a. 100 PCT virgin, UV stabilized acrylic.
      b. Held securely in place but must also be removable for cleaning and relamping.
      c. Luminaires with directional lenses shall include a lens orientation device to ensure that lens installation provides light distribution as designed.
      d. No light leaks between the lens and the luminaire.

H. Reflectors:
   1. As Indicated in the Luminaire Schedule and the Following:
      a. Down Light Reflector and Baffle Finishes: First-quality "Alzak" anodized specular finish.
      b. Troffer reflector finish: Integral reflectors shall be painted white after fabrication with a minimum reflectance value of 90 PCT.

I. Gaskets:
   1. As Indicated in the Luminaire Schedule and the Following:
      a. Gaskets at face plates or frames of recessed luminaires which serve as ceiling trim and which allow interior access.
      b. Moisture seal gaskets at exterior locations and in other designated wet areas.
      c. Secure frames to luminaire bodies with screws or other means, to result in tight installation, without light leaks.

J. Ventilation:
   1. Ventilation openings of adequate size and quantity to permit operation of lamps and ballast without affecting rated output or life expectancy. Include wire mesh screens.

K. Lamp Holders:
   1. Position sockets so that lamps are in optically correct relation to luminaire components.
   2. Secure sockets by screws to luminaire enclosure or husk. Spring mounted sockets are not approved. Do not use plastic or sheet metal sockets unless specified otherwise.
   3. Sockets with open circuit voltage over 300 volts: Safety type, designed to open supply circuit upon lamp removal.
   4. Mount lamp holders such that fluorescent lamps on rapid-start circuits are within 1 IN of grounded metal, a minimum of 1IN wide for full length of lamp.
   5. Halogen: Porcelain body; nickel plated brass socket, pre-lubricated with silicone compound.

L. Wiring:
   1. Factory-wired to be compatible with the project electrical and controls systems.

M. Mounting Accessories:
   1. Provide appropriate mounting accessories for each luminaire, compatible with various structural conditions encountered.
   2. All luminaires with adjustable beam angles shall have a locking device to ensure that the beam distribution is not effected during relamping or cleaning.
   3. Recessed Luminaires:
      a. Plaster Frames: Provide frames for luminaires installed in gypsum board and concealed suspension system ceiling tile. Make frames of non-ferrous metal or suitably rustproof after fabrication.
      b. Baffles and Gaskets: As required to prevent light leakage.
      c. Flanged luminaires are required in all ceiling systems except exposed grid lay-in panel type.
   4. Luminaire Suspension Material:
      a. Unfinished Spaces:
         1) 1/2 IN minimum diameter swivel stem, unless otherwise noted.
         2) Safety chain on high bay type.
      b. Finished Spaces: Unless otherwise noted.
         1) Manufactured cable or stem and outlet box canopy.
            a) Contemporary design with swivel self-aligning features.
            b) Size canopy to cover outlet box, minimize size of canopy not associated with outlet box.
            c) Finish to match luminaire.
         2) Coordinate pendant location with ceiling tiles/ceiling grid.
            a) Submit coordinated mounting accessories as part of Shop Drawing submission.

3) Luminaires mounted on suspended ceiling grids should be provided with outlet box designed for grid mounting with direct cord entry and supported by outlet box.

2.4 SOLID-STATE LUMINAIRES - ADDITIONAL REQUIREMENTS

A. Standards:
   1. IESNA LM-79, IESNA LM-80.
   2. NEMA SSL 1.
   3. UL 1012, 1310, and 8750.
   4. UL 844 for hazardous locations.

B. Solid state modules and driver to be provided and warrantied by luminaire manufacturer.

C. Solid-State Modules:
   1. Uniform color temperature of 4000K unless otherwise noted on the Luminaire schedule.
      a. Color temperature measurement shall have a maximum 3 SDCM on the MacAdam Ellipse for frosted lensed luminaires, and 2 SDCM for other luminaire types (ANSI C78.377).
   2. Minimum color rendering index (CRI) of 80.
   3. LED module light output and efficacy: Measured in accordance with IESNA LM-79 standards.
   4. LED useful life and lumen maintenance: Measured in accordance with IESNA LM-80 standards.
   5. Driver and LED module: Minimum useful life of 50,000 HRS (L70).
   6. Individual LEDs connected such that a failure of one LED will not result in a light output loss of the entire luminaire.

D. Driver:
   1. Compatible with solid-state modules and control devices specified.
   2. Operate from 60 Hz input source of 120V through 277V with sustained variations of ±10 PCT (voltage and frequency).
   3. Input current Total Harmonic Distortion (THD): Less than 20 PCT when operated at nominal line voltage.
   4. Power Factor: Greater than 0.90.
   5. Avoid interference with infrared devices and eliminate visible flicker.
   6. Comply with ANSI C62.41 Category A for Transient protection.
   7. Comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).
   8. Dimmable drivers capable of continuous dimming over a range of 100 PCT to 1 PCT of rated lumen output. Dimming controlled by a 0 - 10 VDC signal, unless otherwise specified in Luminaire Schedule.
   9. Control device must be compatible with type of driver, and coordinated prior to submission of Shop Drawings. List of compatible dimming controllers must include the range of perceived brightness. No visible flicker throughout the dimming range.
   10. Remote-mounting:
      a. Provide maximum allowable distances for secondary wire runs to luminaires.
      b. Provide remote mounting hardware and enclosures as required.
   11. Operating temperature range must be suitable for site temperature conditions within exterior and gasketed luminaires.

E. Emergency Battery Driver:
   1. UL 924.
   2. Confirm compatibility with LED modules utilized.
   3. Consist of a high temperature, maintenance-free nickel cadmium battery, charger and electronic circuitry.
   4. A solid state charging indicator light to monitor the charger and battery.
   5. Single-pole test switch.
   6. The following product family shall be selected based on coordination with LED lamp type:

a. Philips Bodine “BSL23C”: can operate up to 4.5W at 410mA.
b. Philips Bodine “BSL26C”: can operate up to 5.1W at 265mA.
c. Philips Bodine “BSL722 IN: can operate up to 23W at 770mA.
d. Philips Bodine “BSL23C”: can operate up to 23W at 770mA in operating conditions ranging from -20 DEGC (-4 DEGF) to 60 DEGC (140 DEGF).
e. Alternate manufacturer: Iota.

F. Luminaire properly heat-sinked to assure LED junction temperature ratings are not exceeded.
1. Provide ambient operating temperature range for which product is warrantied.

2.5 EXIT SIGNS AND EMERGENCY LIGHTING UNITS

A. Standards:
1. UL 924.
2. NFPA 101.
3. Local State or City requirements.

B. Exit Signs:
1. Housing and finish: As indicated in the Luminaire Schedule.
2. LED illuminated with integral driver.
3. AC powered or AC and battery powered: As indicated in the Luminaire Schedule.
4. Battery powered units:
a. Battery type: As indicated in the Luminaire Schedule.
b. Self-testing/self-diagnostic.
1) Electronic circuitry automatically test emergency lighting for a minimum of 30 seconds every 30 days and 90 minutes once a year.
c. Consist of batter, charger and electronic circuitry.
d. Solid state charging indicator light to monitor the charger and battery.
e. Single-pole test switch.
f. A user selectable audible alarm. The alarm shall be engaged unless noted otherwise on the Drawings.

C. Emergency Lighting Units:
1. Housing: As indicated in the Luminaire Schedule.
2. Lamps: As indicated in the Luminaire Schedule.
3. Battery type: As indicated in the Luminaire Schedule.
4. Self-testing/self-diagnostic.
a. Electronic circuitry automatically test emergency lighting for a minimum of 30 seconds every 30 days and 90 minutes once a year.
5. Consist of batter, charger and electronic circuitry.
6. Solid state charging indicator light to monitor the charger and battery.
7. Single-pole test switch.
8. A user selectable audible alarm. The alarm shall be engaged unless noted otherwise on the Drawings.

D. Emergency Circuit Transfer Device:
1. Transfer device permits emergency lights to be switched under normal conditions and automatically transfers to unswitched emergency circuit upon power interruption.
2. Multiple luminaire switching:
a. Up to 20A.
b. Mounting as indicated on the Drawings.
c. Acceptable product family:
1) Philips Bodine GTD20A or equal.
3. Individual luminaire switching:
a. Mount on top of luminaire or in ballast channel.
b. Acceptable product family:
1) Philips Bodine GTD or equal.

E. Furnish a minimum of 2 or 10 PCT of total of each type and wattage of lamps, whichever is greater.

F. Furnish a minimum of 10 PCT of total of each type and amperage of fuses for fixtures indicated to be fused.

G. Spare parts are to be stored in a box clearly labeled as to its contents.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate Luminaire Types with Ceiling Construction:
   1. Provide mounting hardware for the ceiling system in which the luminaire is to be installed.

B. Fasten luminaires supported by suspended ceiling systems to ceiling framing system with hold down clips.

C. Provide mounting brackets and/or structural mounting support for wall-mounted luminaires.
   1. Do not support luminaire from conduit system.
   2. When luminaire is supported from outlet boxes, install per NFPA 70.
   3. Supports for luminaire mounted on exterior walls shall not be attached to exterior face of the wall.

D. Support surface mounted luminaires from the building structure and not from the ceiling suspension system.
   1. Luminaires up to 4 FT wide and 4 FT long: A minimum of four supporting points, one at each corner.
   2. Luminaires smaller than 2 FT in length: A minimum of two supporting points.

E. Provide pendant luminaires with swivel hangers which will allow luminaire to swing in any direction but will not permit stem to rotate.
   1. Provide hangers with enclosure rating (NEMA 1, 4, or 7) equal to enclosure requirements of area in which they are installed.
   2. Swivel hangers for luminaires in mechanical equipment areas: Shock absorbing type.
   3. Secure low and high bay luminaires with safety chain or safety aircraft cable to the building structure.
      a. Chain or cable to prevent luminaire from falling more than 3 IN before the luminaire is caught by the chain or cable.

F. Locate luminaire in exact center of ceiling tile unless otherwise indicated.
   1. Relocate mis-installed luminaire and replace damaged ceiling materials.

G. Mount luminaire at heights indicated in Specification Section 26 05 00 or per Luminaire Schedule or as indicted on the Drawings.

H. Install exterior luminaires so that water cannot enter or accumulate in the wiring compartment.

I. Ground luminaire.

3.2 LIGHTING CONTROL

A. Exterior wall mounted and interior fixtures controlled as detailed on the Drawings.

3.3 ADJUST AND CLEAN

A. Replace all inoperable lamps with new lamps prior to final acceptance.

B. Aim all emergency lighting units, so that, the path of egress is illuminated.

END OF SECTION

SECTION 26 51 13
BUILDING LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish labor, materials, tools, equipment, and services for Building Lighting, as indicated, in accordance with provisions of Contract Documents.

B. Section includes interior luminaires and accessories, lamps, ballasts and drivers.

C. Completely coordinate with work of other trades.

1.2 QUALITY ASSURANCE

A. Where groups of luminaire types on Lighting Equipment Schedule exhibit same manufacturers, final installation shall consist of same manufacturer's equipment across groupings as specified for consistency of optics, color of light, finishes, aesthetics and similarity of maintenance procedures.
   1. Mixing/matching across groups is unacceptable except where specified.
   2. Mixing/matching across multi-phased projects is unacceptable, except where products have subsequently been discontinued or significantly redesigned in size, appearance, lamping or gear.
   3. See Lighting Equipment Schedule for additional information.

B. Advise Architect of discrepancies between luminaire catalog references shown or specified and actual ceiling construction, prior to submission of shop drawings.
   1. Failure to do so will require correction at no additional cost.

C. Coordinate ballasts/drivers used with lamping/LED modules, lamp sockets, and control devices prior to submitting shop drawings.

D. Each luminaire shall be listed with nationally recognized testing laboratory including but not limited to, UL, CSA, ETL, under UL 1598 and UL 8750, or an equivalent standard from recognized testing laboratory, and manufactured in accordance with NEC.

E. Lamps and ballasts shall comply with U.S. Federal Efficiency laws and TCLP compliance Standards.

F. Materials and installations shall be in accordance with latest revision of National Electrical Code and any applicable Federal, State and local codes and regulations.

G. Luminaires shall comply with relevant and current ANSI, CBM, ESTA, FCC, IEC, IEEE, IESNA, NEMA, NFPA, and UL standards and practices.

H. American National Standards Institute (ANSI):
   1. ANSI C62.41.2 IEEE Recommended Practice on Characterization of Surges in Low Voltage (1000 V and less) AC Power Circuits.
   2. ANSI C78.377: Specifications for the Chromaticity of Solid-State Lighting Products.
   3. ANSI C82.77: Harmonic Emission Limits - Related Power Quality Requirements for Lighting Equipment.
   4. ANSI/IES RP-16-10: Nomenclature and Definitions for Illuminating Engineering.

I. Federal Communications Commission (FCC):
   1. Code of Federal Regulations (CFR), Title 47, Part 18, Industrial, Scientific, and Medical Equipment.
   2. Code of Federal Regulations (CFR), Title 47, Part 15 Class B: Radio Frequency Devices, Commercial Rated.

J. International Electrotechnical Commission (IEC):

1. IEC 61000-3-2: Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)
2. IEC 61347-1: General and Safety Requirements for Lamp Control Gear.
3. IEC 61347-2-13: Particular Requirements for DC or AC. Supplied Electronic Control gear for LED Modules.
4. IEC 61547: Equipment for general lighting purposes - EMC Immunity Requirements.
5. IEC 62384: DC or AC Supplied Electronic Control Gear for LED Modules - Performance Requirements.

K. Institute of Electrical and Electronic Engineers (IEEE):
1. IEEE C62.41-91: Recommended Practice on Surge Voltage in Low Voltage AC Power Circuits.

L. Illuminating Engineering Society of North America (IESNA):
1. IES LM-15: IESNA Guide for Reporting General Lighting Equipment Engineering Data for Indoor Luminaires.
2. IES LM-28: IES Guide for the Selection, Care and Use of Electrical Instruments in the Photometric Laboratory.
3. IES LM-54: Guide to Lamp Seasoning.
4. IES LM-63: ANSI Approved Standard File Format for Electronic Transfer of Photometric Data and Related Information.
5. IES LM-64: Photometric Measurements of Parking Areas.
6. IES LM-72: Directional Positioning of Photometric Data.
7. IES LM-79: Electrical and Photometric Measurements of Solid-State Lighting Products.
8. IES LM-80: Measuring Lumen Maintenance of LED Light Sources.
9. IES LM-82: Characterization of LED Light Engines and LED Lamps for Electrical and Photometric Properties as a Function of Temperature.
10. IES LM-84: Measuring Luminous Flux and Color Maintenance of LED Lamps, Light Engines and Luminaires.
11. IES LM-85: Electrical and Photometric Measurements of High-Powered LEDs.
12. IES TM-21: Projecting Long Term Lumen Maintenance of LED Light Sources.
13. IES TM-30: IES Method for Evaluating Light Source Color Rendition.

M. National Electrical Manufacturer's Association (NEMA):
1. NEMA SSL1: Electronic Drivers for LED Devices, Arrays, or Systems.
2. NEMA SSL3: High-Power White LED Binning for General Illumination.
3. NEMA SSL7A: Phase Cut Dimming for Solid State Lighting: Basic Compatibility.
4. NEMA 410: Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts.

N. National Fire Protection Association (NFPA):
1. NFPA 70: National Electrical Code (NEC)
2. NFPA 101: Life Safety Code.

O. UL International (UL):
1. UL 1310 Standard for Class 2 Power Units.
2. UL 8750 Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products.

1.3 SUBMITTALS

A. Shop Drawings:
1. For continuous pattern luminaires, indicate layout, individual section lengths, and lamp/LED module quantities.
   a. Show details of connections, emergency ballast/driver and lamp/module placement, corners and extensions, end plates, and mounting. Include pendant or bracket locations and show remote transformers/ballasts/drivers.
   b. Provide field-measured overall dimensions in wall-to-wall and wall-to-corner applications.

2. Details of special construction, accessories, and finishes.

B. Product Data:
   1. Submit product data for fixtures indicated on Electrical Drawings, Specifications and Schedules.
   2. Identify luminaires by Lighting Equipment Schedule designation.
      a. For each luminaire, provide cut sheets indicating following information:
         1) Name of manufacturer, model, and complete catalog number.
            a) Include product data details for catalog number references to explain special construction, accessory or finish, and photometric data.
         2) Photometric Data:
            a) Collected by an independent testing laboratory.
            b) Indicate optical performance developed using methods of Illuminating Engineering Society of North America (IESNA) as follows:
               (1) Coefficients of utilization.
               (2) Candlepower data presented graphically and numerically, in maximum 10 degree increments.
               (3) Develop data for up and down quadrants that are normal, parallel, and at 45 DEG to lamp if light output is asymmetric.
               (4) Zonal lumens stated numerically in 10 degree increments as above.
               (5) Fixture efficiency.
   3. Solid state Luminaires:
      a. LED Luminaires:
         1) Total input wattage.
         2) Luminaire voltage.
         3) Delivered lumens.
         4) Color temperature, color rendering index (CRI), and individual R-values, measured in accordance with IESNA standards.
         5) Rated life measured in accordance with IESNA standards.
         6) Total harmonic distortion (THD).
         7) Submit in tabular format the characteristics of submitted fixture per the technical information categories of the Lighting Equipment Schedule. Deviations from specified criteria shall be identified by a plus or minus percentage.
         8) Submit the rated lumen maintenance life of LED luminaires. Life shall be reported based upon the light source's L70 rating.
      b. LED Drivers:
         1) Driver manufacturer and model number.
         2) Driver rated life.
         3) Driver dimensions.
         4) Driver type (0-10V, constant voltage, constant current).
         5) If applicable, include lumen management protocols.
         6) Dimming range and control device compatibility list.
         7) Wiring Diagrams – as needed for special operation or interaction with other systems.
   4. Coordinate ballasts/drivers used with lamping/LED modules, lamp sockets, and control devices prior to submitting Shop Drawings.
   5. Upon request, provide calculations performed in AGI32 IN specific spaces as identified by Architect for submitted optional manufacturers or substitutions.
   6. Coordinate luminaires with ceiling construction.
      a. Confirm clearances and fixture flange compatibility with construction.

C. Project Information:
   1. Manufacturer's installation instructions.

D. Contract Closeout Information:
   1. Warranties.
   2. Inventory of driver/module replacement stocks.

3. At time of Substantial Completion as defined by the Architect, submit all installation and maintenance tools received from various luminaire vendors clearly and permanently tagged with Manufacturer's name and relevant luminaire type(s) to the Owner's Representative.
4. Maintenance and Operating Manuals.
    a. See Section 01 78 23.

E. Review of shop drawings and product data does not waive the Contractor of their obligations.

1.4 WARRANTIES

A. Manufacturer's Warranty shall be from date of Substantial Completion.
1. Include labor allowance for full cost of component replacement.
2. Provide warranties, as specified, for the following equipment:
    a. Finish.
    b. Lenses.
    c. Housings.
    d. Transformers.
    e. LED Drivers.
    f. LED Luminaires.

B. Warrant LED drivers for a minimum of five years from Date of Substantial Completion.
1. Include labor allowance for full cost of driver installation.

C. Warrant the luminaire and all of its components (except the ballast/transformer/driver) to be free from defect in operation or finish for a minimum of five years from the date of Date of Substantial Completion.
1. Warrant LED modules during this period for color and lumen maintenance (percent shift +/- degrees Kelvin).
2. As long as luminaire has been operated within the rated voltage range, Contractor is responsible for cost of materials and labor necessary to repair or replace luminaire.

D. It is the responsibility of the Contractor to manage warranty issues that may arise.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Luminaires:
1. Base:
    a. As indicated on Lighting Equipment Schedule.
2. Optional:
    a. As indicated on Lighting Equipment Schedule.
3. Use catalog numbers listed as a guide only. Follow modifications and other requirements shown or specified.

B. Lamps/LED Modules:
1. GE Lighting.
2. Osram Sylvania.
3. Philips Lighting.
4. Cree (LED only).
5. Soraa (LED only)
6. Xicato (LED only).

C. Drivers:
1. Osram Sylvania.
2. Philips Advance.
3. Mean Well.
4. eldoLED.
5. Hatch.
6. Lutron.

D. Other manufacturers desiring approval comply with Section 01 61 00.

2.2 MATERIALS

A. Luminaires:
1. Resistant to corrosion and thermal and mechanical stresses encountered in normal application. Provide accessory equipment such as starters, sockets and lamp holders, approved by UL and ETL, unless otherwise noted.
2. Electrical components of recessed luminaires shall be accessible and removable through luminaire without having to remove luminaire from ceiling.
3. Housings:
   a. Troffer luminaires: Minimum 22 GA 0.76 MM sheet steel; integral end plates and trim flanges to suit ceiling construction. Provide wire way covers with captive retainers to allow access to electrical components without use of tools.
   b. Downlight luminaires: Minimum 22 GA 0.76 MM sheet steel, or minimum 0.0508 IN sheet aluminum, unless noted otherwise. Provide auxiliary junction box secured to mounting frame.
   c. Extruded aluminum housings, where scheduled, shall be at least 1/8 IN thick.
   d. Punch and form housings prior to finishing (post-paint).
   e. Ballast/driver surface shall be in complete contact with housing, having the mounting method designed for efficient conduction of ballast heat.
4. Trim:
   a. For square and rectangular luminaires, miter and continuously weld corners. Miter perimeter inverted T-Bar angles at corners. Do not butt or overlap squared ends. Finish joints smooth.
5. Castings:
   a. Uniform quality, free from imperfections affecting strength and appearance. Exterior surfaces, if not receiving a finish coat, shall be smooth and match adjacent surfaces. At least one coat of clear methacrylate lacquer shall be applied unless a painted finish is specified.
6. Fasteners:
   a. For aluminum or steel luminaires, fastening hardware shall be cadmium-plated or an equivalent. For stainless steel luminaires stainless steel fasteners shall be used. For bronze luminaires, the fastening hardware shall be bronze or stainless steel.
7. Finishes: As selected from manufacturer's standards unless scheduled otherwise.
   a. Painted surfaces, except as scheduled otherwise:
      1) Manufacturer's standard metal pretreatment and baked or air-dried, light-stabilized enamel finish; acrylic, alkyd, epoxy, polyester or polyurethane.
      2) White finishes shall have minimum 85 PCT reflectance.
   b. Unpainted aluminum surfaces:
      1) Interior luminaires: Clear anodic coating, satin finish, except as scheduled otherwise.
      2) Exterior luminaires: Clear anodic coating.
8. Lens/Louver Frames:
   a. Extruded aluminum with mitered corners unless scheduled otherwise.
   b. Hinging or other normal motion shall not cause lens or louver to drop out.
   c. 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.
9. Lenses:
   a. Utilize 100 PCT virgin, UV stabilized acrylic.
   b. The lenses shall be held securely in place but must also be removable to clean and service the luminaire.
      1) Luminaires with a spread lens shall also include a lens orientation device to ensure that it is not affected during cleaning or relamping.
   c. There shall be no light leaks between the lens and the luminaire.
   d. Acrylic lenses and diffusers shall be properly cast, molded or extruded as necessary to meet the intent of the specified optics, and shall remain free of any dimensional

instability, discoloration, embrittlement, or loss of light transmittance at least for the period of the Manufacturer's warranty.

10. Reflectors:
    a. High-purity No. 12 aluminum reflector sheet, 0.047 IN or heavier if specified, free from fabrication or assembly damages. No exposed rivets, springs or other hardware after installation. Shape reflectors in modified elliptical or parabolic contour to produce no apparent brightness.
    b. Downlight reflector and baffle finishes: First-quality Alzak anodized specular or semi-specular finish of color as specified, unless otherwise noted in Lighting Fixture Schedule.
        1) Downlight reflectors shall be securely fastened but also removable for cleaning and relamping.
    c. Troffer reflector finish: integral reflectors shall be painted white after fabrication and shall have a minimum reflectance value of 90 PCT.
11. Gaskets: Provide gaskets at face plates or frames of recessed luminaires which serve as ceiling trim and which allow interior access. Provide moisture seal gaskets at exterior locations and in other areas designated. Secure frames to luminaire bodies with screws or other means, to result in tight installation, without light leaks. See Lighting Equipment Schedule for other types of seals and gaskets.
12. Ventilation: Provide ventilation openings of adequate size and quantity to permit operation of lamps/LED modules and ballast/driver without affecting rated output or life expectancy.
13. Lamp Holders:
    a. Position sockets so that lamps are in optically correct relation to luminaire components.
    b. Secure sockets by screws to luminaire enclosure. Spring mounted sockets are not approved. Do not use plastic or sheet metal sockets unless specified otherwise.
    c. Halogen: Porcelain body; nickel plated brass socket, pre-lubricated with silicone compound.
    d. Fluorescent: White urea plastic body; silver plated phosphor bronze or beryllium copper contacts.
    e. High Intensity Discharge: Porcelain body; nickel plated brass socket, pre-lubricated with silicone compound. Lamp supplied must be compatible with socket orientation (horizontal, base up or base down.
    f. Light Emitting Diode (LED): Unless otherwise specified, a dedicated means of connecting light source to power shall be used in luminaires purposely made for use with LEDs unless otherwise specified. LED modules shall be field replaceable.
14. Wiring:
    a. Factory wire luminaire to be compatible with project electrical and controls systems.
    b. Ballasted luminaires shall comply with NEC requirements and be supplied with a disconnecting means accessible to qualified persons before servicing or maintaining ballast.
    c. Power supplies and LED modules, unless otherwise specified, shall be field replaceable and 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.
15. Mounting Accessories:
    a. Provide appropriate mounting accessories for each luminaire, compatible with various structural conditions encountered. Provide fastening clips (seismic clips) for luminaires supported from framing members of suspended ceilings.
    b. Luminaires with adjustable beam angles shall have a locking device to ensure that the beam distribution is not affected during relamping or cleaning.
    c. Recessed Luminaires:
        1) Plaster frames: Provide frames for luminaires installed in gypsum board and concealed suspension system ceiling tile. Make frames of non-ferrous metal or suitably rustproof after fabrication.
        2) Baffles and gaskets: As required to prevent light leakage.
        3) Flanged luminaires are required in all ceiling systems except exposed grid lay-in panel type.

d. Luminaire Suspension Material:
    1) Unfinished spaces: 1/2 IN minimum diameter pendant, unless otherwise noted.
    2) Finished spaces: Unless otherwise noted, provide manufactured cable or stem and outlet box canopy; contemporary design with swivel self-aligning features; size canopy to cover outlet box; finished to match luminaire. Coordinate pendant location with ceiling tiles/ceiling grid and submit coordinated mounting accessories as part of Product Data submission.
        a) Provide luminaires mounted on suspended ceiling grids with outlet box designed for grid mounting with direct cord entry.
e. Mechanical Safety: Unless otherwise specified, retain luminaire closures (lens doors, trim frame, hinged housings, etc.) in secure manner by captive screws, chains, captive hinges or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.
f. Luminaires in Hazardous Areas: Luminaires shall be suitable for installation in flammable atmospheres (Class and Group) as defined in NFPA 70 and shall comply with UL 844.
g. LED luminaires shall be manufactured specifically for their respective light source with dedicated electrical connections and with power supplies integral to the fixture, except where remote devices are specified. Assemblies designed to retrofit incandescent luminaires are prohibited except when specifically indicated for renovation of existing luminaires. Luminaires shall be designed for lamps as specified.
h. The Contractor shall assure that all trims and canopies and escutcheons fit snugly and securely to the ceiling and/or wall so that no light leaks occur and so that no gaps or uneven waves are evident.

B. Lamps:
1. LED's:
    a. Color temperature specified shall be uniform for all LED modules within like luminaire types. Color temperature measurement shall have a maximum MacAdam Ellipse boundary of 3 SDCM unless otherwise specified in the Lighting Equipment Schedule.
    b. Color temperature specified shall be uniform for all LED modules within like luminaire types. Color temperature measurement shall have a maximum MacAdam Ellipse boundary of 3 SDCM unless otherwise specified in the Lighting Equipment Schedule at the end of rated life.
        1) Correlated color temperature shall be as defined in the Lighting Equipment Schedule.
    c. Minimum Ra value or color rendering index (CRI) of 80.
    d. LED light output and efficacy shall be measured in accordance with IES LM-79 standards.
    e. LED life and lumen maintenance shall be measured in accordance with IES LM-80 and TM-21 standards.
        1) Rated minimum L70 life of 50,000 HRS at 25 DEG C.
    f. The individual LED's shall be connected such that a catastrophic loss or the failure of one LED will not result in a light output loss of the entire luminaire.

C. Ballasts and Drivers:
1. General:
    a. Comply with UL and ANSI specifications. Enclosure shall display approval label for compliance with UL standards.
    b. Contractor shall verify required voltage, frequency and power factors.
    c. Comply with US Federal Efficiency Laws.
    d. Manufacturing facilities shall maintain ISO 9001 certification.
    e. Equipment shall not contain PCBs.
    f. Manufacturer shall have a ten year history of producing electronic ballasts and/or drivers for the North American market.
2. LED Drivers:
    a. LED Dimming Driver.

1) 4-Wire (0-10V DC Voltage Controlled) Dimming Driver.
2) 2-Wire Forward or Reverse Phase Dimming Driver.

b. General.
1) LED dimming shall be equal in range and quality to a commercial grade incandescent dimmer. Quality of dimming to be defined by dimming range, freedom from perceived flicker or visible stroboscopic flicker, smooth and continuous change in level (no visible steps in transitions), natural square law response to control input, and stable when input voltage conditions fluctuate over what is typically experience in a commercial environment. Demonstration of this compliance to dimming performance will be necessary for substitutions or prior approval.
2) Driver shall operate from 60 Hz input source of 120V through 277V with sustained variations of +/- 10 PCT (voltage and frequency) with no visible change in light output.
3) Total Harmonic Distortion less than 20 PCT and meet ANSI C82.11 maximum allowable THD requirements at full output. THD shall at no point in the dimming curve allow imbalance current to exceed full output THD.
4) Driver shall have a Power Factor greater than 0.90.
5) Driver output shall be regulated to +/- 5 PCT across published load range.
6) Driver shall have a Class A sound rating.
7) Driver shall have a minimum operating temperature of -4 DEGF.
8) Driver shall tolerate sustained open circuit and short circuit output conditions without fail and auto-resetting without need for external fuses or trip devices.
9) Driver output ripple current shall be less than 15 PCT measured peak-to-average, with ripple frequency greater than 100 Hz.
10) Driver must limit inrush current and meet or exceed NEMA 410 driver inrush standard of 430 Amps per 10 Amps load with a maximum of 370 Amps2 – seconds.
11) Driver shall withstand up to a 1,000 volt surge without impairment of performance as defined by ANSI C62.41 Category A for Transient protection.
12) Driver shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).
13) Driver must support automatic adaptation, allowing for future luminaire upgrades and enhancements and deliver improved performance:
    a) Adjustment of forward LED voltage, supporting 3V through 55V.
    b) Adjustment of LED current from 200 mA to 1.05A at the 100 PCT control input point in increments of 1 mA.
    c) Adjustment for operating hours to maintain constant lumens (within 5 PCT) over the 50,000 HR design life of the system and deliver up to 20 PCT energy savings early in the life cycle.
14) Driver: UL Recognized under the component program and shall be modular for simple field replacement. Drivers that are not UL Recognized or not suited for field replacement will not be considered.
15) Drivers shall have a rated life greater than or equal to the stated life of luminaire they control.
16) LED engine must be compatible with type of driver and perform within the dimming range specified and coordinated prior to submission of shop drawings.
17) Coordinate if lighting controls utilize source or sync dimming. Luminaire manufacturer shall provide converter pathway devices as required for luminaires to dim and function as specified.
18) Fixture shall be properly heat-sinked to assure LED junction temperature ratings are not exceeded. Manufacturer shall provide ambient operating temperature range for which product is warranted.
19) If driver is remote-mounted, provide maximum allowable distances for secondary wire runs to luminaires. Driver shall be housed in NEMA enclosures so rated for

the power supply and located in code-compliant, sound-isolated, well-ventilated, easily accessible areas. Size wire according to run length and LED Manufacturer's size and distance-of-run requirements and in accordance with code requirements.

20) All LED power supplies shall be suitably sized to accommodate the LED array consistent with industry standards, including IEC standard 60929 Annex E.
21) Driver shall be available in an all metal-can construction for optimal thermal performance.
22) Driver shall be provided with integral color-coded connectors.
23) Provide with mounting hardware as required.

c. Light Quality.
   1) Over the entire range of available drive currents, driver shall provide step-free, continuous dimming. Driver shall respond similarly when raising.
      a) The luminaire shall be capable of continuous dimming over a range of 100 PCT to 10 PCT of rated lumen output.
         (1) Driver must be capable of 20-bit dimming resolution for white light LED drivers or 15 bit resolution for RGBW LED drivers.
   2) Driver must be capable of configuring a linear or logarithmic dimming curve, allowing fine grained resolution at low light levels.
   3) Drivers to track evenly across multiple fixtures at all light levels and shall have an input signal to output light level that allows smooth adjustment over the entire dimming range.
   4) Driver and luminaire electronics shall deliver illumination that is free from objectionable flicker as measured by flicker index (ANSI/IES RP-16-10). At all points within the dimming range from 100-0.1 PCT luminaire shall have:
      a) LED dimming driver shall provide continuous step-free, flicker-free dimming similar to incandescent source.
      b) Flicker index shall be less than 5 PCT at all frequencies below 800 Hz.

d. Control Input.
   1) 4-Wire (0-10V DC Voltage Controlled) Dimming Drivers.
      a) Must meet IEC 60929 Annex E for General White Lighting LED drivers.
      b) Connect to devices compatible with 0 to 10V Analog Control Protocol, Class 2, capable of sinking 0.6 ma per driver at a low end of 0.3V. Limit the number of drivers on each 0-10V control output based on voltage drop and control capacity.
      c) Must meet ESTA E1.3 for RGBW LED drivers.
      d) Driver shall utilize fully isolated 0-10V control inputs. 0-10V input shall be protected from line voltage mis-wire and shall be immune and output-unresponsive to induced AC voltage on the control leads.

PART 3 - EXECUTION

3.1 COORDINATION

A. Coordinate luminaire mounting and trim type with architectural reflected ceiling plans, suspended ceiling grid and ceiling tile specification, and room finish schedules prior to submission of shop drawings.
   1. Advise Architect of any discrepancies.

B. Coordinate required above-ceiling clearances of recessed luminaires with ductwork and piping.
   1. In exposed ceiling areas, coordinate luminaire locations, mounting heights, and supports with other trades.

C. Coordinate, review and approve fixture locations shown on acoustical ceiling shop drawings prior to submission.
   1. Notify Architect of any discrepancies with lighting plans and review coordinated ceiling shop drawing review comments.

D. Coordinate lighting control devices with fixture ballasts and drivers. Advise Architect of discrepancies prior to submission of shop drawings.

3.2 INSTALLATION

A. Strictly follow the manufacturer's directions for installation of all lighting equipment. Luminaire installation shall include suitable lamps and required equipment, materials, parts, attachments, devices, hardware, cables, supports, frames and brackets necessary for complete and fully operating installation.

B. Locate luminaires in accordance with architectural reflected ceiling plans.
   1. Where field conflicts exist, coordinate relocation of equipment with Architect.

C. Mount luminaires at heights as indicated on drawings. Where field conflicts exist, or mounting height is not stated, coordinate with Architect.

D. Verify structural support is adequate to ensure luminaires are supported to maintain level and alignment.

E. Design support system for custom products and lowering devices by licensed structural engineer based on fixture being installed.
   1. Submit installation instructions and details for information only as part of fixture shop drawing review process.

F. Ground luminaires per NEC Article 410.

G. Provide exit sign at exit locations, with mounting type, number of single or double faces, and directional arrows (chevrons) as required for exiting.
   1. Where exit signs are pendant mounted, provide manufacturers pendant mount stem kit.
   2. Do not mount sign housing to junction box suspended by conduit.

H. Orient horizontally positioned fluorescent lamps or LED circuit boards of luminaires within a single room in same direction unless indicated otherwise. Orient the luminaires so that the horizontal bar or element within the luminaire is parallel to the long axis of the space unless otherwise noted. Orientation of luminaires within similar spaces shall remain consistent.

I. Seal luminaires for wet locations (i.e. knock-outs, pipe and wire entrances) to prevent water wicking.

J. Luminaire finishes which are disturbed in any way during construction shall be touched up or refinished in a manner satisfactory to the Architect and which does not void warranty.

K. Install reflector cones, louvers, baffles, lenses, trims and other decorative elements after completion of ceiling tile installation, plastering, painting and general cleanup.

L. Recessed Luminaires:
   1. Verify mounting details for each space; provide correct luminaire flange mounting accessories for each condition.
   2. Coordinate to ascertain luminaires are furnished in sizes, with flange details, and installed with the devices (hangers, clips, trim frames, flanges), to match ceiling system being installed.
   3. Support luminaire so there is no visible sag in the ceiling system.
   4. Acoustical Tile Ceilings:
      a. Fasten luminaires supported by suspended ceiling systems to ceiling framing system with hold-down clips, each capable of supporting the weight of the luminaire.
      b. In addition to hold-down clips, provide either one of the following:
         1) The electrical contractor must coordinate with the ceiling installer to ensure that a minimum of two ceiling support ties are provided within 24 IN of each luminaire, or;
         2) Provide two 12 GA minimum steel wires connected from opposite, diagonal corners of the luminaire housing to structure.
      c. Additional seismic requirements:

1) For installations located in seismic design categories C, D, E or F, provide the following supplementary supports based on the weight of the individual luminaire:
    a) Less than 10 LBS: provide one 12 GA minimum slack steel wire connected from the luminaire housing to structure.
    b) Between 10 and 55 LBS: provide two 12 GA minimum slack steel wires connected from opposite, diagonal corners of the luminaire housing to structure.
    c) Greater than 55 LBS: provide an independent support directly connection to structure (no slack wires are required).
2) These requirements are in addition to the supplementary hanger wires connected to the ceiling suspension system within 3 IN of each corner of each light fixture installed in categories D, E, or F.

d. Locate luminaires in exact center of tile unless indicated otherwise. Relocate misplaced luminaires and replace damaged ceiling materials.
e. Support downlights and exit signs with rails spanning between runners of suspension system.

5. Gypsum Wallboard Ceilings:
    a. Support troffers in gypsum board ceilings from structural framed openings with adjustable lugs on side of luminaire or yoke mounting as recommended by luminaire manufacturer.
        1) Where structural framed openings are not provided, luminaires must be independently supported from structure.
        2) Additional seismic requirements:
            a) For installations located in seismic design categories C, D, E or F, provide the following supplementary supports based on the weight of the individual luminaire:
                (1) Less than 10 LBS: provide one 12 GA minimum slack steel wire connected from the luminaire housing to structure.
                (2) Between 10 and 55 LBS: provide two 12 GA minimum slack steel wires connected from opposite corners of the luminaire housing to structure.
                (3) Greater than 55 LBS: provide an independent support directly connection to structure (no slack wires are required).
        3) Suspended grid systems for gypsum board ceilings are not approved structural support systems for luminaires.
    b. Support downlights and troffers in metal pan and gypsum board ceilings from plaster frames.
    c. Provide access panels for recessed luminaires that require access for maintenance when such access is not provided for in design of luminaire.
    d. Coordinate trimless or flangeless luminaires with other trades to achieve a trimless or flangeless installation.
        1) Provide a level 5 finish at drywall or plaster ceilings and walls unless otherwise directed by Architect.
6. Use unwired or pre-wired luminaires as required.
    a. Do not use pre-wired luminaires for through-wiring unless UL approved for the purpose.
7. Wherever recessed luminaires are installed in insulated ceiling systems, it is the responsibility of the Contractor to construct above-ceiling enclosures around non-insulation-contact-rated equipment to provide at least 3 IN or airspace on each side of the luminaire.
8. Trims shall fit plumb and flush with ceiling or wall surface.
9. There shall be no light leak around interface between lens door or holder trim flanges and ceiling or wall.

M. Surface-Mounted and Pendant-Hung Luminaires:
1. Attach surface-mounted lighting luminaires to ceiling system with positive clamping devices that completely surround supporting members.

a. Attach safety wires between clamping device and adjacent ceiling hanger or to structure above.
b. Do not exceed design carrying capacity of supporting member for luminaire load.
c. Additional seismic requirements:
1) For installations located in seismic design categories C, D, E or F, provide the following supplementary supports:
a) Support pendant-hung lighting luminaires directly from structure above, using 9 GA steel wire, without relying on ceiling suspension system for support.

2. Pierce ceiling material for hangers and outlet boxes as required.
3. Do not remove ceiling material above surface-mounted luminaires.
4. Hang luminaires plumb with continuous rows in alignment.
5. Unless otherwise noted, suspend luminaires in each room or area at same height regardless of varying clear height conditions.
a. Provide stem lengths as required.
b. The canopy portion of a pendant-hung luminaire installed in a finished space with an exposed-to-structure ceiling shall be installed directly to the bottom of the structural deck unless otherwise noted on the plans. Extending Unistrut, all-thread or similar means from the exposed deck down to a lower mounting height in order to suspend the box/canopy is not acceptable. Notify Engineer immediately if on-site conditions will result in a mounting conflict.
6. Cord of pendant-hung fixtures must enter directly into approved wiring box without passing through plenum, in accordance with NEC.
7. Provide suspended luminaires with flexible cord.
a. Flexible cord shall connect to a junction box located directly above luminaire feed point.
b. Flexible metal conduit and luminaire whips are not allowed for suspended luminaires.
c. Trim cords to length and attach to suspension cable at regular intervals.
d. Do not coil flexible connections.
8. Surface or pendant luminaires mounted end-to-end shall have flat end caps to assure flush alignment and shall be UL listed for through wiring.
9. In exposed ceiling areas, install ballasts/drivers and auxiliary equipment non-integral to luminaire in accessible, permanently installed NEMA-rated metal cabinets or housings. Field paint exposed cabinets or housings to match adjacent surfaces.
10. Provide pendant-hung cylinder luminaires with swivel hangers which allow luminaire to swing in any direction but not permit stem to rotate.
11. In mechanical, electrical and storage spaces, pendant-mounted, open industrial luminaires, not in continuous rows, shall be supported by conduit or metal channel, similar to Unistrut, and All Thread.
a. Pendant-mounted luminaires in continuous rows shall be fastened to each other or mounted on continuous metal channel.
b. Provide reflector alignment clips on industrial luminaires mounted in continuous rows.
12. Contractor shall provide and/or coordinate additional bracing in wall or above ceiling as required to support fixture in accordance with manufacturer's recommendations.

N. Continuous Luminaire Patterns:
1. Fasten sections together for continuously aligned appearance, with no dimpling or light leakage.
a. Provide end extensions where required.
2. Where luminaires run continuously around inside or outside corners, provide prefabricated illuminated corner pieces.
a. Run luminaire lenses, baffles or louvers continuously with luminaire.
b. Miter and/or fan at corners as directed.
3. Where lenses are used, open gaps shall not be visible.
a. Solid-state luminaires shall utilize mitered or rabbited lenses to prevent direct view of modules.

b. Maximum visible gap between the edge of lens and the end of luminaire trim is 1/16 IN, and not allow direct view of solid-state modules.

4. Only where continuous runs do not end at a wall or fascia, provide a finished end plate, with no visible holes and concealed fasteners.
5. Provide a continuous light appearance over total length of assembly.
   a. The luminaire shall run continuously wall to wall or wall to corner without a gap at either end of the fixture when located adjacent to a wall or corner. The maximum permitted non-illuminated length at either end shall not exceed 6 IN.
   b. For continuous direct fluorescent fixtures, overlap sockets to prevent socket shadows.
6. Cove luminaires in architectural coves shall be installed continuously with no gaps between luminaires.
7. Coordinate installation and requirements of undercabinet luminaires with casework installation.
   a. Provide separate segments of luminaires if luminaires cannot run continuously beneath cabinet.
   b. Conceal wiring and conduit to luminaires.

3.3 COMMISSIONING

A. Coordinate lighting operations, including support from Luminaire and Controls Manufacturers, with commissioning and controls.

B. Synchronize fully functional lighting and lighting controls systems to address lighting operation in complete and code compliant manner.

C. Provide documentation related to commissioning, including record drawings identifying luminaire control loops and addresses with respect to specific luminaire types and Initial Preset Schedule Spreadsheet.

3.4 ADJUSTING, RELAMPING AND CLEANING

A. Perform final focusing of adjustable luminaires in presence of Owner's Representative, including times outside regular working hours. Furnish ladders scaffolding and rigging, as required, for focusing and adjustment of luminaires.

B. Replace inoperable luminaires prior to final acceptance.

C. Replace noisy and malfunctioning ballasts prior to final acceptance.

D. Replace lamps and/or ballasts where necessary to eliminate strobing.

E. Align luminaires and remove paint splatters, dirt and debris.

F. Touch up any visible damages to luminaire finish.

G. Wipe clean luminaire reflectors, lenses, lamps and trims, after installation.

H. Install luminaires with caution to avoid fingerprints or smudges on surfaces of parabolic louvers and downlight reflectors.
   1. Use cleaning materials and methods that will not damage finish.
   2. Where fingerprints or smudges cannot be adequately removed, replace affected luminaire.

I. Install architectural cove luminaires after cove has been painted.
   1. Vacuum construction debris from cove to ensure a dust-free reflector surface prior to date of Substantial Completion.

3.5 SPECIAL PROTECTION

A. Remove protective covers immediately prior to date of Substantial Completion.

3.6 FIELD MODIFICATIONS STOCK

A. To facilitate the addition of extra exit signs due to unforeseen deficiencies in satisfying life safety egress requirements, provide the following:

1. Minimum of 5 PCT of each exit sign type.

3.7 REPLACEMENT STOCK

A. Provide Owner's initial lamp replacement stock.

B. Provide Owner LED boards or modules to replace the LEDs in 2 PCT of luminaires, but no fewer than 5 and no more than 30 of luminaire types using identical LED's. For luminaires that are longer than 8 FT in length. Modules to replace one 8 FT length shall be considered sufficient. If the exact same modules are used in multiple luminaire types, maximum quantity of modules/ boards to replace 30 luminaires of most type is sufficient cover all types.
   1. If LED's are irreplaceable and an inherent integral part of luminaire, no spares will be required unless otherwise indicated in Lighting Equipment Schedule.

C. Provide Owner 2 PCT of each ballast/ driver/transformer type but not less than 5 or more than 30 of any one type.
   1. Match ballasts exactly with types specified and provided for installed luminaires.

D. Warranty replacements are not be taken from replacement stock.

END OF SECTION

DIVISION 28

ELECTRONIC SAFETY AND SECURITY

SECTION 28 46 00
FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall provide fire alarm system with initiating devices, notification appliances, and monitoring and control devices as indicated on drawings and as specified herein, and also provide a listed Releasing Service Fire Alarm Control Unit (RSFACU) for the McCourtney Road Transfer Station, located in the County of Nevada, California. The Transfer Station Facility shall be provided with an RSFACU as part of the single-interlock pre-action sprinkler system serving the building and shall also meet the automatic sprinkler system supervision, alarm and monitoring requirements of Section 903 in the CBC. Design of the code-compliant RSFACU serving the single-interlock pre-action sprinkler system to be provided for the Transfer Station Facility is delegated to the Contractor; this system shall be in accordance with these performance specifications and meeting the requirements of all applicable local, regional, and national codes.
   1. A fire alarm system shall be provided for the Transfer Station Facility to control and monitor the RSFACU provided in this building, shall not be required to provide other functions or features of a building fire alarm system (e.g. notification throughout, manual pull stations at exits, etc.). Instead, the RSFACU shall provide its dedicated functions to fill the preaction system with water and provide a sprinkler waterflow and supervisory system alarm.

B. Section includes:
   1. Material and installation requirements for:
      a. Fire Alarm Control Unit
      b. Releasing Service Fire Alarm Control Unit.
      c. Initiating Devices.
      d. Notification Appliances.
      e. Miscellaneous Devices.

C. Related Specification divisions include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 21 05 00 – Fire Protection Systems
   4. Section 26 05 33 - Raceways and Boxes.

1.2 QUALITY ASSURANCE

A. Referenced Standards (appropriate editions as adopted by Authority(ies) Having Jurisdiction (AHJ) and including all local amendments):
   1. Americans with Disabilities Act (ADA):
      a. Accessibility Guidelines for Buildings and Facilities (ADAAG).
      b. ADA Standards for Accessible Design.
   2. National Electrical Manufacturers Association (NEMA).
   3. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC):
         1) Article 760, Fire Alarm Systems.
      b. 72, National Fire Alarm and Signaling Code.
      c. 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
      d. 101, Life Safety Code.
   4. National Institute for Certification in Engineering Technologies (NICET).
   5. Underwriters Laboratories, Inc. (UL):

a. 38, Standard for Manual Signaling Boxes for Fire Alarm Systems.
b. 268, Smoke Detectors for Fire Alarm Systems.
c. 464, Standard for Audible Signaling Appliances.
d. 497B, Standard for Protectors for Data Communication and Fire Alarm Circuits.
e. 521, Standard for Heat Detectors for Fire Protective Signaling Systems.
f. 864, Standard for Control Units and Accessories for Fire Alarm Systems.
g. 1971, Standard for Signaling Devices for the Hearing Impaired.

6. Building code:
   a. California Building Code and associated standards, referred to herein as Building Code, 2019 Edition.
7. Fire Code:
   a. California Fire Code and associated standards, referred to herein as Fire Code, 2019 Edition.

B. Design Criteria:
1. Provide a RSFACU for the Transfer Station Facility. This panel shall also serve as a sprinkler waterflow and supervisory system.
2. Provide an RSFACU as described in the Contract Documents (and according to criteria of the AHJ) and all applicable national and local codes such as NFPA, ADAAG, building code, etc.
   a. Where system requirements described in the Contract Documents exceed those of the AHJ and/or NFPA, meet the requirements of both.
   b. Perform a thorough examination of Contract Documents and coordinate with other disciplines and trades, e.g. verification of hazardous area locations requiring equipment rated for that type of environment.
   c. Contractor shall be responsible for providing a fully functional and code compliant sprinkler waterflow and supervisory system at no additional cost to the Owner.
3. Submit documents after design has been approved by Authority Having Jurisdiction (AHJ).
4. The sprinkler waterflow and supervisory system shall be designed by a NICET Fire Alarm Systems Level III or IV engineering technician.
   a. The designer is responsible for understanding the construction of the building to take in consideration ceiling heights, ceiling construction (flat or not flat), and other features of the building that will affect the layout of devices as required to provide a sprinkler waterflow and supervisory system that is fully compliant with NFPA 72.
5. If required by state regulations, a Professional Fire Protection Engineer shall seal drawings submitted to the AHJ.

C. Service Organization Qualifications:
1. Offer an annual maintenance contract including complete service and equipment costs for maintenance of complete system.
2. Minimum 10 years of experience serving fire alarm systems.
3. Provide for 24 HR emergency service. Response time to site shall be 48 HRS or less and service office shall be within 500 miles of site.
4. System shall be installed under the direct supervision of a technician who is factory trained by manufacturer and is certified as a minimum of NICET Level II in Fire Alarm Systems.

D. Field quality control:
1. Manufacturer's field services: Provide service by a factory-authorized and certified service representative to supervise field assembly and connection of components and pre-testing, testing, and adjustment of system.
2. Pre-testing: Determine, through pre-testing, conformance of system to requirements of drawings and specifications. Correct deficiencies observed in pre-testing. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved.
3. Inspection:
   a. Inspect equipment installation, interconnection with system devices, mounting locations, and mounting methods.

b. Verify that units and controls are properly installed, connected, and labeled and that interconnecting wires and terminals are identified.

E. Authority Having Jurisdiction (AHJ) review:
1. Concurrent or prior to submission to Engineer, submit shop drawing and product data to Authority Having Jurisdiction (AHJ).
2. Upon receipt of comments from AHJ, make resubmissions, if required, to make clarifications or revisions to obtain approval.
3. The AHJ shall witness final testing and inspection in order to obtain final approval for system.

1.3 DEFINITIONS

A. For the purposes of providing materials and installing electrical work the following definitions shall be used.
1. Outdoor Area: Exterior locations where the equipment is normally exposed to the weather and including below grade structures, such as vaults, manholes, handholes and in-ground pump stations.
2. Architecturally Finished Area: Offices, laboratories, conference rooms, restrooms, corridors and other similar occupied spaces.
3. Non-architecturally Finished Area: Pump, chemical, mechanical, electrical rooms and other similar process type rooms.
4. Hazardous areas: Class I, II or III areas as defined in NFPA 70.
5. Shop Fabricated: Manufactured or assembled equipment for which a UL test procedure has not been established.
6. Service Organization: Commercial entity comprised of professionals capable of providing the technical knowledge and a supply of replacement equipment required for the comprehensive maintenance of a sprinkler waterflow and supervisory system.

1.4 SYSTEM DESCRIPTION

A. Automatic and manual, addressable, general alarm and non-coded evacuation alarm, supervised, closed-circuit, 24 VDC microprocessor based sprinkler supervisory, releasing system, and fire detection and alarm system.

B. Provide components and features as required by the applicable codes, AHJ and/or Fire Department, including but not limited to following.
1. RSFACU in the fire riser room (Room 101) as indicated on the Drawings.
a. Provide releasing circuit to release single-interlock pre-action sprinkler system; see Fire Protection Systems Specification 21 05 00 for details on the operational sequence and other requirements.
b. The hose connection single interlock preaction valve shall be manual release only (see ‘Manual Stations’).
2. Manual stations.
a. One adjacent to the RSFACU for manual activation of the system for testing purposes.
b. One in the fire pump / riser room to release the preaction valve and fill the hose connection piping with water.
3. Heat sensors.
a. Linear heat detection will be installed in accordance with NFPA 72 throughout the transfer station’s main level and lower level. Spot-type heat detectors will also be installed in the office space, which contains finished ceilings, and the fire riser / pump room.
4. Smoke sensors.
a. One above the RSFACU as required per NFPA 72.
5. Sprinkler and standpipe flow switch and main waterflow detector circuits.
6. Main, post indicator valve, and indicating sprinkler valve tamper switch circuits.
7. Sprinkler system pressure switch monitoring circuits.
8. A non-silenceable 24 VDC notification appliance circuit serving a dedicated, exterior alarm device activated upon a waterflow alarm.

a. Exterior water flow alarm device shall be a weatherproof audible/visible notification device provided on the exterior of the building located above the Fire Department Connection (FDC).

9. Fire pump alarm supervised circuiting.
10. Sprinkler supervisory and releasing system fire alarm system wire, with all wiring in conduit (except linear heat detection).
11. Tone generator.

C. Basic Performance:
1. Signal Line Circuits (SLC) shall be wired Class B (NFPA Style 4).
2. Notification Appliance Circuits (NAC) shall be wired Class B.
3. Each SLC and NAC shall be limited to only 80 PCT of its total capacity at the time of initial installation.
4. Sprinkler supervisory and releasing fire alarm system and all associated equipment and devices shall be suited to the environment in which it is installed, e.g. in a hazardous areas all equipment shall be appropriately rated as explosion-proof, intrinsically safe, etc.

1.5 SUBMITTALS

A. Shop Drawings:
1. See Specification Division 01 for requirements for the mechanics and administration of the submittal process.
2. Shop drawings submittal shall include minimum required documentation as prescribed in NFPA 72. This includes, but is not limited to, the following:
a. Written narrative providing design intent and system description.
b. Floor plan layout showing location of all devices and control equipment:
1) Indicate salient features of each device (e.g., weatherproof, strobe candela rating).
2) Designate where protective equipment is provided (e.g. pull station covers, device guards, etc).
3) Explosion-proof or intrinsically safe ratings for devices.
c. Wiring diagrams (including riser diagram).
d. Include system details including location of RSFACU and all devices and circuiting.
e. System power and battery backup calculations and voltage drop calculations to assure that system will operate in accordance with prescribed backup time periods and under all voltage conditions per UL and NFPA standards.
f. Provide equipment technical data sheet Submittal for all products specified in product section (PART 2), below.
g. System operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs.
h. Provide list of all input and output points in system with label indicating location or use of IDC, SLC, NAC, relay, sensor, and auxiliary control circuits.
i. Equipment design considerations for future expansion as indicated.
j. Operating instructions for RSFACU.
k. Completed NFPA 72 record of inspection and testing (see Contract Closeout Information: below for additional requirements).
l. Copy of site specific software.
m. Name of local service organization.
n. Documentation of AHJ approval for system submittal.

B. Contract Closeout Information:
1. Operation and Maintenance Data:
a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
2. Field test reports.
3. Owner instruction report.
4. Prorata warranty for batteries.

5. Spare parts: Furnish extra materials, packaged with protective covering for storage, and identified with labels clearly describing contents as follows:
    a. Manual Stations: Furnish quantity equal to 15 PCT of number of manual stations installed but no less than one.
    b. Notification Appliances: Furnish quantity equal to 5 PCT of each type and number of units installed, but not less than one of each type.
    c. Automatic initiation devices including but not limited to smoke sensors, linear heat detection, and spot-type heat sensors: Furnish quantity equal to 5 PCT of each type and number of units installed but not less than one of each type.
    d. Detector or Sensor Bases: Furnish quantity equal to 2 PCT of each type and number of units installed but not less than one of each type.

1.6 AREA DESIGNATIONS

A. Designation of an area will determine the NEMA rating of the electrical equipment enclosures, types of conduits and installation methods to be used in that area.
    1. Outdoor areas:
        a. Wet.
        b. Also, corrosive and/or hazardous when specifically designated on the Drawings or in the Specification Sections.
    2. Indoor areas:
        a. Dry.
        b. Also, wet, corrosive and/or hazardous when specifically designated on the Drawings or in the Specification Sections.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable.
    1. Releasing service fire alarm control unit:
        a. Edwards Systems Technology (EST).
        b. Gamewell FCI.
        c. Protectwire
        d. Siemens Industry.
        e. Silent Knight.
        f. Simplex Grinnell.
        g. Cooper Wheelock.
    2. Manufacturer must have a service organization local to the project site(s).

B. Submit request for substitution in accordance with Specification Section 01 33 00.

C. All Equipment:
    1. UL listed as a product of a single manufacturer under appropriate category.
    2. Equipment shall not be modified or installed to alter or void UL label or listing.
    3. FM approved.
    4. Approved by Fire Marshal.

2.2 FIRE ALARM CONTROL UNIT

1. Cabinets:
    a. Lockable steel enclosure.
        1) Semi-flush mounted.
        2) Specifically designed for public areas.
    b. Arrange so operations required for testing or for normal care and maintenance of system are performed from front of enclosure.
    c. If more than single enclosure is required to form complete control unit, provide matching modular unit enclosures.

d. Accommodate components and allow gutter space for interconnection of units as well as field wiring.
e. Identify each enclosure by engraved, red-laminated, phenolic resin nameplate.
1) Lettering on enclosure nameplate shall not be less than 1 IN high.

2. Systems:
a. Alarm and supervisory systems shall be separate and independent
b. Alarm-initiating zone boards in FACP shall consist of plug in modules.
1) Construction requiring removal of field wiring for module replacement is not acceptable.

3. Following FACP Hardware:
a. 2,000 point capacity minimum where (1) point equals (1) monitor (input) or (1) control (output).
b. 2,000 points of Network Annunciation at FACP Display when applied as Network Node.
c. 2000 points of annunciation where one (1) point of annunciation equals:
1) 1 LED driver output on graphic driver or 1 switch input on graphic switch input module.
2) 1 LED on panel or 1 switch on panel.
d. Provide battery voltage and ammeter readouts on FACP LCD Display from battery charging circuits in system.
e. Remote station signaling unit with disconnect switch, 24VDC Remote Station (reverse polarity), local energy, shunt master box, or form "C" contact output.
1) Listed and labeled according to UL 632.
2) Functional Performance:
a) Unit receives alarm, supervisory, or trouble signal and automatically captures one of two telephone lines and dials preset number for remote central station.
b) When contact is made with central station(s), signal is transmitted.
c) Unit supervises up to two telephone lines. If service on either line is interrupted for longer than 45 seconds, unit initiates local trouble signal and transmits signal indicating loss of telephone line to remote alarm receiving station over remaining line. When telephone service is restored, unit automatically reports that event to central station.
d) If service is lost on both telephone lines, local trouble signal is initiated.
3) Secondary Power:
a) Integral rechargeable battery and automatic charger.
b) Battery capacity to be adequate to comply with NFPA 72 requirements.
f. One auxiliary electronically resettable fused 2A at 24VDC Output, with programmable disconnect operation for 4-wire detector reset.
g. One auxiliary relay, SPDT 2A at 32VDC, programmable as trouble relay, either as normally energized or de-energized, or as auxiliary control.
h. Provide battery charger for charging up to 110Ah batteries.
i. Power supplies with integral intelligent notification appliance circuit Class B for system expansion.
j. Four (4) form C Auxiliary Relay Circuits (Form C contacts rated 2A at 24VDC, resistive), operation to be programmable for trouble, alarm, supervisory of other fire response functions.
1) Relays shall be capable of switching up to 1/2 A at 120VAC, inductive.
k. Remote unit interface: supervised serial communication channel for control and monitoring of remotely located annunciators and I/O panels.
l. Programmable digital alarm communications transmitter (DACT) for either common event reporting or per point reporting.
m. Service port modem for dial in passcode access to all fire control panel information.
a. This project will not use Fire fighters telephone communication system. This exemption has been made by the local AHJ.
b. IBC FCC requirements for fire fighters telephone requirements shall not be considered at the time of bidding.

4. FACP:
    a. Control panel shall be listed under UL Standard 864 (Control Units).
    b. Each control unit shall be stand-alone, complete fire alarm control unit with communications into network and custom network programming capabilities.
    c. All points monitored and controlled by FACP shall be capable of being made available to network by being so programmed. Such points shall include:
        1) Initiating circuit devices such as addressable sensors, including sensor type and sensor values and addressable manual fire alarm pull stations
        2) Supervisory operation, such as for sprinkler flow and tamper monitoring.
        3) Control circuits, such as for notification appliances, fan control, elevator control, and other similar operations.
5. Local audible device shall sound during Alarm, Trouble or Supervisory conditions.
    a. This audible device shall also sound during each key press to provide audible feedback to ensure that key has been pressed properly.
6. Following primary controls shall be visible through door:
    a. LCD display.
    b. Individual fire alarm LED.
    c. Individual priority 2 alarm LED.
    d. Individual supervisory service LED.
    e. Individual trouble LED.
    f. Power on LED.
    g. Signals silenced LED.
    h. Fire alarm acknowledge key.
    i. Priority 2 alarm acknowledge key.
    j. Supervisory service acknowledge key.
    k. Trouble acknowledge key.
    l. Alarm silence key.
    m. System reset key.
7. Control Unit:
    a. Setting of time and date.
    b. LED testing.
    c. Alarm, trouble, and abnormal condition listing.
    d. Enabling and disabling of each monitor point separately.
    e. Activation and deactivation of each control point separately.
    f. Changing operator access levels.
    g. One Person test enable.
    h. Running diagnostic functions.
    i. Displaying software revision level.
    j. Displaying historical logs.
    k. Displaying card status.
    l. Point listing.
8. For maintenance purposes following lists shall be available from point lists menu:
    a. All points list by address.
    b. Monitor point list.
    c. Signal/speaker list.
    d. Auxiliary control list.
    e. Feedback point list.
    f. Pseudo point list.
    g. LED/switch status list.
9. System reset:
    a. System reset button shall be used to return system to normal state after alarm condition has been remedied.
        1) LCD display shall step user through reset process with simple English Language Messages, SYSTEM RESET IN PROGRESS, will first be displayed followed by

message, SYSTEM RESET COMPLETED, and finally, SYSTEM IS NORMAL, should all alarm conditions be cleared.

b. Should alarm condition continue to exist message, SYSTEM RESET IN PROGRESS, will be followed by message, SYSTEM RESET ABORTED, and system will remain in abnormal state.
   1) System control relays shall not reset.
   2) Tone alert and Alarm LED will be on.
   3) Display will indicate total number of alarms and troubles present in system along with prompt to use ACK keys to review points.
   4) These points will not require acknowledgment if they were previously acknowledged.

c. Should Alarm Silence Inhibit function be active, SYSTEM RESET key press will be ignored.
   1) Message, SYSTEM RESET INHIBITED, will be displayed for short time to indicate action was not taken.
   2) As feedback to operator, message SYSTEM RESET NO LONGER INHIBITED will be displayed when inhibit function times out.

10. System shall be capable of logging and storing a minimum of 500 events in alarm log and 500 events in trouble log.
    a. Each recorded event shall include time and date of event's occurrence.
    b. Following historical alarm log events shall be stored:
       1) Alarms.
       2) Alarm acknowledgment.
       3) Alarm Silence.
       4) System reset.
       5) Alarm historical log cleared.
    c. Following historical trouble log events shall be stored:
       1) Trouble conditions.
       2) Supervisory alarms.
       3) Trouble acknowledgment.
       4) Supervisory acknowledgment.
       5) Alarm verification tallies.
       6) One Person test results.
       7) Trouble historical log cleared.
11. FACU:
    a. Output shall be ASCII from EIA RS-232-C connection with adjustable baud rate.
    b. Each RS-232-C port shall be capable of supporting and supervising remote Printer, supporting as many as four (4) remote video display terminals (VDT"s) or printers.
    c. Data amplifiers shall be used to increase VDT or printer line distance.
    d. Each RS-232-C port shall only communicate with one keyboard.
    e. Each port shall be field configurable for supervised operation to be used when remote VDT or printer is permanently installed as part of system or for unsupervised operation for use with portable remote devices that are temporarily connected for testing reports or diagnostic analysis.
       1) FACP shall support up to five (5) RS-232-C ports.
12. Fire Alarm Control System Network:
    a. Each FACU shall operate as proprietary local system with data communication to central FACP. FACP shall monitor all alarms and troubles of each FACP.
    b. Network communications shall be capable of supporting point lists that can be handled as though they were single point.
       1) When any point in list enters into off-normal condition, list is annunciated in that condition.
       2) Network message shall include point list name, point list status, and number of devices in that status.
       3) Network message shall not be burdened with detail information on each point in point list.

a) If such information is needed by network, points required shall be declared public and programmed accordingly.
4) Individual point information shall be available either by inquiry at owner node, or by accessing point at inquiring node.
5) Individual point information shall be available through external PC/Keyboard inquiry at owner node, or by issuing "set host" command to access points on any other node as if it were owner node.

13. Convert main 120 volt AC power to low voltage direct current for 24 volt DC system operation.
    a. Incorporate transformer, rectifier, fuses and other power supply components in FACU, or separate panel if approved for application.
    b. Circuits requiring system-operating power shall be 24 VDC and shall be individually fused at control unit.
    c. Power supply shall supply sufficient power to operate magnetic door holders, annunciator and devices furnished by others, such as door or shutter release mechanisms.
    d. System shall support 100 PCT of addressable devices in alarm or operated at same time, under both primary AC and secondary battery power conditions.
    e. Incoming power to system shall be supervised so that any power failure will be indicated at control unit. Green power on LED shall be displayed continuously at user interface while incoming power is present.
    f. Provide low maintenance sealed type battery designed for fire alarm use with automatic battery charger.
        1) Batteries shall be capable of operating maximum normal load of system for 4 HRS and then capable of operating system for 5 minutes in alarm condition.
        2) System batteries shall be supervised so that low battery or depleted battery condition, or disconnection of battery shall be indicated at control unit and displayed for specific fault type.
        3) System shall support NAC Lockout feature to prevent subsequent activation of notification appliance circuits after depleted battery condition occurs in order to make use of battery reserve for front panel annunciation and control.
    g. Loss of primary power shall sound trouble signal at FACP. FACP shall indicate when system is operating on alternate power supply.

2.3 RELEASING SERVICE FIRE ALARM CONTROL UNIT

A. RSFACU shall perform operations as described in System Operation:

B. The sprinkler supervisory and releasing fire alarm system shall have 100 point minimum initiating device capacity with the capability to add additional 100 point minimum initiating device control modules.

C. Construction shall be modular with solid-state, microprocessor-based electronics.
    1. An 80-character LCD display shall indicate alarms, supervisory service conditions and any troubles.

D. Keyboards or keypads shall not be required to operate system during fire alarm conditions.

E. Provide necessary switches, relays, indicator lamps, wiring terminals, etc., to provide complete operation supervising, control, and testing facilities for entire system.

F. RSFACU shall allow for loading or editing special instructions and operating sequences as required.
    1. System shall be capable of on-site programming to accommodate and facilitate expansion, building parameter changes or changes as required by local codes.
    2. All software operations shall be stored in a non-volatile programmable memory within RSFACU.

G. System shall have provisions for disabling and enabling all circuits individually for maintenance and testing purposes.

H. System shall be capable of logging and storing 300 events in a history log.
   1. These events shall be stored in a battery protected random access memory.
   2. Each recorded event shall include time and date of that event's occurrence.
   3. System shall have capability of recalling alarms, supervisory conditions, trouble conditions, acknowledgments, silencing and reset activities in chronological order for purpose of recreating an event history.

I. RSFACU shall be listed under UL 864.

J. RSFACU shall be in an enclosed metal cabinet with glass door specifically designed for public areas.
   1. Mounting: Surface.
   2. Finish: Red baked enamel.

K. Each addressable device shall be represented individually in RSFACU.
   1. Indicate TROUBLE by a discreet LCD readout for each supervised circuit.
   2. Indicate ALARM by a discreet LCD readout for each alarm initiating addressable device.
   3. Include individual supervisory and alarm relays in each circuit arranged so that ground or open condition in any circuit or group of circuits, will not affect proper operation of any other device.

L. RSFACU shall include a system testing capability to help ensure that zoning and supervision have been maintained throughout system.
   1. Actuation of the enable walk test program at RSFACU shall activate "Walk-Test" mode of system which shall cause the following to occur:
      a. Third party reporting connection circuit shall be disconnected or put in test mode with central station.
      b. Control relay functions shall be bypassed.
      c. RSFACU shall indicate a trouble condition.
      d. RSFACU shall, at a minimum, be capable of causing audible signals to activate for 2 SEC upon alarm activation of any initiation device.
      e. RSFACU shall automatically reset itself after code is complete.
      f. Any momentary opening of alarm initiating or alarm indicating circuit wiring shall cause audible signals to sound continuously for 4 SEC to indicate trouble condition.
      g. System shall have eight distinctive walk test groups such that only a portion of system need be disabled during testing and an alarm in any other area will be processed normally.

M. General Alarm Circuits: Positive non-interfering type so that a second device can be annunciated simultaneously, or closely following first zone.

N. Power Supply:
   1. Power limited operation per NFPA 70, Article 760.
   2. 120 VAC dedicated circuit from panel board to integral 24 VDC regulated power supply in RSFACU and battery charger.
      a. The power supply shall provide all panel and peripheral device power needs.
   3. If the RSFACU cannot provide power for the required number of notification appliances a power extender shall be used.
      a. An additional 120 VAC dedicated circuit from a panel board shall be used to power the power extenders power supply and battery charger.
   4. Provide transient voltage surge suppression (TVSS) for the RSFACU for power supply and communication channel(s).

O. Battery:
   1. Low maintenance sealed type, for fire alarm use with automatic battery charger.

2. Sprinkler supervisory and releasing system fire alarm systems without voice evacuation capability shall be provided with batteries capable of operating maximum normal load of system for 24 HRS and then capable of operating system for 5 minutes in alarm condition.
3. Size batteries for the total maximum number of devices that can be connected to the RSFACU not the install number of devices.

2.4 INITIATING DEVICES

A. Addressable Manual Pull Stations:
   1. Pull-type with handle which shall lock in a protruding manner to facilitate quick visual identification of activated station.
      a. Reset using key or special tool after operation.
      b. Non-coded.
      c. Double action.
   2. High impact red Lexan with operating directions in white letters.
      a. Semi-flush mounted in architecturally finished areas.
      b. Surface mounted in non-architecturally finished areas.
      c. Surface mounted with clear Lexan weatherproof protective shield in areas designated as wet or in areas indicated in the schedules herein.
      d. A clear cover shall be placed over the manual pull station that actuates the preaction valve to fill the sprinkler system with water. The clear cover shall lift / rotate to allow activation of the device. This manual pull station shall be clearly labeled.
   3. Stations shall be keyed alike with RSFACU.
   4. Standards: UL 38.

B. Addressable Detector Base:
   1. Plug-in arrangement:
      a. Detector and associated encapsulated electronic components are mounted in a module that connects to a fixed base with a twist-locking plug connection.
      b. The plug connection requires no springs for secure mounting and contact maintenance.
      c. Terminals in the fixed base accept building wiring.
      d. Detector construction shall have a mounting base with a twist-lock detecting head that is lockable.
      e. The locking feature must be field removable when not required.
      f. Removal of the detector head shall interrupt the supervisory circuit of the sprinkler supervisory and releasing system fire alarm detection loop and cause a trouble signal at the RSFACU.
   2. LED that will flash each time it is scanned by the RSFACU.
      a. When the Control Unit determines that a detector is in an alarm or a trouble condition, the Control Unit shall command the LED on that detector's base to turn on steady indicating that abnormal condition exists.
      b. Detectors which do not provide a visible indication of an abnormal condition at the detector location shall not be acceptable.
   3. Each detector shall be scanned by the Control Unit for its type identification to prevent inadvertent substitution of another detector type.
      a. The Control Unit shall operate with the installed device but shall initiate a "Wrong Device" or “Incorrect Device ID” trouble condition until the proper type is installed or the programmed detector type is changed.
   4. Addressability: Detectors include a communication transceiver in the detector or mounting base having a unique identification and capability for status reporting to the RSFACU.
   5. Provide auxiliary relays in detector base to provide local control of equipment as described under system operation.
      a. Provide separate 24 VDC supply to detector base with auxiliary relays to guarantee that sufficient power will be available to operate relays.

C. Addressable Heat Detectors:
   1. Fixed temperature type.

2. Rated at 135 DEGF for ordinary areas where normal ceiling temperatures do not exceed 100 DEGF, or rated 190 DEGF for up to 150 DEGF ceiling temperatures. Rated at 195 DEGF for areas where high temperature sprinkler heads are used.
3. Self-restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
4. Quantity and spacing based upon manufacturer's UL listed spacing and the following:
    a. Provide detectors in accordance with NFPA 72 and the requirements of the AHJ.
    b. Devices shall be suitable for environment in which they are installed.
    c. For ceilings higher than the base UL listing, reduce spacing as required by manufacturer and NFPA 72.
5. The detector's electronics shall be immune from false alarms caused by EMI and RFI.
6. Standards: UL 521.

D. Linear Heat Detection:
1. The linear heat detection cable shall be a fixed temperature sensing element comprised of two electrical current carrying wires separated by a heat sensitive insulation material.
2. The detection cable shall detect the specified temperature anywhere along the detector length, regardless of the source of the heat. Averaging, analog-integrating, or thermistor-type detection cables, and rate compensated, or rate-of-rise detection devices, are not acceptable.
3. Detectors that depend on open flame, density of smoke, or rate of temperature increase are not acceptable.
4. The detection cable shall be constructed by spiral wrapping the two conductors with a protective mylar tape and then wrapping them in protective outer coverings of cotton braid, PVC, or weather resistant Nylon as required for the intended environment. The detection cable shall be capable of withstanding severe seasonal temperature variations and structural vibrations. The temperature rating of the detection cable shall be clearly printed on the cable jacket.
5. When the detection cable will be required to span distances in excess of the manufacturer's standard mounting guidelines, it shall be constructed with an integral messenger wire. The messenger wire shall consist of a high tensile strength corrosion-resistant steel wire which shall be wrapped around the detection cable at a minimum rate of one turn per linear foot of cable length.
6. The initiating circuits shall be capable of intrinsically safe service and approved for Class I, II, or III, Div. 1, 2, or 3, and applicable groups A, B, C, D, E, F, & G.
7. The detection cable shall be available in several temperature settings to allow for different ambient space temperature ranges and alarm points.
8. The detection cable temperature ranges shall be selected for the expected maximum ambient temperature and the alarm activation temperature suitable for the application in accordance with the manufacturer's guidelines.
9. Detection cables of different temperature ratings shall have the ability to be easily spliced together in series without affecting the adjacent detector alarm point.

E. Addressable Smoke Detectors:
1. Photoelectric type that utilizes a sensor chamber with a light source and a photosensitive element that detects products of combustion.
2. Self-restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
3. Quantity and spacing based upon manufacturer's UL listed spacing and the following:
    a. Provide detectors in accordance with NFPA 72 and the requirements of the AHJ.
    b. Devices shall be suitable for environment in which they are installed.
    c. Spacing shall be reduced for increased air changes as required by NFPA 72.
4. Detectors in non-accessible or controlled access locations shall be provided with a remotely located test switch to provide for ease of testing.
5. The detector's electronics shall be immune from false alarms caused by EMI and RFI.
6. Standards: UL 268.

F. Addressable Monitor Modules:
   1. Provides addressability and supervision to a conventional initiating device (e.g., tamper switches, pressure switches, flow switches, etc).
      a. The conventional initiating device shall be wired Class B, Style B.
   2. Integral or remote LED shall be provide that will flash each time it is scanned by the RSFACU.
      a. When the RSFACU determines that a monitor module is in an alarm or a trouble condition, the RSFACU shall command the LED on that module to turn on steady, change color, or otherwise indicate that an abnormal condition exists.

G. Sprinkler System Devices:
   1. Provide monitor module as specified herein for waterflow switches(s).
      a. Waterflow switches provided in Specification Section 21 05 00.
   2. Provide monitor module as specified herein for pressure switch(es).
      a. Pressure switch(es) provided in Specification Section 21 05 00.
   3. Provide monitor module as specified herein, for tamper switches associated with main water valve, post indicator valve (PIV) or OS&Y valves.
      a. Tamper switches provided in Specification Section 21 05 00.
   4. Monitor fire pump per Specification Section 21 05 00.

2.5 AUTOMATIC CONTROL DEVICES

A. Addressable Relay/Control Modules:
   1. Allows RSFACU to control a remotely located Form "C" contact (e.g., HVAC fans, dampers, fire shutters, elevator capture).

2.6 MISCELLANEOUS DEVICES

A. Isolated Loop Circuit Protector (Transient Suppression):
   1. Hybrid solid state high performance suppression system.
      a. Do not use gas tubes, spark gaps or other suppression system components which might short or crowbar the line resulting in interruption of normal power flow to connected loads.
   2. Line-to-line response time of less than 1 nanosecond capable of accepting a 2000 A (8 x 20 usec pulse) at 28 V.
   3. Line-to-ground response time of less than 1 nanosecond capable of accepting a 2000 A (8 x 20 usec pulse) to earth.
   4. Shield-to-ground shall be capable of accepting a 5,000 A (10 x 50 usec pulse) to earth.
   5. Standard: UL 497B.

B. Fault Isolation Module:
   1. Bi-directional short circuit protection for SLC communication lines.
   2. Isolators optimize communication integrity by creating device groups, any group with short circuited wiring can be isolated, allowing communications to continue to the other groups.
   3. RSFACU mounted or individually mounted.

2.7 WIRING

A. Conduit:
   1. 1/2 IN minimum.
   2. See Specification Section 26 05 33.

B. Conductors:
   1. Insulation type per NFPA 70, Article 760.
   2. 120 VAC and power supply connections: 12 GA, minimum.
   3. Low-voltage general alarm circuits: 14 GA, minimum.
   4. Low-voltage initiating circuits: 18 GA, minimum.
   5. Annunciator and data communication circuits: As required by manufacturer, UL listed.
   6. Use larger wire sizes when recommended by equipment manufacturer and per voltage drop calculations.

C. Outlet Boxes: See Specification Section 26 05 33.

2.8 SYSTEM OPERATION

A. Activation of any alarm-causing initiating device shall cause the following:
   1. Automatic control devices to operate as defined by the operating sequences.
   2. Alarm information shall be displayed at the RSFACU.

B. Activation of any system trouble shall initiate the following:
   1. Common audible trouble signal shall sound and common trouble light shall illuminate at the RSFACU.
   2. Specific device in trouble shall be indicated.

C. Audible trouble signal shall be silenceable by RSFACU.
   1. Visual trouble indication remains until trouble condition is corrected.
      a. A subsequent trouble condition received after manually silencing shall cause audible trouble signal to resound.
      b. Restoration of system to normal causes audible trouble signal until silencing switch is returned to normal position.
   2. Trouble signal(s) will be initiated under following conditions:
      a. Open on an initiation or alarm indicating circuit.
      b. Ground fault condition.
      c. Auxiliary manual control switch out of normal position.
      d. Loss of 120 VAC operating power to the RSFACU.
      e. Low or no battery voltage condition.
      f. Main sprinkler valve is closed.
      g. Post indicator valve is closed.
      h. Any sprinkler or standpipe indicating valve is closed.
      i. Fire pump controller signals:
         1) Motor or pump running condition.
         2) Loss of line power to any phase on line side of fire pump motor starter.
         3) Phase reversal on line side of fire pump motor starter.
         4) Fire pump transfer switch isolating means is open.
         5) Engine generator not in automatic mode.

D. Install isolated loop circuit protectors on all sprinkler supervisory and releasing system fire alarm data communication circuits, SLC and NAC wiring, including shields, which extends beyond the building.
   1. The isolated loop circuit protector shall be located as close as practicable to the point at which the circuits leave or enter a building.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all sprinkler supervisory and releasing system fire alarm equipment and wiring in accordance with local and national codes and NFPA 72.

B. Install all wiring in raceways and all devices in boxes:
   1. Install raceways and boxes in accordance with Specification Section 26 05 33.
   2. In unfinished areas, exposed sprinkler supervisory and releasing system fire alarm conduit shall be red in color.
   3. All boxes are to be red in color (either painted or a manufacturer’s red box).

C. Install all components as indicated and in accordance with manufacturer's wiring diagrams, instructions and recommendations.

D. Make all sprinkler supervisory and releasing system fire alarm wiring continuous from terminal to terminal or from terminal to device pigtail lead.
   1. Circuit splices not permitted.

2. Wiring joints, only when required at device pigtail leads shall utilize insulated conical spring connector.

E. Color coding or other identification is required for all sprinkler supervisory and releasing system fire alarm wiring.
   1. Coordinate requirements with Owner.

F. Installation of equipment and devices that pertain to other work in contract shall be closely coordinated with appropriate subcontractors.
   1. Coordinate 8 IN minimum square access door with rubber gasket in duct approximately 2 FT upstream from smoke detector for testing and servicing.

G. Detection devices shall be protected during construction as required by NFPA 72.

H. Device Mounting Schedule:
   1. Dimensions are to center of item unless otherwise indicated.
   2. Mounting heights as indicated below unless otherwise indicated on the Contract Drawings.
      a. Manual pull stations (Install per ADA and ADAAG Standards):
         1) Forward Reach.
            a) Unobstructed: Maximum 48 IN.
            b) Obstructed High Reach (depth less than 20 IN): Maximum 48 IN.
            c) Obstructed High Reach (depth greater than 20 IN): Maximum 44 IN.
         2) Side Reach.
            a) Unobstructed: Maximum 48 IN.
         3) Obstructed High Reach (reach depth less than 10 IN): Maximum 48 IN.
         4) Obstructed High Reach (reach depth greater than 10 IN): Maximum 46 IN.
      b. Notification appliances: Lens is not less than 80 IN and not greater than 96 IN.
      c. Control panels and remote annunciators: 72 IN to top (display at eye level).

I. Linear Heat Detection:
   1. When mounted on ceilings, the following shall be observed:
      a. The linear heat detection cable shall be located on the ceiling or side wall not more than 20 inches from the ceiling.
      b. Except in the case of solid open joist construction, the linear heat detection cable shall be mounted on the bottom of the joists. In the case of beam construction where beams are less than 12 inches in depth and less than 8 feet on center, the linear heat detection cable may be installed at the bottom of the beam.
   2. As a minimum, the linear heat detection cable shall be formed in accordance with the following:
      a. The cable shall be installed by hand; mechanical devices shall not be applied to the cable.
      b. All bending and fitting shall be performed with installer's fingers. Pliers or other hand tools shall not be used to form the cable.
      c. The minimum bend radius shall be two and one-half (2 ½) inches; bends shall be freely formed, consistent with the nature of the cable.
   3. As a minimum, the linear heat detection cable shall be fastened and supported to maintain tautness in accordance with the following:
      a. Only fastening and support devices approved by the manufacturer shall be used to support or connect the cable.
      b. Only stapling machines or tackers approved by the manufacturer shall be used to fasten the cable.
      c. Only mounting clips approved by the manufacturer shall be used to attach the cable.
      d. Fastening and supporting devices, including staples, straps, and mounting clips, shall not be placed at intervals greater than ten (10) feet.
      e. When messenger wire is used to support the linear heat detection cable, turnbuckles and eyebolts shall be employed at each end of the wire. The messenger wire turnbuckles and eyebolts shall be mounted to fixed points. The linear heat detection cable shall be unwrapped from the messenger wire far enough to form a loop in the messenger wire.

The loop shall be clamped with a U-bolt and the loop slipped over the turnbuckle and the turnbuckle adjusted such that the messenger wire has only a little sag. The messenger wire supports shall not exceed 250 feet in length. Messenger cables shall be supported at a minimum of every 50 feet using a standoff with a grommet. Support the linear heat detection cable at each end of the run with a double looped cable strap, when mounting to sprinkler branch lines.

4. The linear heat detection cable shall be installed in a manner to protect it from physical damage. In areas where it may be subject to physical damage, the contractor shall install mechanical protection for the cable. As a minimum, the cable shall be protected in accordance with the following:
    a. In areas subject to abrasion and/or pinching, the cable shall be mechanically and electrically insulated, as recommended by the manufacturer.
    b. When the cable passes through a wall, beam, or joist, the hole shall be large enough to allow the cable to be freely drawn through the opening. The cable shall be protected when passing through masonry walls with conduit, tape, or PVC sleeving.
    c. A bushing shall be installed at the open end of metal conduit through which the cable enters or exits.
    d. In areas where the linear heat detection cable is subject to abuse, it shall be installed in perforated stainless steel conduit in accordance with the manufacturer's guidelines.
    e. When the cable is installed lower than seven (7) feet from the floor, or when the area to be protected is less than seven (7) feet in the air and unprotected by a structure, the contractor shall install physical protection in accordance with the manufacturer's guidelines.
5. As a minimum, the linear heat detection cable shall be connected in accordance with the following:
    a. The length of the linear heat detection circuits shall not exceed the limits prescribed by the manufacturer, unless otherwise expressly stipulated in writing and approved by the manufacturer.
    b. Detection circuit wire other than linear heat detection cable provided by the manufacturer shall not be employed for any part of any linear heat and fire detection circuit, other than field cables from the RSFACU to the start or end of the detection circuit.
    c. All linear heat and fire detection zones shall be terminated in the RSFACU.
    d. All linear heat detection cable and fire protection circuits shall be wired in series loop configuration. Circuits with T taps or Y branches shall not be acceptable.
    e. Except where special fittings are used, all connections to terminals shall be made by means of soft copper leads (PFL) furnished by the manufacturer.
    f. All splices made in the linear heat detection cable shall be made only by using splicing connectors furnished by the manufacturer.
    g. Provide end-of-line test stations where the detection circuit is extended in conduit down to a serviceable height (approximately 6'-0").

3.2 TESTING

A. Obtain services of factory trained representative of system manufacturer to supervise installation and its progress, supervise final connections to equipment and provide testing to assure that system is in proper operating condition, and is in compliance with all applicable regulations.

B. Entire system shall test free from opens, grounds, and short circuits.

C. Test system to satisfaction of Engineer and state and local fire authorities in accordance with NFPA 72, state and local codes and manufacturer's requirements. Test sprinkler supervisory and releasing system fire alarm system in accordance with requirements from the Poudre Fire Authority Contractor's Handbook.

D. Acceptance Operational Tests:
    1. Perform operational system tests to verify conformance with specifications:
        a. Each alarm initiating device installed shall be operationally tested.

b. Each device shall be tested for alarm and trouble conditions.
c. Submit written certification that the sprinkler supervisory and releasing system fire alarm system installation is complete including all punch-list items.
d. Test battery operated emergency power supply. Test emergency power supply to minimum durations specified.
e. Test supervising station signal transmitter. Coordinate testing with supervising station monitoring firm/entity.
f. Test each notification appliance installed for proper operation. Submit written report indicating sound pressure levels at specified distances.
g. Test RSFACU.

2. Provide minimum 5 business days' notice of acceptance test performance schedule to Owner, and local Authority Having Jurisdiction (AHJ).

E. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by system test that total system meets Specifications and complies with applicable standards.

F. Report of Tests and Inspections: Provide written record of inspections, tests, and detailed test results in form of test log. Use NFPA 72 Forms for documentation.

G. Final Test, Record of Completion, and Certificate of Occupancy:

H. Test system as required by Authority Having Jurisdiction in order to obtain certificate of occupancy. Provide completed NFPA 72 Record of Completion form to Owner and AHJ.

3.3 CLEANING AND ADJUSTING

A. Cleaning: Remove paint splatters and other spots, dirt, and debris from all devices and equipment panels. Clean panel internally using methods and materials recommended by manufacturer.

B. Occupancy Adjustments: When requested within one year of date of substantial completion, provide on-site assistance in adjusting sound pressure levels and adjusting controls and sensitivities to suit actual occupied conditions. Provide up to three visits to site for this purpose.

3.4 TRAINING

A. Provide services of factory-authorized service representative to demonstrate system and train Owner's personnel in operation of system as specified below.
1. Train Owner's maintenance personnel in procedures and schedules involved in operating, troubleshooting, servicing, and preventive maintaining of system.
2. Provide minimum of 8 HRS training.
3. Schedule training with Owner at least two weeks in advance.
4. Fill out Owner instruction reports.

END OF SECTION

DIVISION 31

EARTHWORK

SECTION 31 10 00
SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Site clearing, tree protection, stripping topsoil and demolition.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 31 23 00 - Earthwork.
   4. Section 31 25 00 - Soil Erosion and Sediment Control.
   5. Section 32 91 13 - Topsoiling and Finished Grading.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION

3.1 PREPARATION

A. Clearly define limits of Construction and install all erosion control prior to commencing any earthwork/land clearing activities.

B. Contractor shall coordinate with Owner to ensure existing operations are not interrupted by construction activities.

C. Protect existing trees and other vegetation to remain against damage.
   1. Do not smother trees by stockpiling construction materials or excavated materials within drip line.
   2. Avoid foot or vehicular traffic or parking of vehicles within drip line.
   3. Provide temporary protection as required.

D. Repair or replace trees and vegetation damaged by construction operations.
   1. Repair to be performed by a qualified tree surgeon/licensed arborist.
   2. Remove trees which cannot be repaired and restored to full-growth status.
   3. Replace with new trees of minimum 4 IN caliper or as required by local tree ordinance.

E. Owner will obtain authority for removal and alteration work on adjoining property, as applicable.

3.2 SITE CLEARING

A. Topsoil Removal:
   1. Strip topsoil to depths encountered or as specified within the soils report, 4 IN minimum.
      a. Remove heavy growths of grass before stripping.
      b. Stop topsoil stripping sufficient distance from such trees to prevent damage to main root system.
      c. Separate from underlying subsoil or objectionable material.
   2. Stockpile topsoil where directed by Engineer.
      a. Construct storage piles to freely drain surface water.
      b. Seed or cover storage piles to prevent erosion.
   3. Do not strip topsoil in wooded areas where no change in grade occurs.
   4. Borrow topsoil: Reasonably free of subsoil, objects over 2 IN DIA, weeds and roots.

B. Clearing and Grubbing:

1. Clear from within limits of construction all trees not marked to remain.
    a. Include shrubs, brush, downed timber, rotten wood, heavy growth of grass and weeds, vines, rubbish, structures and debris.
2. Grub (remove) from within limits of construction all stumps, roots, root mats, logs and debris encountered.

C. Disposal of Waste Materials:
1. Do not burn combustible materials on site.
2. Remove all waste materials from site.
3. Do not bury organic matter on site.

END OF SECTION

SECTION 31 23 00
EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Earthwork - excavation, backfilling, grading, compaction, disposal of waste and surplus materials, placing crushed stone, construction of berms, sheeting, bracing, dewatering and other Earthwork related work.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 07 26 00 - Under Slab Vapor Retarder.
   4. Section 31 25 00 - Soil Erosion and Sediment Control.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. C33/C33M, Standard Specification for Concrete Aggregates.
      b. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 FT-LBF/FT^3).
      c. D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 FT-LBF/FT^3(2,700 kN-M/M^3)).
      d. D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
      e. D3786, Standard Test Method for Bursting Strength of Textile Fabrics--Diaphragm Bursting Strength Tester Method.
      f. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
      g. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
      h. D4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
   2. Occupational Safety and Health Administration (OSHA):
      a. 29 CFR Part 1926.650, Safety and Health Regulations for Construction - Excavations, referred to herein as OSHA Standards.

1.3 DEFINITIONS

A. Excavation:
   1. Consists of removal of material encountered to subgrade elevations required or indicated.
   2. Includes excavation of soils; pavements and other obstructions visible on surface; underground structures, utilities, and other items indicated to be demolished and removed; boulders; and rock.

B. Foundations: Footings, base slabs, foundation walls, mat foundations, grade beams, piers and any other support placed directly on soil or rock.

C. Geotechnical Engineer: Independent geotechnical specialist providing field quality control for the project.

D. Non-Structural Fill/Backfill: Soil materials placed and compacted to achieve finish grade elevations that do NOT support foundations, slabs, paving, or other flatwork.

E. Structure: Buildings, foundations, slabs, tanks, curbs, or other man-made stationary features occurring above or below ground surface.

F. Subgrade: The earth or soil layer immediately below foundation bearing elevation, subbase material, fill material, backfill material, or topsoil materials.

G. Unauthorized Excavation:
   1. Consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Engineer.
      a. Unauthorized excavation, as well as associated remedial work as directed by Engineer or Geotechnical Engineer, shall be at Contractor's expense.
   2. Unsuitable Soil Materials: Soil materials encountered at or below subgrade elevation of insufficient strength and stiffness to support construction as determined by the Geotechnical Engineer.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   3. Certifications.

B. Samples:
   1. Coordinate samples and testing for approval of off-site materials with the Geotechnical Engineer.
   2. Test reports.

1.5 PROJECT CONDITIONS

A. Salvageable Items: Carefully remove items to be salvaged, and store on Owner's premises unless otherwise directed.

B. Dispose of waste materials, legally, off site.
   1. Burning, as a means of waste disposal, is not permitted.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fill and Backfill:
   1. Selected material approved by Geotechnical Engineer from site excavation or from off site borrow.
   2. Structural Fill:
      a. Free of organic matter and debris.
      b. Granular soil:
         1) ASTM D2487 classification: SP SP-SM.
   3. Non-Structural Fill:
      a. ASTM D2487 classification: SP or SM.
      b. Liquid limit: Less than 45.
      c. Maximum plasticity index: 20.

B. Granular Fill Under Building Floor Slabs-On-Grade, Electrical Equipment Pads, Manholes and Handholes:
   1. Clean, granular material.
   2. Less than 5 PCT fines passing the No. 200 sieve.
   3. ASTM C33/C33M gradation size No. 57, 3/4 IN to No. 4 or other material acceptable to Geotechnical Engineer.

C. Granular Fill Under Base Slabs with Pressure Relief Valves:
   1. Drainage material: Conform to ASTM C33/C33M, Size No. 67.

2. Filter material: Conform to ASTM C33/C33M requirements for fine aggregate.

D. Granular Fill Under Electrical Equipment Pads, Manholes and Handholes: Clean, crushed, nonporous rock, crushed or uncrushed gravel complying with ASTM C33/C33M gradation size No. 67, 3/4 IN to No. 4.

E. Geotextile Filter Fabric:
   1. Nonwoven type.
   2. Equivalent opening size: 50 - 100 (U.S. Standard Sieve).
   3. Permeability coefficient (cm/second): 0.07 minimum, 0.30 maximum.
   4. Grab strength: 90 LBS minimum in either direction in accordance with ASTM D4632 requirements.
   5. Mullen burst strength: 125 PSI minimum in accordance with ASTM D3786 requirements.

F. Vapor Retarder: Refer to Specification Section 07 26 00.

PART 3 - EXECUTION

3.1 PROTECTION

A. Erosion Control:
   1. See Specification Section 31 25 00.
   2. Clean paved roadways daily of any spillage of dirt, rocks or debris from vehicles and equipment entering or leaving site.
   3. Conduct work to minimize erosion of site. Remove eroded material washed off site.
      a. If necessary or requested by Engineer, construct stilling areas to settle and detain eroded material.

B. Protect existing surface and subsurface features on-site and adjacent to site as follows:
   1. Provide barricades, coverings, or other types of protection necessary to prevent damage to existing items indicated to remain in place.
   2. Protect and maintain bench marks, monuments or other established reference points and property corners.
      a. If disturbed or destroyed, replace at own expense to full satisfaction of Owner and controlling agency.
   3. Verify location of utilities.
      a. Omission or inclusion of utility items does not constitute nonexistence or definite location.
      b. Secure and examine local utility records for location data.
      c. Take necessary precautions to protect existing utilities from damage due to any construction activity.
         1) If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations.
         2) Do not interrupt existing utilities serving facilities occupied by Owner or others, during occupied hours, except when permitted in writing by Owner and then only after acceptable temporary utility services have been provided.
         3) Obtain Owner's approval prior to disconnecting any utility service.
      d. Repair damages to utility items at own expense.
      e. In case of damage, notify Engineer at once so required protective measures may be taken.
   4. Maintain free of damage, existing sidewalks, structures, and pavement, not indicated to be removed.
      a. Protect new and existing structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
      b. Any item known or unknown or not properly located that is inadvertently damaged shall be repaired to original condition.
      c. All repairs to be made and paid for by Contractor.

5. Provide full access to public and private premises, fire hydrants, street crossings, sidewalks and other points as designated by Owner to prevent serious interruption of travel.
6. Maintain stockpiles and excavations in such a manner to prevent inconvenience or damage to structures on-site or on adjoining property.
7. Avoid surcharge or excavation procedures which can result in heaving, caving, or slides.

3.2 SITE EXCAVATION AND GRADING

A. The site excavation and grading work includes the offsite disposition of all material:
   1. That exceed quantities required for earthwork on the project.
   2. That the Geotechnical engineer classifies as unclassified excavation.
   3. That the Geotechnical engineer classifies as unacceptable.
   4. That the Geotechnical engineer classifies as potentially contaminated.

B. Excavation and Grading:
   1. Perform as required by the Contract Drawings.
   2. Contract Drawings may indicate both existing grade and finished grade required for construction of Project.
      a. Stake all units, structures, piping, roads, parking areas and walks and establish their elevations.
      b. Perform other layout work required.
      c. Replace property corner markers to original location if disturbed or destroyed.
   3. Preparation of ground surface for embankments or fills:
      a. Before fill is started, scarify to a minimum depth of 6 IN in all proposed embankment and fill areas.
      b. Where ground surface is steeper than one vertical to four horizontal, plow surface in a manner to bench and break up surface so that fill material will bind with existing surface.
   4. Protection of finish grade:
      a. During construction, shape and drain embankment and excavations.
      b. Maintain ditches and drains to provide drainage at all times.
      c. Protect graded areas against action of elements prior to acceptance of work.
      d. Reestablish grade where settlement or erosion occurs.

C. Borrow:
   1. Provide necessary amount of approved fill compacted to density equal to that indicated in this Specification.
   2. Include cost of all borrow material in original proposal.
   3. Fill material to be approved by Geotechnical Engineer prior to placement.

D. Construct embankments and fills as required by the Contract Drawings:
   1. Construct embankments and fills at locations and to lines of grade indicated.
      a. Completed fill shall correspond to shape of typical cross section or contour indicated regardless of method used to show shape, size, and extent of line and grade of completed work.
   2. Provide approved fill material which is free from roots, organic matter, trash, frozen material, and stones having maximum dimension greater than 6 IN.
      a. Ensure that stones larger than 4 IN are not placed in upper 6 IN of fill or embankment.
      b. Do not place material in layers greater than 8 IN loose thickness.
      c. Place layers horizontally and compact each layer prior to placing additional fill.
   3. Compact soils as required to obtain specified density. Selection of appropriate equipment is the Contractor's responsibility.
      a. In general, compact cohesive soils by sheepsfoot, and granular soils by pneumatic rollers, vibrators, or by other equipment as required to obtain specified density.
      b. Control moisture for each layer necessary to meet requirements of compaction.

E. Grading Tolerances: 1.0±IN.

3.3 USE OF EXPLOSIVES

A. Blasting with any type of explosive is prohibited.

3.4 COMPACTION DENSITY REQUIREMENTS

A. Obtain approval from Geotechnical Engineer with regard to suitability of soils and acceptable subgrade prior to subsequent operations.

B. Provide dewatering system necessary to successfully complete compaction and construction requirements.

C. Remove frozen, loose, wet, or soft material and replace with approved material as directed by Geotechnical Engineer.

D. Stabilize subgrade with well graded granular materials as directed by Geotechnical Engineer.

E. Assure by results of testing that compaction densities comply with the following requirements:
   1. Sitework:

LOCATION	COMPACTION DENSITY	MOISTURE CONTENT
Under Paved Areas, Sidewalks and Piping:		
Cohesive soils	95 PCT per ASTM D698	-2 to +3 PCT of optimum
Cohesionless soils	75 PCT relative density per ASTM D4253 and ASTM D4254	
Unpaved Areas:		
Cohesive soils	90 PCT of ASTM D698	-2 to +3 PCT of optimum
Cohesionless soils	65 PCT relative density per ASTM D4253 and ASTM D4254	

   2. Structures:

LOCATION	COMPACTION DENSITY	MOISTURE CONTENT
Inside of structures under foundations, under equipment support pads, under slabs-on-grade and scarified existing subgrade under fill material	95 PCT per ASTM D1557	-2 to +3 PCT of optimum
Outside structures next to walls, piers, columns and any other structure exterior member	95 PCT per ASTM D1557	-2 to +3 PCT of optimum

   3. Specific areas:

LOCATION	COMPACTION DENSITY	MOISTURE CONTENT
Outside structures under equipment support foundations	95 PCT per ASTM D1557	-2 to +3 PCT of optimum
Under void	85 PCT per ASTM D1557	-2 to +3 PCT of optimum
Granular fill under base slabs with pressure relief valves	75 PCT relative density per ASTM D4253 and ASTM D4254 or 95 PCT of ASTM D1557	
Granular fill under building floor slabs-on-grade	60 PCT relative density per ASTM D4253 and ASTM D4254	

3.5 EXCAVATION, FILLING, AND BACKFILLING FOR STRUCTURES

A. General:
   1. In general, work includes, but is not necessarily limited to, excavation for structures and retaining walls, removal of underground obstructions and undesirable material, backfilling, filling, and fill, backfill, and subgrade compaction.
   2. Obtain fill and backfill material necessary to produce grades required.
      a. Materials and source to be approved by Geotechnical Engineer.
      b. Excavated material approved by Geotechnical Engineer may also be used for fill and backfill.
   3. In the paragraphs of this Specification Section, the word "soil" also includes any type of rock subgrade that may be present at or below existing subgrade levels.

B. Excavation Requirements for Structures:
   1. General:
      a. Do not commence excavation for foundations for structures until Geotechnical Engineer approves:
         1) The removal of topsoil and other unsuitable and undesirable material from existing subgrade.
         2) Density and moisture content of site area compacted fill material meets requirements of specifications.
         3) Site surcharge or mass fill material can be removed from entire construction site or portion thereof.
         4) Surcharge or mass fill material has been removed from construction area or portions thereof.
      b. Engineer grants approval to begin excavations.
   2. Dimensions:
      a. Excavate to elevations and dimensions indicated or specified.
      b. Allow additional space as required for construction operations and inspection of foundations.
      c. Slope sides of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction.
      d. Maintain sides and slopes of excavations in safe condition until completion of backfilling.
   3. Removal of obstructions and undesirable materials in excavation includes, but is not necessarily limited to, removal of old foundations, existing construction, unsuitable subgrade soils, expansive type soils, and any other materials which may be concealed beneath present grade, as required to execute work indicated on Contract Drawings.
      a. If undesirable material and obstructions are encountered during excavation, remove material and replace as directed by Geotechnical Engineer.
      b. Remove unsuitable subgrade soils located below foundations. The bottom of the overexcavation shall be located outside the exterior limits of foundations around the perimeter of structure the following horizontal distance, whichever is greater:
         1) Distance equal to depth of overexcavation below bottom of foundations.
         2) 5 FT.
         3) As directed by Geotechnical Engineer.
      c. When excavation has reached required subgrade elevations, notify Geotechnical Engineer, who will make an inspection of conditions.
         1) If Geotechnical Engineer determines that bearing materials at required subgrade elevations are unsuitable, provide Subgrade Stabilization as specified herein.
   4. Install working surface over approved subgrade.
      a. Minimum thickness: by General Contractor.
   5. Level off bottoms of excavations to receive foundations, floor slabs, equipment support pads, or compacted fill.
      a. Remove loose materials and bring excavations into approved condition to receive concrete or fill material.

b. Where compacted fill material must be placed to bring subgrade elevation up to underside of construction, scarify existing subgrade upon which fill material is to be placed to a depth of 6 IN and then compact to density stated in this Specification Section before fill material can be placed thereon.
c. Do not carry excavations lower than shown for foundations except as directed by Geotechnical Engineer or Engineer.
d. If any part of excavations is carried below required depth without authorization, notify Engineer and correct unauthorized excavation as directed. Corrections may include:
    1) Under soil supported footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation.
        a) Concrete fill may be used to bring elevations to proper position.
    2) In locations other than those above, including slabs on grade and pile supported foundations, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Geotechnical Engineer.
    3) No extra compensation will be made to Contractor for correcting unauthorized excavations.

6. Make excavations large enough for working space, forms, damp proofing, waterproofing, and inspection.
7. Notify Geotechnical Engineer and Engineer as soon as excavation is completed in order that subgrades may be inspected.
    a. Do not commence further construction until subgrade under compacted fill material, under foundations, under floor slabs-on-grade, under equipment support pads, and under retaining wall footings has been inspected and approved by the Geotechnical Engineer as being free of undesirable material, being of compaction density required by this specification, and being capable of supporting the allowable foundation design bearing pressures and superimposed foundation, fill, and building loads to be placed thereon.
    b. Geotechnical Engineer shall be given the opportunity to inspect subgrade below fill material both prior to and after subgrade compaction.
    c. Place fill material, foundations, retaining wall footings, floor slabs-on-grade, and equipment support pads as soon as weather conditions permit after excavation is completed, inspected, and approved and after forms and reinforcing are inspected and approved.
    d. Before concrete or fill material is placed, protect approved subgrade from becoming loose, wet, frozen, or soft due to weather, construction operations, or other reasons.
8. Dewatering:
    a. Where groundwater is or is expected to be encountered during excavation, install a dewatering system to prevent softening and disturbance of subgrade below foundations and fill material, to allow foundations and fill material to be placed in the dry, and to maintain a stable excavation side slope.
    b. Groundwater shall be maintained at least 3 FT below the bottom of any excavation.
    c. Review Geotechnical investigation before beginning excavation and determine where groundwater is likely to be encountered during excavation.
    d. Employ dewatering specialist for selecting and operating dewatering system.
    e. Keep dewatering system in operation until dead load of structure exceeds possible buoyant uplift force on structure.
    f. Dispose of groundwater to an area which will not interfere with construction operations or damage existing construction.
        1) Install groundwater monitoring wells as necessary.
    g. Shut off dewatering system at such a rate to prevent a quick upsurge of water that might weaken the subgrade.
9. Subgrade stabilization:
    a. If subgrade under foundations, fill material, floor slabs-on-grade, or equipment support pads is in a frozen, loose, wet, or soft condition before construction is placed thereon,

remove frozen, loose, wet, or soft material and replace with approved compacted material as directed by Geotechnical Engineer.

b. Provide compaction density of replacement material as stated in this Specification Section.
c. Loose, wet, or soft materials, when approved by Geotechnical Engineer, may be stabilized by a compacted working mat of well graded crushed stone.
d. Compact stone mat thoroughly into subgrade to avoid future migration of fines into the stone voids.
e. Remove and replace frozen materials as directed by Geotechnical Engineer.
f. Method of stabilization shall be performed as directed by Geotechnical Engineer.
g. Do not place further construction on the repaired subgrades, until the subgrades have been approved by the Geotechnical Engineer.

10. Do not place floor slabs-on-grade including equipment support pads until subgrade below has been approved, piping has been tested and approved, reinforcement placement has been approved, and Contractor receives approval to commence slab construction.
    a. Do not place building floor slabs-on-grade including equipment support pads when temperature of air surrounding the slab and pads is or is expected to be below 40 DEGF before structure is completed and heated to a temperature of at least 50 DEGF.
11. Protection of structures:
    a. Prevent new and existing structures from becoming damaged due to construction operations or other reasons.
    b. Prevent subgrade under new and existing foundations from becoming wet and undermined during construction due to presence of surface or subsurface water or due to construction operations.
12. Shoring:
    a. Shore, slope, or brace excavations as required to prevent them from collapsing.
    b. Remove shoring as backfilling progresses but only when banks are stable and safe from caving or collapse.
    c. Construct shoring that is required to retain water as part of the dewatering system, using non-permeable details such as interlock sealant for sheet piles.
13. Drainage:
    a. Control grading around structures so that ground is pitched to prevent water from running into excavated areas or damaging structures.
    b. Maintain excavations where foundations, floor slabs, equipment support pads or fill material are to be placed free of water.
    c. Provide pumping required to keep excavated spaces clear of water during construction.
    d. Should any water be encountered in the excavation, notify Engineer and Geotechnical Engineer.
    e. Provide free discharge of water by trenches, pumps, wells, well points, or other means as necessary and drain to point of disposal that will not damage existing or new construction or interfere with construction operations.
14. Frost protection:
    a. Do not place foundations, slabs-on-grade, equipment support pads, or fill material on frozen ground.
    b. When freezing temperatures may be expected, do not excavate to full depth indicated, unless foundations, floor slabs, equipment support pads, or fill material can be placed immediately after excavation has been completed and approved.
    c. Protect excavation from frost if placing of concrete or fill is delayed.
    d. Where a concrete slab is a base slab-on-grade located under and within a structure that will not be heated, protect subgrade under the slab from becoming frozen until final acceptance of the Project by the Owner.
    e. Protect subgrade under foundations of a structure from becoming frozen until structure is completed and heated to a temperature of at least 50 DEGF.

C. Fill and Backfill Inside of Structure and Below Foundations, Base Slabs, Floor Slabs, Equipment Support Pads and Piping:

1. General:
    a. Subgrade to receive fill or backfill shall be free of undesirable material as determined by Geotechnical Engineer and scarified to a depth of 6 IN and compacted to density specified herein.
    b. Surface may be stepped by at not more than 12 IN per step or may be sloped at not more than 2 PCT.
    c. Do not place any fill or backfill material until subgrade under fill or backfill has been inspected and approved by Geotechnical Engineer as being free of undesirable material and compacted to specified density.
2. Obtain approval of fill and backfill material and source from Geotechnical Engineer prior to placing the material.
3. Granular fill under floor slabs-on-grade: Place all floor slabs-on-grade on a minimum of 6 IN of granular fill unless otherwise indicated.
4. Vapor barrier: Install a continuous vapor barrier under floor slabs-on-grade as required by Specification Section 07 26 00 and shown on Contract Drawings.
5. Fill and backfill placement:
    a. Prior to placing fill and backfill material, optimum moisture and maximum density properties for proposed material shall be obtained from Geotechnical Engineer.
    b. Place fill and backfill material in thin lifts as necessary to obtain required compaction density.
    c. Compact material by means of equipment of sufficient size and proper type to obtain specified density.
    d. Use hand operated equipment for filling and backfilling within 5 FT of walls and less than 3 FT above pipes.
        1) Compaction equipment exceeding 3000 LBS dead weight shall not be used within 5 FT of the wall as a minimum
        2) Contractor is responsible for method of compaction so as not to damage wall.
    e. Use hand operated equipment for filling and backfilling next to walls.
    f. Do not place fill and backfill when the temperature is less than 40 DEGF and when subgrade to receive fill and backfill material is frozen, wet, loose, or soft.
    g. Use vibratory equipment to compact granular material; do not use water.
6. Where fill material is required below foundations, place fill material, conforming to the required density and moisture content as required to fill the specified overexcavation to bottom of foundation.

D. Filling and Backfilling Outside of Structures:
1. This paragraph of this Specification applies to fill and backfill placed outside of structures above bottom level of both foundations and piping but not under paving.
2. Provide material as approved by Geotechnical Engineer for filling and backfilling outside of structures.
3. Fill and backfill placement:
    a. Prior to placing fill and backfill material, obtain optimum moisture and maximum density properties for proposed material from Geotechnical Engineer.
    b. Place fill and backfill material in thin lifts as necessary to obtain required compaction density.
    c. Compact material with equipment of proper type and size to obtain density specified.
    d. Use hand operated equipment for filling and backfilling within 5 FT of walls and less than 3 FT above pipes.
        1) Compaction equipment exceeding 3000 LBS dead weight shall not be used within 5 FT of the wall as a minimum
        2) Contractor is responsible for method of compaction so as not to damage wall.
    e. Use only hand operated equipment for filling and backfilling next to walls and retaining walls.
    f. Do not place fill or backfill material when temperature is less than 40 DEGF and when subgrade to receive material is frozen, wet, loose, or soft.
    g. Use vibratory equipment for compacting granular material; do not use water.

4. Backfilling against walls:
    a. Do not backfill around any part of structures until each part has reached specified 28-day compressive strength and backfill material has been approved.
    b. Do not start backfilling until concrete forms have been removed, trash removed from excavations, pointing of masonry work, concrete finishing, dampproofing and waterproofing have been completed.
    c. Do not place fills against walls until floor slabs at top, bottom, and at intermediate levels of walls are in place and have reached 28-day required compressive strength to prevent wall movement.
        1) See Contract Drawings for specific exceptions.
    d. Bring backfill and fill up uniformly around the structures and individual walls, piers, or columns.

E. Backfilling Outside of Structures Under Piping or Paving:
1. When backfilling outside of structures requires placing backfill material under piping or paving, the material shall be placed from bottom of excavation to underside of piping or paving at the density required for fill under piping or paving as indicated in this Specification Section.
2. This compacted material shall extend transversely to the centerline of piping or paving a horizontal distance each side of the exterior edges of piping or paving equal to the depth of backfill measured from bottom of excavation to underside of piping or paving.
3. Provide special compacted bedding or compacted subgrade material under piping or paving as required by other Specification Sections for the Project.

3.6 FIELD QUALITY CONTROL

A. All excavation, trenching, and related sheeting, bracing, etc. shall comply with the requirements of OSHA Standards, and state requirements. Where conflict between OSHA and state regulations exists, the more stringent requirements shall apply.

B. Responsibilities of Field Quality Control Inspector:
1. Review proposed materials for fill and backfill around structures.
2. All testing, observation and work indicated as being performed by the Geotechnical Engineer in Article 3.5 of this Specification Section .
3. Services will include verification and documentation of satisfactory soil materials, subgrade quality, sampling, placement, moisture conditioning, compaction and testing of proposed soil materials, and field testing for quality control.
4. Moisture density relations, to be established by the Geotechnical Engineer required for all materials to be compacted.
5. Extent of compaction testing will be as necessary to assure compliance with specifications.
6. Prepare and submit inspection and test reports to Engineer.
    a. Coordinate such work with other Inspectors.
7. Test reports to include the following:
    a. Report and certification of aggregate fill and drainage fill.
    b. Test reports on borrow material.
    c. Verification of suitability of each footing subgrade material, in accordance with specified requirements.
    d. Field reports; in-place soil density and moisture tests.
    e. One optimum moisture-maximum density curve for each type of soil encountered.
    f. Report of actual unconfined compressive strength and/or results of bearing tests of each strata tested.
    g. Other documentation necessary for Geotechnical Engineer to approve earthwork.
    h. Assist Engineer to determine corrective measures necessary for defective work.

C. Responsibilities of Testing Agency for Site Excavation and Grading:
1. All testing, observation and work indicated as being performed by the Geotechnical Engineer in other than Article 3.5 of this Specification Section.

2. Services will include verification and documentation of satisfactory soil materials, subgrade quality, sampling, placement, moisture conditioning, compaction and testing of proposed soil materials, and field testing for quality control.
3. Moisture density relations, to be established by the Geotechnical Engineer required for all materials to be compacted.
4. Extent of compaction testing will be as necessary to assure compliance with specifications.

END OF SECTION

SECTION 31 23 33
TRENCHING, BACKFILLING, AND COMPACTING FOR UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Excavation, trenching, backfilling and compacting for all underground utilities.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.
   4. Division 26 - Electrical.
   5. Section 31 23 00 - Earthwork.
   6. Section 33 05 16 - Precast Concrete Manhole Structures.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. C33/C33M, Standard Specification for Concrete Aggregates.
      b. D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 FT-LBF/FT^3 (2,700 kN-M/M^3).
      c. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
      d. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.

B. Qualifications: Hire an independent soils laboratory to conduct in-place moisture-density tests for backfilling to assure that all work complies with this Specification Section.

C. If required by State Law, obtain a Registered professional engineer, licensed in the State of California for the design of trench shoring systems or other trench safety plans.

D. Registered professional engineer licensed in California shall approve the design of trench shoring systems or other trench safety plans.

1.3 DEFINITIONS

A. Excavation: All excavation will be defined as unclassified.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   3. Submit respective pipe or conduit manufacturer's data regarding bedding methods of installation and general recommendations.
   4. Submit sieve analysis reports on all granular materials.

B. Informational Submittals:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Trench shield (trench box) certification if employed:
      a. Specific to Project conditions.

b. Re-certified if members become distressed.
c. Certification by registered professional structural engineer, registered in the state where the Project is located.
d. Engineer is not responsible to, and will not, review and approve.

1.5 SITE CONDITIONS

A. Avoid overloading or surcharge a sufficient distance back from edge of excavation to prevent slides or caving.
   1. Maintain and trim excavated materials in such manner to be as little inconvenience as possible to public and adjoining property.

B. Provide full access to public and private premises and fire hydrants, at street crossings, sidewalks and other points as designated by County to prevent serious interruption of travel.

C. Protect and maintain bench marks, monuments or other established points and reference points and if disturbed or destroyed, replace items to full satisfaction of County and controlling agency.

D. Verify location of existing underground utilities

PART 2 - PRODUCTS

2.1 MATERIALS

A. Backfill Material:
   1. Backfill shall conform to the requirements for Structural Fill in Specification 31 22 00

B. Gravel trench backfill materials:
   1. Fine aggregate for cement concrete, in accordance with the Caltrans Standard Specifications, latest edition, shall be used to backfill the trench above and around the underdrain aggregate envelope.

C. Subgrade Stabilization Materials: If required, provide subgrade stabilization material as approved by the Geotechnical Engineer.

D. Bedding Materials:
   1. As approved by the Geotechnical Engineer.
   2. Granular bedding materials:
      a. ASTM D2321 Class 1B.
         1) Well-graded crushed stone.
         2) ASTM C33/C33M; gradation 57 (1 IN to No 4 sieve) or 67 (3/4 IN to No. 4 sieve) as defined per Caltrans Division IV Coarse AggregateWell-graded crushed stone.
   3. Flowable fill:
      a. Description: Flowable fill shall be a mixture of cement, fly ash, fine sand, water, and air having a consistency which will flow under a very low head.
      b. Material characteristics:
         1) The approximate quantities of each component per cubic yard of mixed material shall be as follows:
            a) Cement (Type I or II): 50 LBS.
            b) Fly ash: 200 LBS.
            c) Fine sand: 2,700 LBS.
            d) Water: 420 LBS.
            e) Air content: 10 PCT.
         2) Actual quantities shall be adjusted to provide a yield of 1 cubic yard with the materials used.
         3) Approximate compressive strength should be 85 to 175 PSI.
         4) Fine sand shall be an evenly graded material having not less than 95 PCT passing the No. 4 sieve and not more than 5 PCT passing the No. 200 sieve.
         5) Mixing and handling of the material shall be in accordance with Specification Section 03 31 31.

PART 3 - EXECUTION

3.1 GENERAL

A. Remove and dispose of unsuitable materials off-site. County

3.2 EXCAVATION

A. Unclassified Excavation: Remove, clay, silt, gravel, hard pan, loose shale, and loose stone as directed by Geotechnical Engineer.

B. Excavation for Appurtenances:
   1. 12 IN (minimum) clear distance between outer surface and embankment.
   2. See Specification Section 31 23 00 for applicable requirements.

C. Groundwater Dewatering:
   1. Where groundwater is, or is expected to be, encountered during excavation, install a dewatering system to prevent softening and disturbance of subgrade to allow subgrade stabilization, pipe, bedding and backfill material to be placed in the dry, and to maintain a stable trench wall or side slope.
   2. Groundwater shall be drawn down and maintained at least 2 FT below the bottom of any trench or manhole excavation prior to excavation.
   3. Review soils investigation before beginning excavation and determine where groundwater is likely to be encountered during excavation.
      a. Employ dewatering specialist for selecting and operating dewatering system.
   4. Keep dewatering system in operation until dead load of pipe, structure and backfill exceeds possible buoyant uplift force on pipe or structure.
   5. Dispose of groundwater to an area which will not interfere with construction operations or damage existing construction.
   6. Install groundwater monitoring wells as necessary.
   7. Shut off dewatering system at such a rate to prevent a quick upsurge of water that might weaken the subgrade.
   8. Cost of groundwater dewatering shall be compensated at the unit price for Bid Item - Groundwater Dewatering.

D. Trench Excavation:
   1. Excavate trenches by open cut method to depth shown on Drawings and necessary to accommodate work.
      a. Support existing utility lines and yard piping where proposed work crosses at a lower elevation.
         1) Stabilize excavation to prevent undermining of existing utility and yard piping.
   2. Open trench outside buildings, units, and structures:
      a. No more than the distance between two manholes, or 300 LF, whichever is less.
      b. Maximum spacing between sewer cleanouts shall be 75 LF for lines less than 8-IN in diameter.
      c. Field adjust limitations as weather conditions dictate.
   3. Trenching within buildings, units, or structures:
      a. No more than 100 LF at any one time.
   4. Any trench or portion of trench, which is opened and remains idle for seven calendar days, or longer, as determined by the County, may be directed to be immediately refilled, without completion of work, at no additional cost to County.
      a. Said trench may not be reopened until County is satisfied that work associated with trench will be prosecuted with dispatch.
   5. Observe following trenching criteria:
      a. Trench size:
         1) Excavate width to accommodate free working space.
         2) Maximum trench width at top of pipe or conduit may not exceed outside diameter of utility service by more than the following dimensions:

OVERALL DIAMETER OF UTILITY SERVICE	EXCESS DIMENSION
33 IN and less	18 IN
more than 33 IN	24 IN

3) Cut trench walls vertically from bottom of trench to 1 FT above top of pipe, conduit, or utility service.
4) Keep trenches free of surface water runoff.
   a) No separate payment for surface water runoff pumping will be made.

E. Trenching for Electrical Installations:
1. Observe the preceding Trench Excavation paragraph in PART 3 of this Specification Section.
2. Modify for electrical installations as follows:
   a. Open no more than 300 LF of trench in exterior locations for trenches more than 12 IN but not more than 30 IN wide.
   b. Any length of trench may be opened in exterior locations for trenches which are 12 IN wide or less.
   c. Do not over excavate trench.
   d. Cut trenches for electrical runs with minimum 30 IN cover, unless otherwise specified or shown on Drawings.
   e. See Division 26 for additional requirements.

F. Flowable Fill:
1. Flowable fill shall be:
   a. Discharged from a mixer by any means acceptable to the Engineer into the area to be filled.
   b. Placed in 2 FT maximum lifts to the elevations indicated.
      1) Allow 12 HR set-up time before placing next lift or as approved by the Engineer.
      2) Place flowable fill lifts in such a manner as to prevent flotation of the pipe.
2. Subgrade on which flowable fill is placed shall be free of disturbed or softened material and water.
3. Conform to appropriate requirements of Specification Section 31 23 00.
4. Flowable fill batching, mixing, and placing may be started if weather conditions are favorable, and the air temperature is 34 DEGF and rising.
5. At the time of placement, flowable fill must have a temperature of at least 40 DEGF.
6. Mixing and placing shall stop when the air temperature is 38 DEGF or less and falling.
7. Each filling stage shall be as continuous an operation as is practicable.
8. Prevent traffic contact with flowable fill for at least 24 HRS after placement or until flowable fill is hard enough to prevent rutting by construction equipment.
9. Flowable fill shall not be placed until water has been controlled or groundwater level has been lowered in conformance with the requirements of the preceding Groundwater Dewatering paragraph in PART 3 of this Specification Section.

3.3 PREPARATION OF FOUNDATION FOR PIPE LAYING

A. Over-Excavation:
1. Backfill and compact to 90 PCT of maximum dry density per ASTM D1557.
2. Backfill with granular bedding material as option.

B. Rock Excavation:
1. There is no excavation classified as Rock on this Project.

C. Subgrade Stabilization:
1. Stabilize the subgrade when directed by the County and as indicated on the Drawings.
2. Observe the following requirements when unstable trench bottom materials are encountered.
   a. Notify County when unstable materials are encountered.

1) Define by drawing station locations and limits.

b. Remove unstable trench bottom caused by Contractor failure to dewater, rainfall, or Contractor operations.
   1) Replace with subgrade stabilization with no additional compensation.

3.4 BACKFILLING METHODS

A. Do not backfill until tests to be performed on system show system is in full compliance with specified requirements.

B. Carefully Compacted Backfill:
   1. Furnish where indicated on Drawings, specified for trench embedment conditions and for compacted backfill conditions up to 12 IN above top of pipe or conduit.
   2. Comply with the following:
      a. Place backfill in lifts not exceeding 8 IN (loose thickness).
      b. Hand place, shovel slice, and pneumatically tamp all carefully compacted backfill.
      c. Observe specific manufacturer's recommendations regarding backfilling and compaction.
      d. Compact each lift to specified requirements.

C. Common Trench Backfill:
   1. Perform in accordance with the following:
      a. Place backfill in lift thicknesses capable of being compacted to densities specified.
      b. Observe specific manufacturer's recommendations regarding backfilling and compaction.
      c. Avoid displacing joints and appurtenances or causing any horizontal or vertical misalignment, separation, or distortion.

D. Water flushing for consolidation is not permitted.

E. Backfilling for Electrical Installations:
   1. Observe the preceding Carefully Compacted Backfill paragraph or Common Trench Backfill paragraph in PART 3 of this Specification Section or when approved by the Engineer.
   2. Modify for electrical installation as follows:
      a. Observe notes and details on electrical drawings for fill in immediate vicinity of direct burial cables.

3.5 COMPACTION

A. General:
   1. Place and assure bedding, backfill, and fill materials achieve an equal or higher degree of compaction than undisturbed materials adjacent to the work.
   2. In no case shall degree of compaction below minimum compactions specified be accepted.

B. Compaction Requirements:
   1. Unless noted otherwise on Drawings or more stringently by other Specification Sections, comply with following minimum trench compaction criteria.
      a. Bedding material:

LOCATION	SOIL TYPE	COMPACTION DENSITY
All locations	Cohesionless soils	75 PCT relative density by ASTM D4253 and ASTM D4254

      b. Carefully compacted backfill:

LOCATION	SOIL TYPE	COMPACTION DENSITY
All applicable areas	Cohesive soils	95 PCT of maximum dry density by ASTM D1557

	Cohesionless soils	75 PCT relative density by ASTM D4253 and ASTM D4254

c. Common trench backfill:

LOCATION	SOIL TYPE	COMPACTION DENSITY
Under pavements, roadways, surfaces within highway right-of-ways	Cohesive soils	98 PCT of maximum dry density by ASTM D1557
	Cohesionless soils	60 PCT of relative density by ASTM D4253 and ASTM D4254
Under turfed, sodded, plant seeded, nontraffic areas	Cohesive soils	85 PCT of maximum dry density by ATM D1557
	Cohesionless soils	40 PCT of relative density by ASTM D4253 and ASTM D4254

3.6 FIELD QUALITY CONTROL

A. Testing:
1. Perform in-place moisture-density tests as directed by the County.
2. Perform tests through recognized testing laboratory approved by County.
3. Costs of "Passing" tests paid by County.
4. Perform additional tests as directed until compaction meets or exceeds requirements.
5. Cost associated with "Failing" tests shall be paid by Contractor.
6. Reference to Engineer in this Specification Section will imply Geotechnical Engineer when employed by County and directed by Engineer to undertake necessary inspections as approvals as necessary.
7. Assure County has immediate access for testing of all soils related work.
8. Ensure excavations are safe for testing personnel.

END OF SECTION

SECTION 31 25 00
SOIL EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Soil erosion and sediment control.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Erosion control standards: Standards and Specifications for Soil Erosion and Sediment Control in Developing Areas by the United Sates Department of Agriculture (USDA), Soil Conservation Service, College Park, Maryland.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Straw bales, twine tied.

B. Pipe Riser and Barrel: 16 GA corrugated metal pipe (CMP) of size indicated.

C. Stone for Stone Filter: 2 IN graded gravel or crushed stone.

D. Grass Seed: Annual ryegrass.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prior to General Stripping Topsoil and Excavating:
   1. Install perimeter dikes and swales.
   2. Excavate and shape sediment basins and traps.
   3. Construct pipe spillways and install stone filter where required.
   4. Machine compact all berms, dikes and embankments for basins and traps.
   5. Install straw bales where indicated.
      a. Provide two stakes per bale.
      b. First stake angled toward previously installed bale to keep ends tight against each other.

B. Construct sediment traps where indicated on Drawings during rough grading as grading progresses.

C. Temporarily seed basin slopes and topsoil stockpiles:
   1. Rate: 1/2 LB/1000 SQFT.
   2. Reseed as required until good stand of grass is achieved.

3.2 DURING CONSTRUCTION PERIOD

A. Maintain Basins, Dikes, Traps, Stone Filters, Straw Bales, etc.:
   1. Inspect regularly especially after rainstorms.
   2. Repair or replace damaged or missing items.

B. After rough grading, sow temporary grass cover over all exposed earth areas not draining into sediment basin or trap.

C. Construct inlets as soon as possible.
   1. Excavate and tightly secure straw bales completely around inlets as detailed on Drawings.

D. Provide necessary swales and dikes to direct all water towards and into sediment basins and traps.

E. Do not disturb existing vegetation (grass and trees).

F. Excavate sediment out of basins and traps when capacity has been reduced by 50 PCT.
   1. Remove sediment from behind bales to prevent overtopping.

G. Topsoil and Fine Grade Slopes and Swales, etc.: Seed and mulch as soon as areas become ready.

3.3 NEAR COMPLETION OF CONSTRUCTION

A. Eliminate basins, dikes, traps, etc.

B. Grade to finished or existing grades.

C. Fine grade all remaining earth areas, then seed and mulch.

END OF SECTION

DIVISION 32

EXTERIOR IMPROVEMENTS

SECTION 32 12 16
ASPHALTIC CONCRETE VEHICULAR PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Asphaltic concrete vehicular paving.
   2. Line painting.

B. Related Specification Sections include but are not necessarily limited to:

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Federal Specifications (FS):
      a. TT-P-1952F, Paint, Traffic and Airfield Marking, Waterborne.
   2. Construction standards: State of California, Department of Transportation, "2018,", as amended to date.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Asphalt design mix.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Asphaltic Concrete: Per Caltrans Section 39.

B. Line Paint:
   1. Nonreflective.
   2. White.
   3. FS TT-P-1952F.
   4. Thermoplastic.

2.2 MIXES

A. Comply with mix design category Type A HMA Specification Section 39.

PART 3 - EXECUTION

3.1 APPLICATION

A. Construct to line, grade and section as shown on Drawings and in accordance with referenced State Specifications.

B. Install a 12 IN compacted layer of asphaltic base course in accordance with Section 26 of the referenced State Specifications.

C. Spread Asphalt Binder (prime coat) uniformly on compacted aggregate base course at rate of 0.05 to 0.10 GAL per square yard in accordance with Section 39 of State Specifications.

D. Install asphalt in 2 IN layers, in accordance with Section 39 of State Specifications.

3.2 LINE PAINTING:

A. Thoroughly clean surfaces which are to receive paint.

B. Dry completely before paint is applied.

C. Do not paint until minimum of five days has elapsed from time surface is completed.
   1. A longer period may be required if directed by Engineer.

D. Do not apply paint over wet surfaces, during wet or damp weather, or when temperature is below 40 DEGF.

E. Lay out markings and striping in accordance with Drawings.
   1. Width of painted lines: 4 IN.

END OF SECTION

SECTION 32 13 13
CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Concrete pavement.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 03 05 05 - Testing.
   4. Section 03 31 30 - Concrete, Materials and Proportioning.
   5. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.

C. Payment Adjustment for Deficient Thickness of Concrete Pavement:
   1. A deduction in price shall be made for each lane of concrete pavement one block (400 FT) or more in length, or for any lane less than one block (400 FT) in total length, if the average concrete pavement thickness, when determined as provided herein, is within 1 IN tolerance but not within the 1/4 IN tolerance permitted.
      a. Payment reduction formula:

      Payment = -2x(d/ts)x(Contract Price)

      Where d = thickness deficiency determined by coring = ts - ta, but less than 1 IN
      ts = design thickness
      ta = actual thickness determined by coring

   2. When any core shows a deficiency of more than 1 IN, the length of adjacent pavement deducted, and for which payment shall be withheld, shall be the sum of the distance, measured parallel to the centerline, from the deficient boring to the nearest borings, in both directions, which show a thickness not more than 1 IN deficient.
   3. Deductions in all cases shall be for the full width of the lane which the borings represent.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Association of State Highway and Transportation Officials (AASHTO):
      a. M153, Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction (ASTM D1752).
      b. M171, Standard Specification for Sheet Materials for Curing Concrete (ASTM C1271).
      c. M182, Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats.
      d. M213, Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types) (ASTM D1751).
      e. M224, Standard Specification for Use of Protective Sealers for Portland Cement Concrete.
      f. M233, Standard Specification for Boiled Linseed Oil Mixture for Treatment of Portland Cement Concrete.
   2. American Concrete Institute (ACI):
      a. 305R, Guide to Hot Weather Concreting.
      b. 306R, Guide to Cold Weather Concreting.
   3. ASTM International (ASTM):

a. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
b. A1064/A1064M, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
c. C33/C33M, Standard Specification for Concrete Aggregates.
d. C150/C150M, Standard Specification for Portland Cement.
e. C174/C174M, Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores.
f. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
g. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 FT-LBF/FT^3 (600 kN-M/M^3)).
h. D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
i. D1752, Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
j. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
k. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.

4. Federal Specification (FS):
   a. SS-S-1614, Sealants, Joint, Jet-Fuel-Resistant, Hot-Applied for Portland Cement and Tar Concrete Pavements (Withdrawn with no replacement).
   b. Concrete installer shall have successfully completed at least three other projects of similar size and type.

1.3 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Product technical data including:
   a. Acknowledgement that products submitted meet requirements of standards referenced.
   b. Manufacturer's installation instructions
3. Mix design(s) in accordance with Specification Section 03 31 30 and Specification Section 03 05 05.
4. Qualifications of concrete installer.
5. Drawings detailing all reinforcing.
6. Scaled cross section detail of crown template with dimensions showing off sets from level line.
7. Concrete pavement joint pattern for paved areas.
8. Test reports:
   a. Concrete cylinder test results from field quality control.

B. Samples:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Samples of fabricated jointing materials and devices.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II.

B. Aggregates:
1. ASTM C33/C33M, gradation size #67, 3/4 IN to #4.
2. Clean, crushed gravel.

C. Water: Potable quality.

D. Admixtures: Comply with Specification Section 03 31 30.

E. Reinforcing Bars: ASTM A615/A615M, Grade 60.

F. Welded Wire Reinforcement:
   1. ASTM A1064/A1064M.
   2. Flat.
   3. Clean, free from dirt, scale, rust.

G. Preformed Joint Filler:
   1. Non-extruding cork, self-expanding cork, sponge rubber or cork rubber.
   2. AASHTO M153 or AASHTO M213.

H. Hot-Poured Joint Sealing Material:
   1. FS SS-S-1614.

I. Membrane Curing Compound: ASTM C309.

J. Cover Materials for Curing:
   1. Burlap:
      a. AASHTO M182.
      b. Minimum Class 2, 8 OZ material (1 YD x 42 IN).
   2. Polyethylene film, AASHTO M171.

K. Paper Subgrade Cover: Polyethylene film, AASHTO M171.

L. Concrete Treatment:
   1. Boiled linseed oil mixture.
   2. AASHTO M233.

M. Traffic Paint:
   1. Thermoplastic

N. Forms:
   1. Steel or wood.
   2. Size and strength to resist movement during concrete placement and able to retain horizontal and vertical alignment.
   3. Free of distortion and defects.
   4. Full depth.
   5. Metal side forms:
      a. Minimum 7/32 IN thick.
      b. Depth equal to edge thickness of concrete.
      c. Flat or rounded top minimum 1-3/4 IN wide.
      d. Base 8 IN wide or equal to height, whichever is less.
      e. Maximum deflection 1/8 IN under center load of 1,700 LBS.
      f. Use flexible spring steel forms or laminated boards to form radius bends.

2.2 MIXES

A. Mix design to provide 4,000 PSI 28-day compressive strength.

B. Article 2.2 refers to Division 03 Specification Sections for concrete mix. However, some information is covered in PART 2 of this Specification Section. There are also occasions when DOT mixes are specified. This Article should be clarified as to exactly what portions of Specification Section 03 31 30 - CONCRETE, MATERIALS AND PROPORTIONING and Specification Section 03 31 31 - CONCRETE MIXING, PLACING, JOINTING, AND CURING are to apply to this Specification Section. Possible conflicts include, cement type, minimum cement content, acceptable aggregates, fly ash, admixtures, etc. If you choose to include the optional reference to Specification Section 03 31 30 and Specification Section 03 31

31, be specific as to what the reference is regarding and verify it does not conflict with other information in this Specification Section.

PART 3 - EXECUTION

3.1 PREPARATION

A. Subgrade Preparation:
   1. Prepare using methods, procedures, and equipment necessary to attain required compaction densities, elevation and section.
   2. Scarify and recompact top 12 IN of fills and embankments which will be under paved areas.
   3. Remove soft or spongy areas.
      a. Replace with structural backfill.
      b. Coordinate with Geotechnical Engineer.
   4. Compact to the following densities:
      a. Cohesive soils: 95 PCT per ASTM D698.
   5. Assure moisture content is within limits prescribed to achieve required compaction density.
   6. Following compaction, trim and roll to exact cross section.
      a. Check with approved grading template.
   7. Perform density tests on subgrade to determine that subgrade complies with the specification.
   8. Coordinate aggregate course with Structural Engineer and Soils/Geotechnical Engineer.

B. Loose and Foreign Material: Remove loose and foreign material immediately before application of paving.

C. Appurtenance Preparation:
   1. Block out or box out curb inlets and curb returns.
   2. Provide for joint construction as detailed and dimensioned on Drawings.
   3. Adjust manholes, inlets, valve boxes and any other utility appurtenances to design grade.
      a. Secure to elevation with concrete.
      b. Place concrete up to 5 IN below design grade.
   4. Headers:
      a. Construct at open ends of pavements.
      b. Use same concrete to construct headers as that used in the abutting structure.
      c. Extend header full width of pavement and crown same as pavement.
   5. Clean and oil forms.

3.2 INSTALLATION

A. Concrete Production: Comply with Specification Section 03 31 31.

B. Forms:
   1. Form support:
      a. Compact soil foundation and cut to grade to support forms and superimposed machine loads.
      b. Use bearing stakes driven flush with bottom of form to supplement support as necessary.
      c. Do not use earth pedestals.
   2. Staking forms:
      a. Joint forms neatly and tightly.
      b. Stake and pin securely with at least three pins for each 10 FT section.
   3. Clean and oil forms prior to placement of concrete.
   4. Set forms sufficiently in advance of work (minimum of 2 HRS) to permit proper inspection.
   5. Previously finished concrete pavement, curb or sidewalk contiguous with new work may serve as side form when specifically approved.

C. Reinforcing:
   1. Locate longitudinal edge bars between 3 and 6 IN from edge of slab.

2. Lap mats one full space.
3. Tie end transverse member of upper mat securely to prevent curving.
4. Lap nonwelded bars 12 IN minimum.
5. Support:
    a. Place bars and heavy mats securely on chairs at called-for height.
    b. Place other fabric on the first of a two-course pour and cover promptly with final pour, or place fabric by a fabric-placer if procedure is reviewed and approved by Engineer.

D. Joints:
1. Hold joint location and alignment to within +1/4 IN.
2. Finish concrete surface adjacent to previously placed slab to within +1/8 IN, with tooled radius of 1/4 IN.
3. Metal keyway joints:
    a. Form by installing metal joint strip left in place.
    b. Stake and support like side form.
    c. Provide dowels or tie bars.
4. Weakened plane joints:
    a. Tooled joints:
        1) Form groove in freshly placed concrete with tooling device.
        2) Groove dimensions shall be 3/8 IN at surface and 1/4 IN at root.
    b. Sawed joints:
        1) Saw 1/4 IN groove in green concrete.
        2) Commence sawing as soon as concrete is hard enough to withstand operation without chipping, spalling or tearing, regardless of nighttime or weather.
        3) Thoroughly wet surface to protect membrane cure and recoat afterward.
        4) Complete saw cutting before shrinkage stresses cause cracking.
5. Stake in place load transfer device for expansion joints consisting of dowels:
    a. Supporting and spacing means and premolded joint filler as per Drawing details.
    b. Provide preformed joint filler at all junctions with existing curb, sidewalk, steps, or other structures.
6. Install construction joints at end of day's work or wherever concreting must be interrupted for 30 minutes or more.
7. Thoroughly clean and fill joints with joint sealing material as specified.
8. Fill joints without overflowing onto pavement surface.
9. Upper surface of filled joint to be flush to 1/8 IN below finish surface.

E. Place Concrete:
1. Comply with Specification Section 03 31 31.
2. Construct driveway openings, ramps, and other features as per Drawing details.

F. Cold and Hot Weather Concreting:
1. Cold weather:
    a. Cease concrete placing when descending air temperature in shade falls below 40 DEGF.
    b. Do not resume until ambient temperature rises to minimum 40 DEGF.
    c. If placing below 40 DEGF is authorized by Engineer, maintain temperature of mix between 60 and 80 DEGF.
    d. Heat aggregates or water or both.
    e. Water temperature may not exceed 175 DEGF.
    f. Aggregate temperature may not exceed 150 DEGF.
    g. Remove and replace frost damaged concrete.
    h. Salt or other antifreeze is not permitted.
    i. Comply with ACI 306R.
2. Hot weather:
    a. Cease concrete placing when plastic mix temperature cannot be maintained under 90 DEGF.
    b. Aggregates or water or both may be cooled.

c. Cool water with crushed ice.
d. Cool aggregates by evaporation of water spray.
e. Never batch cement hotter than 160 DEGF.
f. Comply with ACI 305R.

G. Finishing:
1. As soon as placed, strike off and screed to crown and cross section, slightly above grade, so that consolidation and finishing will bring to final Drawing elevations.
2. Maintain uniform ridge full width with first pass of first screed.
3. Pavement and similar surfaces:
a. Float by longitudinally reciprocating float, passing gradually from edge to edge.
b. Assure successive advances do not exceed half the length of the float.
c. Test level of slab with minimum 10 FT straightedge.
d. Fill depressions with fresh material, consolidate and refinish.
e. Cut down high areas and retest.
f. Belt surface with two-ply canvas belt, using transverse strokes while advancing along center line.
g. Provide final finish by full width burlap or carpet drag, drawn longitudinally.
h. Keep drag clean to avoid build up and consequent scarring.
i. Tool pavement edges with suitable edger.
j. Retest with straightedge and if pavement shows deviation of more than 1/8 IN in 10 FT, remove and replace.

H. Curing:
1. Apply membrane curing compound complying with ASTM C309, and in accordance with manufacturer's directions but at a minimum rate of 200 SQFT/GAL.
2. Apply curing compound within 4 HRS after finishing or as soon as surface moisture has dissipated.
3. Cure for minimum of seven days.
4. When average daily temperature is below 50 DEGF, provide insulative protection of 12 IN minimum thickness loose dry straw, or equivalent, for 10 days.
5. Linseed oil sealant:
a. Seal surface with linseed oil.
b. Apply linseed oil to clean surface as per AASHTO M224 after concrete has cured for one month.
c. Apply first application at minimum rate of 67 SQYD per gallon.
d. Apply second application to a dry surface at minimum rate of 40 SQYD per gallon.

I. Protection of Concrete:
1. Protect concrete surfaces and appurtenances from traffic for minimum of 14 days.
2. Erect and maintain warning signs, lights, watchmen to direct traffic.
3. Repair or replace parts of concrete surfaces damaged by traffic, or other causes, occurring prior to final acceptance.
4. Protect concrete pavement against public traffic, construction traffic and traffic caused by employees and agents.
5. No equipment shall be driven or moved across concrete surfaces unless such equipment is rubber-tired and only if concrete is designed for and capable of sustaining loads to be imposed by the equipment.
6. Do not drive over new or existing concrete with tracked vehicles and equipment.

J. Painting and Striping:
1. Stripe and mark pavement per the Drawings following sufficient cure time for pavement.
2. Lay out markings with guidelines, templates, and forms.
3. Apply 6 IN wide stripe with self-contained striping machine to a clean and dry pavement surface.
4. Temperature must be above 40 DEGF and precipitation should not be expected during drying period.

5. Use thermoplastic paint; color as approved by the local reviewing authority for the specific use (i.e., white, yellow, blue).
6. Apply at 1 GAL per 105 SQFT.

K. Opening to Traffic:
1. After 14 days, pavement may, at Owner's discretion, be opened to traffic if job cured test cylinders have attained a compressive strength of 3,000 LBS per square inch when tested in accordance with ASTM standard methods.
2. Prior to opening to traffic, clean and refill joints as required with the specified filler material.

L. Clean Up:
1. Assure clean up work is completed within two weeks after pavement has been opened to traffic.
2. No new work will begin until clean up work has been completed, or is maintained within two weeks after pavement has been opened to traffic.

M. Pavement Patching:
1. Comply with material and density requirements as mentioned elsewhere in this Specification except provide minimum 6 IN aggregate immediately below the patch.
2. Place pavement patch providing a thickened edge.
3. Assure that patch in plane of "cold" joint has a thickness 6 IN greater than that of the existing pavement.
4. Extend patch under existing pavement for a distance of 6 IN minimum.
5. Fill void under existing pavement with concrete.
6. Undercut existing pavement 6 IN all around patch and to a depth of 6 IN.
7. Prior to placing patch, sawcut edge of existing concrete to 1/4 depth and remove to provide a vertical face for a straight and true joint.

3.3 FIELD QUALITY CONTROL

A. Provide test cylinders in accordance with Specification Section 03 05 05 for each 100 CUYD of concrete placed, as requested by the Quality Assurance Testing Engineer.

B. Pavement Thickness Testing:
1. General:
a. Core pavement to determine the actual thickness as directed by Engineer.
b. Determine thickness by ASTM C174/C174M.
c. Fill holes from removal of cores with concrete of the same mixture as specified.
d. Cost incidental to coring of cores showing a deficiency greater than 1/4 IN shall be paid by the Contractor.
e. Cost of cores showing a deficiency of 1/4 IN or less shall be paid by the Owner.
f. If average pavement thickness, as directed by core measurement, is outside specified tolerances, payment will be reduced per PART 1 of this Specification Section.
g. If deficiency in pavement thickness is 1 IN or more, remove and replace pavement at Contractor's expense.
2. Core categories:
a. In determining the average thickness of acceptable pavement for which payment will be made, utilize the following core categories:

CATEGORY NUMBER	CORE THICKNESS IN RELATION TO DESIGN	CORE LENGTH USED IN CALCULATING
1	1 IN or more deficiency	NOT USED
2	Less than 1 IN deficiency through 1/2 IN excess	Actual Core Thickness
3	More than 1/2 IN excess	Design Thickness plus 1/2 IN

b. Core sampling:
    1) Take cores in each lane in each block.
c. Take cores at locations where the cement content was found to be low when checking the quantities of cement used during the progress of the work.
d. Each separately poured lane of the pavement to be considered as a unit.
e. A lane shall be considered to be the pavement surface between longitudinal construction joints, between a longitudinal construction joint and the edge, or between two pavement edges in cases where the entire width of the pavement is poured in one operation.
f. Should any core show a deficiency in thickness in excess of 1 IN, check cores shall be taken 5 FT on either side of this location parallel to the centerline of the pavement.
g. If both of these cores are within the 1 IN tolerance, no further special borings for this individual zone of deficiency will be made.
h. If either one or both of these cores are not within the 1 IN tolerance, the procedure will be to cut cores in the following order on either side of the original short core parallel to the centerline of the pavement:
    1) 25 FT, 50 FT, the same to be measured from the location of original core found to be deficient in thickness, then at 50 FT intervals until a thickness within the 1 IN tolerance is found in both directions.
    2) On either side of the original deficient core, the procedure will then be to make a coring approximately half the distance within the first core which comes within the 1 IN tolerance.
    3) Repeat the above procedure until the station (+5 FT), at which the pavement comes within the 1 IN tolerance is located.
    4) If for some reason two or more cores are taken at the same station and at least one of them is beyond the 1 IN tolerance, the section of pavement at the station shall be considered as unacceptable.

END OF SECTION

SECTION 32 16 13
CONCRETE CURB AND GUTTER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Concrete curb and gutter.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 01 - General Requirements.
   2. Section 03 31 30 - Concrete, Materials and Proportioning.
   3. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.
   4. Section 03 05 05 - Testing.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Association of State Highway and Transportation Officials (AASHTO):
      a. M153,Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
      b. M171, Standard Specification for Sheet Materials for Curing Concrete.
      c. M182, Burlap Cloth Made from Jute or Kenef.
      d. M213, Preformed Expansion Joint Fillers for Concrete Paving and Structure Construction (Nonextruding and Resilient Bituminous Types).
      e. M233, Boiled Linseed Oil Mixture for Treatment of Portland Cement Concrete.
   2. American Concrete Institute (ACI):
      a. 305R, Hot Weather Concreting.
      b. 306R, Cold Weather Concreting.
   3. ASTM International (ASTM):
      a. A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
      b. C33, Standard Specification for Concrete Aggregates.
      c. C150, Standard Specification for Portland Cement.
      d. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
      e. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 FT-lb/ft3).
      f. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
      g. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
   4. Federal Specification (FS):
      a. SS-S-1614, Sealants, Joint, Jet-Fuel-Resistant, Hot-Applied for Portland Cement and Tar Concrete Pavements.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   3. Mix design(s) in accordance with Specification Section 03 31 30 and Specification Section 03 05 05.

4. Drawings detailing all reinforcing.
5. Test reports:
    a. Concrete cylinder test results from field quality control.

B. Samples:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Samples of fabricated jointing materials and devices.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Chemical admixtures:
    a. Sika Chemical Corporation.
    b. BASF Admixtures, Inc.
    c. Protex Industries.
    d. W. R. Grace and Company.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. Portland Cement:
1. ASTM C150, Type I or II.

B. Aggregates:
1. ASTM C33, gradation size #67, 3/4 IN to #4.

C. Water:
1. Potable quality.

D. Admixtures:
1. Comply with Specification Section 03 31 30.

E. Reinforcing Bars:
1. ASTM A615, Grade 60.

F. Preformed Joint Filler:
1. Nonextruding cork, self-expanding cork, sponge rubber or cork rubber.
2. AASHTO M153 or AASHTO M213.

G. Hot-Poured Joint Sealing Material:
1. FS SS-S-1614.

H. Membrane Curing Compound:
1. ASTM C309.

I. Cover Materials for Curing:
1. Burlap:
    a. AASHTO M182.
    b. Minimum Class 2, 8 OZ material (1 YD x 42 IN).
2. Polyethylene film, AASHTO M171.

J. Paper Subgrade Cover:
1. Polyethylene film, AASHTO M171.

K. Concrete Treatment:
1. Boiled linseed oil mixture.
2. AASHTO M233.

L. Forms:
   1. Steel or wood.
   2. Size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment.
   3. Free of distortion and defects.
   4. Full depth.
   5. Metal side forms:
      a. Minimum 7/32 IN thick.
      b. Depth equal to edge thickness of concrete.
      c. Flat or rounded top minimum 1-3/4 IN wide.
      d. Base 8 IN wide or equal to height, whichever is less.
      e. Maximum deflection 1/8 IN under center load of 1700 LBS.
      f. Use flexible spring steel forms or laminated boards to form radius bends.

2.3 MIXES

A. Mix design to provide 4,000 PSI 28-day compressive strength, 1-1/2 IN +1 IN slump, 6 PCT air.

B. Comply with Specification Section 03 31 30 and Specification Section 03 31 31.

PART 3 - EXECUTION

3.1 PREPARATION

A. Subgrade Preparation:
   1. Prepare using methods, procedures, and equipment necessary to attain required compaction densities, elevation and section.
   2. Scarify and recompact top 6 IN of fills and embankments which will be under concrete curb and gutters.
   3. Remove soft or spongy areas.
      a. Replace with aggregate material.
   4. Compact to the following densities:
      a. Cohesive soils: 95 percent per ASTM D698.
   5. Assure moisture content is within limits prescribed to achieve required compaction density.
   6. Following compaction, trim and roll to exact cross section.
   7. Check with approved grading template.
   8. Perform density tests on subgrade to determine that subgrade complies with the specification.

B. Aggregate Course:
   1. Place material in not more than 6 IN thick layers.
   2. Spread, shape, and compact all material deposited on the subgrade during the same day.
   3. Compact to 75 percent relative per ASTM D4253 and ASTM D4254.

C. Loose and Foreign Material:
   1. Remove loose and foreign material immediately before application of paving.

D. Appurtenance Preparation:
   1. Block out or box out curb inlets and curb returns.
   2. Provide for joint construction as detailed and dimensioned on Drawings.
   3. Adjust manholes, inlets, valve boxes and any other utility appurtenances to design grade.
      a. Secure to elevation with concrete.
      b. Place concrete up to 5 IN below design grade.
   4. Clean and oil forms.

3.2 INSTALLATION

A. Concrete Production:
   1. Comply with Specification Section 03 31 31.

B. Forms:
   1. Form support:
      a. Compact soil foundation and cut to grade to support forms and superimposed machine loads.
      b. Use bearing stakes driven flush with bottom of form to supplement support as necessary.
      c. Do not use earth pedestals.
   2. Staking forms:
      a. Joint forms neatly and tightly.
      b. Stake and pin securely with at least three (3) pins for each 10 FT section.
   3. Clean and oil forms prior to placement of concrete.
   4. Set forms sufficiently in advance of work (minimum of 2 HRS) to permit proper inspection.
   5. Previously finished pavement or sidewalk contiguous with new work may serve as side form when specifically approved.

C. Reinforcing:
   1. Lap nonwelded bars 12 IN minimum.
   2. Support:
      a. Place bars securely on chairs at called-for height.

D. Joints:
   1. Hold locations and alignment to within +1/4 IN.
   2. Finish concrete surface adjacent to previous section to within +1/8 IN, with tooled radius of 1/4 IN.
   3. Expansion joints:
      a. Locate at 48 FT intervals and at all intersection curb returns.
      b. Stake in place load transfer device consisting of dowels.
      c. Supporting and spacing means and premolded joint filler as per Drawing details.
      d. Provide preformed joint filler at all junctions with existing curb and gutter or other structures.
   4. Contraction joints:
      a. Locate at 6 FT intervals.
      b. Use steel template at least 1/4 IN thick, conforming to cross section of curb and gutter.
      c. Remove template where concrete has set sufficiently to prevent spalling or adhesion of concrete.
      d. If machine placed, use tooled joint formed in freshly placed concrete.
      e. Groove dimensions shall be 3/8 IN at surface and 1/4 IN at root.
   5. Install construction joints at end of day's work or wherever concreting must be interrupted for 30 minutes or more.
   6. Thoroughly clean and fill joints with joint sealing material as specified.
   7. Upper surface of filled joint to be flush to 1/8 IN below finished surface.

E. Place Concrete:
   1. Comply with Specification Section 03 31 31.
   2. Construct driveway openings, ramps, and other features as per Drawing details.

F. Cold and Hot Weather Concreting:
   1. Cold weather:
      a. Cease concrete placing when descending air temperature in shade falls below 40 DEGF.
      b. Do not resume until ambient temperature has risen to 40 DEGF.
      c. If placing is authorized below 40 DEGF by Engineer, maintain temperature of mix between 60 and 80 DEGF.
      d. Heat aggregates or water or both.
      e. Water temperature may not exceed 175 DEGF.
      f. Aggregate temperature may not exceed 150 DEGF.
      g. Remove and replace frost-damaged concrete.
      h. Salt or other antifreeze is not permitted.

i. Comply with ACI 306R.

2. Hot weather:
   a. Cease concrete placing when plastic mix temperature cannot be maintained under 90 DEGF.
   b. Aggregates or water or both may be cooled.
   c. Cool water with crushed ice.
   d. Cool aggregates by evaporation of water spray.
   e. Never batch cement hotter than 160 DEGF.
   f. Comply with ACI 305R.

G. Finishing:
   1. Bring combination curb and gutter to grade by running straightedge over steel templates with sawing motion.
   2. Float surface with a wood float to draw cement to surface.
   3. Broom finish after floating.
   4. Tool edges with suitable edger.
   5. Upon removal of forms, fill honeycombed or unevenly filled sections immediately with cement mortar.
   6. Assure that expansion joints are cleared of concrete, both at bottom of gutter and back of curb.

H. Curing:
   1. Apply membrane curing compound complying with ASTM C309, and in accordance with manufacturer's directions but at a minimum rate of 200 SQFT per gallon.
   2. Apply curing compound within 4 HRS after finishing or as soon as surface moisture has dissipated.
   3. Cure for 7 days.
   4. When average daily temperature is below 50 DEGF, provide insulative protection of 12 IN minimum thickness loose dry straw, or equivalent, for 10 days.

I. Protection of Concrete:
   1. Protect new curb and gutter and its appurtenances from traffic for minimum of 14 days.
   2. Repair or replace parts of curb and gutter damaged by traffic, or other causes, occurring prior to final acceptance.

J. Opening to Traffic:
   1. After 14 days, area may, at Owner's discretion, be opened to traffic if job cured test cylinders have attained a compressive strength of 3,000 LBS per square inch when tested in accordance with ASTM standard methods.
   2. Prior to opening to traffic, clean and refill joints as required with specified filler material.

K. Clean Up:
   1. Assure clean up work is completed within two (2) weeks after work has been opened to traffic.
   2. No new work will begin until clean up work has been completed, or is maintained within two (2) weeks after work has been opened to traffic.

3.3 FIELD QUALITY CONTROL

A. Provide test cylinders in accordance with Specification Section 03 05 05 for each 100 CY of concrete placed.

END OF SECTION

SECTION 32 16 23
CONCRETE SIDEWALK AND STEPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Concrete sidewalk and steps.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 03 31 30 - Concrete, Materials and Proportioning.
   4. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.
   5. Section 03 05 05 - Testing.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Association of State Highway and Transportation Officials (AASHTO):
      a. M153, Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
      b. M171, Sheet Materials for Curing Concrete.
      c. M182, Burlap Cloth Made from Jute or Kenaf.
      d. M213, Preformed Expansion Joint Fillers for Concrete Paving and Structure Construction (Nonextruding and Resilient Bituminous Types).
      e. M224, Use of Protective Sealers for Portland Cement Concrete.
      f. M233, Boiled Linseed Oil Mixture for Treatment of Portland Cement Concrete.
   2. American Concrete Institute (ACI):
      a. 305R, Hot Weather Concreting.
      b. 306R, Cold Weather Concreting.
   3. ASTM International (ASTM):
      a. A185, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
      b. A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
      c. A1064, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
      d. C33, Standard Specification for Concrete Aggregates.
      e. C150, Standard Specification for Portland Cement.
      f. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
      g. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 FT-lbf/ft^3).
      h. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
      i. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
   4. Federal Specification (FS):
      a. SS-S-1614, Sealants, Joint, Jet-Fuel-Resistant, Hot-Applied for Portland Cement and Tar Concrete Pavements.
      b. TT-S 00227 E(3), Sealing Compound: Elastomeric Type, Multi-Component (for Calking, Sealing, and Glazing in Buildings and Other Structures).

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   3. Mix design(s) in accordance with Specification Section 03 31 30 and Specification Section 03 05 05.
   4. Qualifications of concrete installer.
   5. Drawings detailing all reinforcing.
   6. Concrete cylinder test results from field quality control.

B. Samples:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Samples of fabricated jointing materials and devices.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Chemical admixtures:
      a. Sika Chemical Corporation.
      b. BASF Admixtures, Inc.
      c. Protex Industries.
      d. W. R. Grace and Company.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. Portland Cement:
   1. ASTM C150, Type I or II.

B. Aggregates:
   1. ASTM C33, gradation size #67, 3/4 IN to #4.

C. Water:
   1. Potable quality.

D. Admixtures:
   1. Comply with Specification Section 03 31 30.

E. Reinforcing Bars:
   1. ASTM A615, Grade 60.

F. Welded Wire Reinforcement:
   1. ASTM A185 or ASTM A1064.
   2. Flat.
   3. Clean, free from dirt, scale, rust.

G. Preformed Joint Filler:
   1. Nonextruding cork, self-expanding cork, sponge rubber or cork rubber.
   2. Meet AASHTO M153 or AASHTO M213.

H. Hot-Poured Joint Sealing Material:
   1. FS SS-S-1614.

I. Sidewalk Joint Sealant:
   1. Two compound, polyurethane sealant.
   2. Class A, Type 1.
   3. Self-leveling.
   4. Nontracking.
   5. FS TT-S 00227 E(3).

J. Membrane Curing Compound:
   1. ASTM C309.

K. Cover Materials for Curing:
   1. Burlap:
      a. AASHTO M182.
      b. Minimum Class 2, 8 OZ material (1 YD x 42 IN).
   2. Polyethylene film:
      a. AASHTO M171.

L. Paper Subgrade Cover:
   1. Polyethylene film, AASHTO M171.

M. Concrete Treatment:
   1. Boiled linseed oil mixture.
   2. Meets AASHTO M233.

N. Forms:
   1. Steel or wood.
   2. Size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment.
   3. Free of distortion and defects.
   4. Full depth.
   5. Metal Side Forms:
      a. Minimum 7/32 IN thick.
      b. Depth equal to edge thickness of concrete.
      c. Flat or rounded top minimum 1-3/4 IN wide.
      d. Base 8 IN wide or equal to height, whichever is less.
      e. Maximum deflection 1/8 IN under center load of 1700 LBS.
      f. Use flexible spring steel forms or laminated boards to form radius bends.

2.3 MIXES

A. Mix design to provide 4,000 PSI 28-day compressive strength, 1-1/2 IN +1 IN slump, 6 PCT air.

B. Comply with Specification Section 03 31 30 and Specification Section 03 31 31.

PART 3 - EXECUTION

3.1 PREPARATION

A. Subgrade Preparation:
   1. Prepare using methods, procedures, and equipment necessary to attain required compaction densities, elevation and section.
   2. Scarify and recompact top 6 IN of fills and embankments which will be sidewalk and step areas.
   3. Remove soft or spongy areas.
      a. Replace with aggregate material.
   4. Compact to the following densities:
      a. Cohesive soils: 95 percent per ASTM D698.
   5. Assure moisture content is within limits prescribed to achieve required compaction density.
   6. Following compaction, trim and roll to exact cross section.
      a. Check with approved grading template.

7. Perform density tests on subgrade to determine that subgrade complies with the specification.

B. Aggregate Course:
   1. Place material in not more than 6 IN thick layers.
   2. Spread, shape, and compact all material deposited on the subgrade during the same day.
   3. Compact to 75 percent relative per ASTM D4253 and ASTM D4254.

C. Loose and Foreign Material:
   1. Remove loose and foreign material immediately before application of paving.

D. Appurtenance Preparation:
   1. Block out or box out curb inlets and curb returns.
   2. Provide for joint construction as detailed and dimensioned on Drawings.
   3. Adjust manholes, inlets, valve boxes and any other utility appurtenances to design grade.
      a. Secure to elevation with concrete.
      b. Place concrete up to 5 IN below design grade.
   4. Clean and oil forms.

3.2 ERECTION, INSTALLATION AND APPLICATION

A. Concrete Production:
   1. Comply with Specification Section 03 31 31.

B. Forms:
   1. Form support:
      a. Compact soil foundation and cut to grade to support forms.
      b. Use bearing stakes driven flush with bottom of form to supplement support as necessary.
      c. Do not use earth pedestals.
   2. Staking forms:
      a. Joint forms neatly and tightly.
      b. Stake and pin securely with at least three (3) pins for each 10 FT section.
   3. Clean and oil forms prior to placement of concrete.
   4. Set forms sufficiently in advance of work (minimum 2 HRS) to permit proper inspection.
   5. Previously finished pavement or curb and gutter contiguous with new work may serve as side form when specifically approved.

C. Reinforcing:
   1. Lap mats one (1) full space.
   2. Tie end transverse member of upper mat securely to prevent curling.
   3. Lap nonwelded bars 12 IN minimum.
   4. Support:
      a. Place bars securely on chairs at called-for height.
      b. Place other fabric on the first of a two-course pour and cover promptly with final pour, or place fabric by a fabric-placer if procedure is reviewed and approved by Engineer.

D. Joints:
   1. Hold locations and alignment to within + 1/4 IN.
   2. Finish concrete surface adjacent to previous section to within + 1/8 IN, with tooled radius of 1/4 IN.
   3. Metal keyway joints:
      a. Form by installing metal joint strip, left in place.
      b. Stake and support like side form.
      c. Provide dowels or tie bars.
   4. Weakened plane joints:
      a. Locate at 6 FT intervals.
      b. Tool groove in freshly placed concrete with tooling device.
      c. Groove dimensions shall be 3/8 IN at surface and 1/4 IN at root.

5. Install construction joints at end of day's work or wherever concreting must be interrupted for 30 minutes or more.
6. Expansion joints:
    a. Locate at 48 FT intervals and at all intersection curb returns.
    b. Stake in place load transfer device consisting of dowels.
    c. Supporting and spacing means and premolded joint filler as per Drawing details.
    d. Provide preformed joint filler at all junctions with existing sidewalks, steps, or other structures.
7. Thoroughly clean and fill joints with joint sealing material as specified.
8. Upper surface of filled joint to be flush to 1/8 IN below finish surface.

E. Place Concrete:
1. Comply with Specification Section 03 31 31.
2. Construct driveway openings and other features as per Drawing details.

F. Cold and Hot Weather Concreting:
1. Cold weather:
    a. Cease concrete placing when descending air temperature in shade falls below 40 DEGF.
    b. Do not resume until ambient temperature has risen to 40 DEGF.
    c. If placing is authorized below 40 DEGF by Engineer, maintain temperature of mix between 60 and 80 DEGF.
    d. Heat aggregates or water or both.
    e. Water temperature may not exceed 175 DEGF.
    f. Aggregate temperature may not exceed 150 DEGF.
    g. Remove and replace frost damaged concrete.
    h. Salt or other antifreeze is not permitted.
    i. Comply with ACI 306R.
2. Hot weather:
    a. Cease concrete placing when plastic mix temperature cannot be maintained under 90 DEGF.
    b. Aggregates or water or both may be cooled.
    c. Cool water with crushed ice.
    d. Cool aggregates by evaporation or water spray.
    e. Never batch cement hotter than 160 DEGF.
    f. Comply with ACI 305R.

G. Finishing:
1. As soon as placed, strike off and screed to crown and cross section, slightly above grade, so that consolidation and finishing will bring to final Drawing elevations.
2. Maintain uniform ridge full width with first pass of first screed.
3. Test with 6 FT straightedges equipped with long handles and operated from sidewalk.
4. Draw excess water and laitance off from surface.
5. Float finish so as to leave no disfiguring marks but to produce a uniform granular or sandy texture.
6. Broom finish after floating.
7. Tool edges with suitable edger.
8. Provide exposed aggregate surfaces in areas indicated on the Drawings.
9. Provide method such as abrasive blasting, bush hammering, or surface retarder acceptable to the Engineer.

H. Curing:
1. Apply membrane curing compound complying with ASTM C309, and in accordance with manufacturer's directions but at a rate of minimum 200 SQFT per gallon.
2. Apply curing compound within 4 HRS after finishing or as soon as surface moisture has dissipated.
3. Cure for minimum of seven (7) days.

4. When average daily temperature is below 50 DEGF, provide insulative protection of 12 IN minimum thickness loose dry straw, or equivalent, for 10 days.
5. Linseed oil sealant:
    a. For concrete sidewalk and step, seal surface with linseed oil.
    b. Apply linseed oil to clean surface as per AASHTO M224 after concrete has cured for 1 month.
    c. Apply first application at rate of 67 SQYD per gallon.
    d. Apply second application to a dry surface at rate of 40 SQYD per gallon.

I. Protection of Concrete:
1. Protect new sidewalk, steps, and their appurtenances from traffic for a minimum of 14 days.
2. Repair or replace parts of sidewalk and steps damaged by traffic, or other causes, prior to final acceptance.

J. Opening to Traffic:
1. After 14 days, area may, at Owner's discretion, be opened to traffic if job cured cylinders have attained a compressive strength of 3000 LBS per square inch when tested in accordance with ASTM standard methods.
2. Prior to opening to traffic, clean and refill joints as required with specified filler material.

K. Clean Up:
1. Assure clean-up work is completed within two (2) weeks after sidewalk has been opened to traffic.
2. No new work will begin until clean-up work has been completed, or is maintained within 2 weeks after sidewalk has been opened to traffic.

3.3 FIELD QUALITY CONTROL

A. Provide test cylinders in accordance with Specification Section 03 05 05 for each 100 CY of placed concrete.

END OF SECTION

SECTION 32 91 13
TOPSOILING AND FINISHED GRADING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Topsoiling and finished grading.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 31 10 00 - Site Clearing.
   4. Section 31 23 00 - Earthwork.
   5. Section 31 25 00 - Soil Erosion and Sediment Control.

C. Location of Work: All areas within limits of grading and all areas outside limits of grading which are disturbed in the course of the work.

1.2 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Project Data: Test reports for furnished topsoil.

1.3 SITE CONDITIONS

A. Verify amount of topsoil stockpiled and determine amount of additional topsoil, if necessary to complete work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil:
   1. Original surface soil typical of the area.
   2. Existing topsoil stockpiled under Specification Section 31 10 00.
   3. Friable, loamy soil capable of supporting native plant growth.

2.2 TOLERANCES

A. Finish Grading Tolerance: ±0.1 FT from required elevations.

PART 3 - EXECUTION

3.1 PREPARATION

A. Correct, adjust and/or repair rough graded areas.
   1. Cut off mounds and ridges.
   2. Fill gullies and depressions.
   3. Perform other necessary repairs.
   4. Bring all sub-grades to specified contours, even and properly compacted.

B. Loosen surface to depth of 2 IN, minimum.

C. Remove all stones and debris over 2 IN in any dimension.

3.2 ROUGH GRADE REVIEW

A. Reviewed by Engineer in Specification Section 31 10 00.

3.3 PLACING TOPSOIL

A. Do not place when subgrade is wet or frozen enough to cause clodding.

B. Spread and lightly compact to a depth of 4 IN for all disturbed earth areas.

C. If topsoil stockpiled is less than amount required for work, furnish additional topsoil at no cost to Owner.

D. Provide finished surface free of stones, sticks, or other material 1 IN or more in any dimension.

E. Provide finished surface smooth and true to required grades.

F. Restore stockpile area to condition of rest of finished work.

3.4 ACCEPTANCE

A. Upon completion of topsoiling, obtain Engineer's acceptance of grade and surface.

B. Make test holes where directed to verify proper placement and thickness of topsoil.

END OF SECTION

DIVISION 33

UTILITIES

SECTION 33 05 15
PRECAST CONCRETE UTILITY STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Precast concrete utility structures, non-circular in plan, and appurtenant items.
      a. Valve and meter vaults.
   2. Design and fabrication of precast concrete utility structures.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 03 21 00 - Reinforcement.
   4. Section 03 31 30 - Concrete, Materials and Proportioning.
   5. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.
   6. Section 09 96 00 - High Performance Industrial Coatings.
   7. Section 31 23 00 - Earthwork.
   8. Section 33 05 16 - Precast Concrete Manhole Structures.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. C857, Standard Practice for Minimum Design Loading for Underground Precast Concrete Utility Structures.
      b. C858, Standard Specification for Underground Precast Concrete Utility Structures.
      c. C890, Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures.
      d. C990, Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
      e. D1227, Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   3. Concrete mix design(s):
      a. Include submittal information defined in Specification Section 03 31 30.
      b. Certification in accordance with ASTM C858, Section 12.
   4. Fabrication and/or layout drawings:
      a. Include detailed diagrams of utility structures showing typical components and dimensions, reinforcement, and other details.
      b. Itemize, on separate schedule, elevations or sectional breakdown of each utility structure with all components and refer to drawing identification number or notation.
      c. Indicate required penetration details for all piping entering each structure.
   5. Drawings and calculations: All Drawings, including layout drawings, certifications and calculations shall be sealed by a Professional Engineer registered in the state where the project is located.

a. Provide certification stating that calculations provided have been prepared specifically for this Project and that they match and pertain to the Shop Drawings provided.
b. Provide a summary document as part of the above certification listing the design criteria used for precast design including:
1) Codes and standards.
2) Soil load.
3) Exterior groundwater load.
4) Live loads.
5) Other loads.

6. Test Reports:
a. Copies of source quality control tests, including compressive strength and air content, for units provided.

1.4 SITE CONDITIONS

A. Design groundwater elevation for precast structure design shall be the 100-year flood elevation shown on the Contract Documents.
1. If the 100-year flood elevation is not shown on the Contract Documents, the design groundwater elevation shall be equal to the ground surface elevation at the structure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Manhole rings, covers and frames:
a. Conform to requirements of Specification Section 33 05 16 for nonpressure type frames.
2. Premolded joint sealant:
a. NPC Bidco, Inc., C-56.
b. Ram-Nek, Henry Co.
c. EZ-Stik, Press-Seal Gasket Corp.
d. CS-102, Conseal.
3. Elastomeric joint seals:
a. Kent Seal.
4. External joint wrap.
a. NPC, Bidco, Inc.
b. EZ-Wrap, Press-Seal Gasket Corp.
c. RUBR-Nek, Henry Co.
5. Emulsified fibrated asphalt compound:
a. Sonneborn Hydrocide 700B Semi-Mastic.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 PRECAST UTILITY STRUCTURE COMPONENTS

A. Provide utility structures with interior dimensions as shown on the Drawings.

B. Provide the following components for each utility structure:
1. Precast base section with integral or cast in place base slab.
2. Precast wall section(s).
3. Precast flat top.
a. Where reinforcement is shown for top slab, furnish slab with reinforcing as designed, but not less than reinforcing shown on Drawings.

C. Provide openings and appurtenances as shown on Drawings.
1. Manhole frames and covers:
a. Furnish and install in accordance with Specification Section 33 05 16.

b. Cast frames into top slab.

D. Concrete:
1. Conform to requirements of Specification Section 03 31 30.
2. Conform to requirements of ASTM C858, where stricter than Specification Section 03 31 30.
a. Minimum 28-day compressive strength 4500 PSI.
b. All portions of precast utility structure are considered to be exposed to freeze-thaw cycles.

E. Joints:
1. Joints of precast riser and top sections:
a. Preformed flexible joint sealants: ASTM C990.
b. Exterior joint wrap.
2. Pipe and conduit entry for utility structures.
a. In accordance with Specification Section 01 73 20.

F. Coatings:
1. Vertical wall surfaces:
a. Emulsified fibrated asphalt compound meeting ASTM D1227 Type I for all vertical wall exterior surfaces.

2.3 DESIGN

A. General Design Requirements:
1. Design precast units and appurtenances in accordance with ASTM C858.
a. Notify Engineer and furnish cast-in-place structures if sizes of precast utility structures shown on Drawings cannot be designed or fabricated.

B. Design loads:
1. Design precast units for all loads and load cases described in ASTM C857, with the following values and selections:
a. Wheel loads shall be considered.
1) Use wheel load designation A-16 (HS20-44) as shown in ASTM C857, Table 1.
2) Wheel loads and uniform live load do not act concurrently.
b. Unit weight of soil W shall be taken as no less than 100 LB/CU FT.
c. Minimum lateral soil pressure coefficient (K_0): 0.50.

C. Specific Design Requirements:
1. Out-of-plane shear:
a. Out-of-plane shear shall be shown in the calculations.
b. Wall thickness shall be determined based on meeting design requirements for out-of-plane shear resulting from soil and groundwater loads.
c. Wall sections shall be designed as one-way spans between corners for calculation of out-of-plane shear. Transfer of shear or bending load shall not be considered to be transferred across joints between precast units or between walls and slabs, unless unit as integrally cast together.
d. Use of shear steel reinforcement to increase out-of-plane shear capacity shall be prohibited.
2. The distribution of moments in adjacent walls of different lengths in rectangular structures shall be considered.
3. Design precast units taking into account reduced cross section at openings and penetrations.
4. Structure shall be checked for buoyancy.
a. The minimum factor of safety for uplift with the design groundwater elevation shall be 1.25, unless a larger factor of safety is required by the local governing body or Building Code.
b. The minimum factor of safety for uplift at the fully submerged condition shall be no less than 1.0.

c. If the buoyant weight of soil above base slab extensions beyond the external dimensions of the structure is used to resist uplift, the volume of soil considered to resist uplift shall be limited to soil within the vertical projection of the edge of the base slab extensions.

PART 3 - EXECUTION

3.1 PRECAST UTILITY STRUCTURE CONSTRUCTION

A. General:
   1. Prepare subgrade for base as required by Specification Section 31 23 00.
      a. For precast base slabs, place and compact 6 IN of Granular Fill or Bedding Material as shown on Drawings.
      b. For cast-in-place concrete base slabs, support base section and prepare bottom joint with preformed strip-type hydrophilic waterstop in accordance with Specification Section 03 31 31.
      c. Confirm that base is level and fully supported by stable material.
   2. For structures with open pipe flow, make inverts in accordance with Section 33 05 16.
   3. Ensure accurate vertical placement and leveling prior to placement of interior grout.
      a. Provide vertical alignment tolerance of maximum 1 IN horizontal to 10 FT vertical.

B. Build each structure to dimensions shown on plans and at such elevation that pipe sections built into wall of structure will be true line of pipe extensions.

C. For all horizontal mating surfaces between precast concrete units, apply premolded flexible joint sealant to clean mating surfaces in accordance with sealant manufacturer's written instructions. Apply sufficient pressure to each concrete unit to seat unit in sealant.

D. Seal all pipe penetrations in manhole.
   1. Where post-installed seals are permitted, form pipe openings smooth and well-shaped.
   2. After installation, seal exterior of penetration with non-shrink grout.
   3. After grout cures, wire brush smooth and apply two coats emulsified fibrated asphalt compound to minimum wet thickness of 1/8 IN to ensure complete seal.

E. Set top slab level to elevation shown on Drawings.

3.2 FIELD QUALITY CONTROL

A. Any proposed repairs of precast components or structures shall be submitted to Engineer for approval.

B. Structures shall be observed for signs of leakage during periods of high groundwater.

C. No leakage that includes visible flow through joints between precast concrete sections or through pipe penetrations shall be permitted.

D. Damp spots on interior wall surfaces shall be considered leakage and shall not be permitted.
   1. Damp spots shall be defined as spots where moisture from a source outside the structure can be picked up on a dry hand.
   2. Locate the source of water movement through the wall and permanently seal.

E. Dampness on the top of the base slab will not be construed as leakage.

END OF SECTION

SECTION 33 05 16
PRECAST CONCRETE MANHOLE STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Precast concrete round manhole structures and appurtenant items.
      a. Sanitary sewer manholes and appurtenances.
      b. Drain manholes and appurtenances.
      c. Storm sewer manholes and appurtenances.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 03 21 00 - Reinforcement.
   4. Section 03 31 30 - Concrete Materials and Proportioning.
   5. Section 31 23 33 - Trenching, Backfilling, and Compacting for Utilities.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. A48/A48M, Standard Specification for Gray Iron Castings.
      b. C150/C150M, Standard Specification for Portland Cement.
      c. C478, Standard Specification for Precast Reinforced Concrete Manhole Sections.
      d. C923, Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
      e. D1227, Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing.
      f. D4586, Standard Specification for Asphalt Roof Cement, Asbestos-Free.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   3. Fabrication and/or layout drawings:
      a. Include detailed diagrams of manholes showing typical components and dimensions, reinforcements and other details.
      b. Itemize, on separate schedule, sectional breakdown of each manhole structure with all components and refer to drawing identification number or notation.
      c. Indicate knockout elevations for all piping entering each manhole.
   4. Buoyancy uplift and structural calculations.
   5. Drawings shall be signed and sealed by a Professional Engineer registered in state corresponding to the project location.

B. Unless approved prior to submittal, submit all products from this Specification Section in one complete submittal package. Include all products and accessories together.

1.4 SITE CONDITIONS

A. For this project, the established high groundwater elevation is approximately 0-6 inches below existing grade.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Manhole rings, covers and frames:
      a. Neenah Foundry and Neenah Enterprises, Inc.
      b. Deeter Foundry.
   2. Black mastic joint compound:
      a. Kalktite 340.
      b. Tufflex.
      c. Plastico.
   3. Premolded joint compound:
      a. RAM-NEK.
      b. Kent Seal.
   4. Emulsified fibrated asphalt compound:
      a. Sonneborn Hydrocide 700B.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 SANITARY SEWER, STORM AND DRAIN MANHOLE STRUCTURE COMPONENTS

A. Manhole Components:
   1. Reinforcement: ASTM C478.
   2. Minimum wall thickness: 5 IN.
   3. Minimum base thickness: 12 IN.
   4. Provide the following components for each manhole structure:
      a. Base (precast) with integral bottom section or (cast-in-place).
      b. Precast bottom section(s).
      c. Precast barrel section(s).
      d. Precast eccentric transition section.
      e. Precast adjuster ring(s).
      f. Precast concrete transition section.
      g. Precast flat top.
   5. Unless dimensioned or specifically noted on Drawings, provide manhole section with minimum 48 IN inside dimensions.

B. Nonpressure Type Frames and Cover:
   1. Cast iron frame and covers: ASTM A48/A48M, Class 35 (minimum).
   2. Use only cast ductile iron of best quality, free from imperfections and blow holes.
   3. Furnish frame and cover of heavy-duty construction a minimum total weight of 335 LBS.
   4. Machine all horizontal surfaces.
   5. Furnish unit with solid nonventilated lid with concealed pickholes.
      a. Letter covers "SEWER" for all collection system manholes, "DRAIN" for all gravity unit drains returning flow to the headworks, and "STORM" for storm sewer systems.
   6. Ensure minimum clear opening of 24 IN DIA.

C. Special Coatings and Joint Treatment:
   1. Joints of precast sections:
      a. Black mastic compound: ASTM D4586.
   2. Vertical wall surfaces:
      a. Emulsified fibrated asphalt compound meeting ASTM D1227 Type II for all exterior and interior vertical wall surfaces.

D. Sanitary Sewer Manhole Concrete:
   1. Provide all sanitary manholes constructed with Portland ASTM C150/C150M, Type I or II cement with a tricalcium aluminate content not to exceed 8 PCT.
   2. Mix aggregate shall be a minimum of 50 PCT crushed limestone.
   3. Provide 3000 PSI nonshrink grout.

PART 3 - EXECUTION

3.1 MANHOLE CONSTRUCTION

A. General:
   1. Construct cast-in-place concrete base slabs.
   2. Make inverts with a semi-circular bottom conforming to the inside contour of the adjacent sewer sections.
      a. See detail on Drawings.
      b. If pipes deflect at manhole, shape as specified in Paragraphs 2 and 3 in this General Paragraph.
   3. Shape inverts accurately and steel trowel finish.
      a. For changes in direction of the sewer and entering branches into the manhole, make a circular curve in the manhole invert using as large a radius as manhole inside diameter will permit.
      b. Pour base slab integral with bottom barrel section.

B. Build each manhole to dimensions shown on plans and at such elevation that pipe sections built into wall of manhole will be true extensions of line of pipe.

C. For all horizontal mating surfaces between concrete and concrete or concrete and metal, above established high groundwater elevation shown trowel apply to clean surface black mastic joint compound to a minimum wet thickness of 1/4 IN immediately prior to mating the surfaces.

D. For horizontal joints that fall below established high groundwater elevation shown, install a resilient O-ring type gasket or pre-molded joint compound.

E. Seal all pipe penetrations in manhole.
   1. Form pipe openings smooth and well shaped.
   2. After installation, seal cracks with, non shrink grout.
   3. After grout cures, wire brush smooth and apply two coats emulsified fibrated asphalt compound to minimum wet thickness of 1/8 IN to ensure complete seal.

F. Set and adjust frame and cover final 6 IN (minimum) to 18 IN (maximum) to match finished pavement or finished grade elevation using precast adjuster rings.

END OF SECTION

SECTION 33 11 13
WATER MAIN CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Coordination and interface with existing facilities and utilities.
   2. Connections to existing water mains.
   3. Testing, flushing and disinfection.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 03 31 30 – Concrete, Materials and Proportioning
   4. Section 31 10 00 - Site Clearing.
   5. Section 31 23 33 - Trenching, Backfilling, and Compacting for Utilities.
   6. Section 32 91 13 - Topsoiling and Finished Grading.
   7. Section 33 12 19 - Fire Hydrant.
   8. Section 40 05 00 - Pipe and Pipe Fittings: Basic Requirements.
   9. Section 40 05 51 - Valves: Basic Requirements.
   10. Section 40 05 61 - Gate Valves.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Water Work Association (AWWA):
      a. B300, Standard for Hypochlorites.
      b. B301, Standard for Liquid Chlorine.
      c. C651, Standard for Disinfecting Water Mains.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Fabrication and/or layout drawings.
      d. Certifications.
      e. Test reports.
   3. Submit results of the leakage tests, identifying the specific length of pipe tested, the test pressure, the duration of test and the amount of leakage.
   4. Submit satisfactory bacteriological test reports on disinfection requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pipe: Refer to Specification Section 40 05 00.

B. In-Line Valves:
   1. Refer to Specification Section 40 05 61.
   2. Provide adjustable valve boxes.
      a. Include price of valve boxes in price of valve installed complete.

C. Fire Hydrants: Refer to Specification Section 33 12 19.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install water main to the line and grade on the Drawings.
   1. Water mains to be staked at a minimum 100 FT interval with depth of cuts monitored.

C. Field verify depth of utilities that will be crossed.
   1. Adjust water main elevation as required during construction.
   2. No separate payment will be made for field verification or adjustment of main depths as required.

D. Contractor will restore all existing structures or services damaged by Contractor's operations at no cost to County.

3.2 INTERRUPTION OF SERVICE

A. No interruption of service to Transfer Station facility shall be allowed.
   1. Notify County for all work associated with connection of new water mains to existing buildings a minimum of 24 HRS in advance.

3.3 UNDERGROUND SERVICES

A. Notify utility representative prior to construction to obtain available information on location of existing utilities.
   1. Contractor shall be responsible for locating all utilities.

3.4 DRIVEWAY REMOVAL AND REPLACEMENT

A. All Portland cement concrete and asphalt noted for removal and replacement shall be cut prior to removal.
   1. Cut by sawing, vertical cut to be 1 IN minimum.
   2. The remaining depth of section may be broken out in a manner subject to Engineers approval.
   3. Width of section removed to be either a width not greater than the outside diameter of the water main plus 4 FT-0 IN or broken out to the nearest joint.

B. Replace Portland cement concrete and asphalt equal to or better than original paving.

C. Debris resulting from the above operations shall be removed and hauled as directed by the Engineer.

D. Include driveway removal and replacement in cost of the bid unit price of the water main.

3.5 PROTECTION OF EXISTING UTILITIES

A. Contractor to verify the location of all underground utilities.
   1. Omission from, or the inclusion of utility locations on the plans is not to be considered as the nonexistence of or a definite location of existing underground utilities.

B. A representative of the underground utilities shall be notified 24 HRS in advance of crossings.

3.6 CONNECTIONS TO EXISTING WATER MAINS

A. Make connections to existing water mains as shown on Drawings, by attaching to existing or changed fitting.
   1. Cost for making connections shall include cost of all fittings including flexible couplings, and shall be included in the bid unit price of the water main.

B. Contractor is responsible for controlling and disposing of water in the trench at no additional cost to the County.

3.7 SEWER CROSSINGS

A. Water mains crossing storm sewers or sanitary sewers shall be laid to provide a vertical separation of at least 18 IN between the bottom of the water main and the top of the sewer, or as otherwise noted with specific descriptions on the Drawings.

B. Payment for crossings shall be included in the bid unit price of the water main.

3.8 TREES

A. Do not remove trees without written instructions from the Engineer unless tree removal is shown on Drawings.
   1. No separate payment will be made for tree removal and the cost shall be included in the bid unit price for transmission main.

3.9 FENCES, SIGNS, MAILBOXES, ETC.

A. Restore all damaged fences, signs, etc., to their original conditions.
   1. No separate payment will be made for these items.

3.10 FIELD QUALITY CONTROL

A. Sealing, Flushing, and Disinfection of Potable Water Systems:
   1. Maintain interior of all pipes, fittings and other accessories free from dirt and foreign material at all times.
      a. If, in the opinion of the Engineer, the pipe contains dirt that will not be removed by flushing, the pipe interior shall be cleaned and swabbed with bactericidal solution.
      b. At close of day's work or whenever workmen are absent from jobsite, plug, cap or otherwise provide watertight seal from open ends of pipe to prevent ingress of foreign material.
      c. If water is in trench, seal shall remain in place until trench is pumped dry.
   2. After favorable performance of pressure test and prior to final acceptance, thoroughly flush the entire potable water piping system and perform disinfection as prescribed.
      a. Perform all work including preventative measures during construction in full compliance to AWWA C651.
   3. Flush each segment of the system to provide a flushing velocity of not less than 2.5 FT per second.
   4. Drain flushing water to location approved by the County.
   5. Perform disinfection using one of the following forms:
      a. Application of chlorine gas-water mixture by means of solution-feed chlorinating device.
         1) Liquid chlorine shall comply with AWWA B301.
      b. Application of calcium hypochlorite, or sodium hypochlorite.
         1) Chlorine compounds shall comply with AWWA B300.
   6. Disinfect pipe with chlorinated water as per AWWA C651.
      a. Method of application of chlorine shall be by continuous feed method or slug method.
      b. During disinfection procedure, ensure that initial and residual chlorine concentrations meet AWWA C651 requirements by testing by an approved method as directed by the County.
      c. Cost of testing shall be included in the Bid Unit Price for water mains and no separate payment will be made for this item.
   7. Tag the system during the disinfection procedure.
   8. Following disinfection for required contact period, neutralize chlorine residual in water by treating with reducing agent.
      a. Refer to AWWA C651.
      b. Flush all treated water from pipeline at its extremities until replacement water throughout pipe, upon test is proved comparable in quality to water in existing system.
      c. Take two (2) samples to test for bacteriological quality as directed by Engineer.
      d. Repeat disinfection procedure until two (2) satisfactory results are obtained.

e. Quality of water delivered by the new water main to remain satisfactory for a minimum period of two (2) days.

9. Secure satisfactory bacteriological reports on samples from the system.
   a. Ensure all sampling and testing procedures are in full compliance to AWWA C651, and applicable requirements of the State of California.
      1) No separate payment will be made for this item.
10. The County will provide the water required to fill the main initially and will pay for the water required to flush the main once.
   a. Filling and flushing shall be performed during periods of low usage or outside of facility hours of operation, unless other proposed scheduled times are approved by the County.
   b. Flushing water will be based on a maximum of 8 HRS total.
   c. Any additional refilling or reflushing to be at the Contractor's expense.

END OF SECTION

SECTION 33 12 19
FIRE HYDRANT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Dry-barrel fire hydrant.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 09 96 00 - High Performance Industrial Coatings.
   4. Section 40 05 00 - Pipe and Pipe Fittings: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Water Works Association (AWWA):
      a. C502, Standard for Dry-Barrel Fire Hydrants.
      b. M17, Installation, Operation and Maintenance of Fire Hydrants.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data:
      a. Acknowledgement that products submitted meet the requirements of the standards referenced.
      b. Manufacturer's installation instructions.
      c. Acknowledge and verify dimensions and provide list of integral parts and materials.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Mueller.
   2. American Flow Control.
   3. Waterous.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 FIRE HYDRANT

A. Design and Fabrication:
   1. Conform to AWWA C502.
   2. Provide with either compression or gate design.
   3. Provide with a minimum 5-1/4 IN valve opening, nozzle section consisting of two (2) 2-1/2 IN hose nozzles and one (1) 4-1/2 IN steamer.
   4. Provide with water passages to permit full flow of water to minimize friction loss.

5. Designed to throttle flow when partially opened.
6. Designed to allow removal of valve and valve stem without digging up hydrant.
7. Suitable for 4 FT of bury.
8. Furnish with mechanical (gland type) joint inlet connections.
9. Design to break off at ground line when struck by a vehicle.
10. Furnish with O-ring packing only.
11. Furnish hose and steamer nozzles with threads conforming to standard threads used by local Fire Department.
12. Furnish with direction of opening as required by local Fire Department with direction of opening cast on dome.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install hydrants at locations indicated in accordance with AWWA M17 and the following:
   1. Remove foreign material from barrel of hydrant before placement.
   2. Install plumb and at same elevation as connecting pipe and main.
   3. Firmly tamp carefully compacted backfill around hydrant to surface of ground and to a distance of 5 FT in front of hydrant.

3.2 COATINGS AND FINISHES

A. Provide hydrant with below grade and above grade coatings as per Section 09 96 00.
   1. Paint above grade with color = SAFETY YELLOW..
   2. Paint hydrant caps County required color based on results from hydrant test flow rates.

END OF SECTION

SECTION 33 16 24
STEEL TANK - EPOXY-COATED

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Storage tank and foundation.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Division 03 - Concrete.
   4. Section 31 23 00 - Earthwork.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Civil Engineers (ASCE):
      a. 7, Minimum Design Loads for Buildings and Other Structures.
   2. ASTM International (ASTM):
      a. A36, Standard Specification for Carbon Structural Steel.
      b. A307, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
      c. A570, Hot-Rolled Sheet and Strip, Structural Quality.
   3. American Water Works Association (AWWA):
      a. C652, Standard for Disinfection of Water Storage Facilities.
      b. D103, Standard for Factory-Coated Bolted Steel Tanks for Water Storage.
   4. American Petroleum Institute (API):
      a. 12B, Bolted Tanks for Storage of Production Liquids.
   5. National Sanitation Foundation International (NSF).
   6. Occupational, Safety and Health Administration (OSHA).
   7. Steel Structures Painting Council Standards/NACE International (SSPC/NACE):
      a. SP 10/NACE No. 2, Near-White Blast Cleaning.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that product submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Accessories furnished with each tank, including level indicators, instrumentation, ladders, etc.
   3. Fabrication and/or Layout Drawings:
      a. Complete construction details:
         1) Anchor bolt locations and embedment details into foundation, for installation by Contractor.
         2) Anchor bolts calculations and shop drawings in accordance with Section 03 15 19.
      b. Complete detailed engineering drawings of equipment furnished. Equipment shall be drawn to scale using common engineering scales. Provide plan and elevation views for the specific tank being furnished.
      c. Include dimensions for tank, manways and piping connection sizes.
   4. Provide tank coating information.
   5. Certifications:

a. Certificates of compliance with standards specified for all major components incorporated into work.
6. Test reports.

B. Contract Closeout Information:
1. Operation and Maintenance Data:
a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

C. Informational Submittals:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Steel Members:
1. Handle and store steel members above ground on platforms, skids, or other supports.
2. Keep members free of dirt, grease and other foreign material.

PART 2 - PRODUCTS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Colombian Steel Tank (CST) Industries, Inc.
2. National Storage Tank, Inc.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. Steel:
1. Sheets:
a. Hot-rolled per ASTM A570, Grade 33.
b. Minimum yield strength: 33,000 PSI.
2. Plates:
a. Per ASTM A36.
b. Minimum yield strength: 36,000 PSI.
3. Rolled structural shapes:
a. Per ASTM A36.

B. Bolts, Nuts and Washers:
1. Galvanized bolts, nuts and washers.
2. Minimum 1/2 IN DIA.
3. Per API 12B.
4. Poly-capped bolt heads.
5. Per ASTM A307.
6. Steel nuts in contact with the liquid in the tank to be factory-encapsulated for corrosion protection.
7. Neoprene backed steel washers at bolts in contact with stored liquid.

C. Gaskets:
1. Bolted connections:
a. Buna-N gaskets.
b. Minimum 1-3/4 IN wide.
2. Vertical seams:
a. Single-piece double-punched.

2.3 WATER STORAGE TANK DESIGN REQUIREMENTS (WST-1)

A. Size:
   1. Nominal Tank Capacity: 8,900 GAL
   2. Tank Diameter: 12 FT.
   3. Tank Height: 10 FT.

B. Design tank in accordance with AWWA D103.

C. Design Loads:
   1. Specific gravity: 1.0
   2. Wind:
      a. Velocity:
         1) Per ASCE 7-16.
      b. Importance factor: 1.0.
      c. Exposure category: C.
   3. Shape factor: 0.5 (standard).
   4. Seismic:
      a. Seismic use group: II.
      b. Importance factor: 1.0.
      c. Seismic design category: D.
      d. Seismic design parameters: Per General Structural Notes – D on contract Sheet 00S001

D. Provide glass lined bolted steel walls.
   1. Radially sectioned type roof.
   2. Provide columns and structural framing.

E. Provide anchor bolts and other materials as required to install tank to foundation. Anchor bolts shall be designed and detailed per ACI 318 Chapter 17 requirements and be signed and stamped by a professional civil or structural engineer registered in the State of California. See Section 03 15 19 for more details and requirements.

F. Foundation Design:
   1. Engineer's foundation design shall be verified by tank manufacturer based on requirement for equipment provided.
   2. Foundation concrete shall conform to Division 03.
   3. Earthwork to conform to Specification Section 31 23 00.
   4. Refer to the Geotechnical Report for the project for soil bearing capacity and differential settlement characteristics.
   5. Requests for foundation modifications by the tank manufacturer shall be made to the Engineer for approval.

G. Connections:
   1. Flanged connections shall be ANSI Class 150.
   2. Design the following in accordance with AWWA D103, with locations of connections as shown on the Drawings.
      a. Two Manways – One on top and one on side of tank.
      b. Two flanged 3 IN for inlet and outlet piping connections.
      c. One flanged 3 IN connection for analog level sensor.
      d. One vent located near center of roof with vent cap and insect screen.
      e. One flanged 3 IN connection for normal drain.
      f. One flanged 3 IN connection for overflow drain.
      g. One flanged 3 IN connection for mechanical level indicator.
      h. One flanged 2 IN connection for water sample valve.
      i. Two flanged 3 IN connections on top of tank for spares.

2.4 ACCESSORIES

A. Coatings and surfaces of tank accessories in contact with the stored water shall be NSF-61 compliant for use in potable water applications.

B. Outside Tank Ladder:
   1. Design in accordance with AWWA D103 to meet or exceed OSHA standards.
   2. Caged with top landing.
   3. Provide a security door with hasp and lock.

C. Roof Walkway:
   1. Furnish roof walkway with railings for access to roof-mounted connections.
   2. Design in accordance with AWWA D103 to meet or exceed OSHA standards.

D. Manway Hatches:
   1. Provide one roof hatch and one sidewall hatch with bolted hinged covers and locks.
   2. Furnish hatches in the locations shown on Drawings.
   3. Furnish hatches with minimum openings of at least 24 IN DIA and standoffs at least 4 IN in depth.
   4. Overlap the standoffs with the covers at least 2 IN.
   5. Hatch doors shall be constructed of the same material as the tank.

E. Tank Level Sensor:
   1. Submersible, loop powered, analog 4-20 mA output over the full depth of the tank.
   2. PVC or ABS body, suitable for potable well water applications.
   3. Manufactured by Mission Communications, or equal.

F. Mechanical tank level indicator:
   1. Float and gauge board type for liquid level measurement.
   2. Coated aluminum gauge board with level indicated in feet and inches.
   3. All wetted parts to be fabricated from 316 stainless steel.
   4. Equal to Varec model 6700 Liquid Level Indicator.

G. Vent:
   1. Provide one gravity roof ventilator designed in accordance with AWWA D103.
   2. Size for maximum of 0.5 IN WC pressure drop when 200 CFM of air enters or exits the tank.
   3. Furnish with insect screen.

2.5 SHOP OR FACTORY FINISHING

A. Epoxy linings in contact with the stored water shall be NSF certified for use in potable water applications.

B. Cleaning:
   1. Thoroughly wash and rinse tank parts to remove grease, oil and foreign matter.
   2. Immediately oven-dry after washing.

C. Surface Preparation:
   1. Grit blast on both sides to the equivalent of SSPC/NACE SP 10/NACE No. 2 to 1-2 MIL profile.

D. Coating:
   1. All parts to be coated within 15 minutes of blasting.
   2. Interior coating:
      a. Thermally cured modified epoxy powder, Trico-Bond EP.
      b. Electrostatic application of NSF approved thermoset epoxy to 5 MIL dry film thickness.
   3. Exterior coating:
      a. Thermally cured modified epoxy powder, Trico-Bond EP and acrylic polyurethane.
      b. First coat: Powder modified epoxy, Trico-Bond EP, 2.5 MIL dry film thickness.
      c. Second coat: Acrylic polyurethane, 1.5 MIL dry film thickness.
   4. Curing:
      a. Baking ovens to be used for curing after each coat.
      b. Final coat cured for at least 15 minutes.

E. Inspection:
   1. Inspect all coated sheets for mil thickness (Mikrotest or equal).
   2. Check all coated sheets for color uniformity by an electronic colorimeter.
   3. Perform an electrical leak detection test on the inside surface after fabrication of the sheet.
      a. Reject sheets with electrical leaks.

F. Repair coatings damaged during shipping or defective as recommended by tank manufacturer.

G. Packaging:
   1. Protect all approved sheets from damage prior to packing for shipment.
   2. Place heavy paper or plastic foam sheets between each panel to eliminate sheet-to sheet abrasion
   3. Wrap individual stacks of panels in heavy mil black plastic and steel banded special wood pallets built to the roll-radius of the tank panels to eliminate contact or movement of finished panels during shipment.
   4. Shipment from the factory to the jobsite will be by truck, hauling the tank components exclusively.

PART 3 - EXECUTION

3.1 ERECTION

A. Tank Type – Potable Water Storage Tank:
   1. Sidewall structure.
   2. Field erection of the bolted steel tank shall be in strict accordance with the procedures outlined in the manufacturer's erection manual.
      a. Performed by an authorized dealer of the tank manufacturer regularly engaged in erection of these tanks.
   3. Use specialized erection jacks and building equipment developed and manufactured by the tank manufacturer to erect the tanks.
   4. Take particular care in handling and bolting of the tank panes and members to avoid damage of the coating system.
      a. The Engineer and Owner's representative reserve the right to visually inspect all surface areas of the tank prior to the liquid test.
      b. Inspection of the tank by the Engineer and/or Owner's representative shall not relieve the bidder from his responsibility for liquid tightness.
   5. Repair coating damaged during shipping or defective as recommended by tank manufacturer.
   6. After erection is complete, clean tank of all excess material and debris.

3.2 FIELD QUALITY CONTROL

A. Tank Type – Potable Water Storage Tank:
   1. Testing:
      a. After construction of tank is completed provide leak test in accordance with AWWA D103, Section 9.2.
         1) Fill the tank completely.
         2) Repair any leaks found.
         3) Repairs shall be made while the water level is above the point being repaired.
   2. Perform an electrical leak test during erection using a 9 V leak detection device.
      a. Repair all electrical leak points found on the inside surface in accordance with manufacturer's published touch-up procedure.
      b. Properly restore any lining or coating damaged by repairs or construction.

3.3 DISINFECTION

A. Disinfect tank per AWWA C652, Chlorination method 2:
   1. Jet wash the interior of the tank with a chlorine solution of minimum 200 PPM.
      a. Use a chlorine product free of acid components.

b. Provide the mixing water and remove the chlorine solution that accumulates in the bottom of the tank the same workday it is applied.
c. Rinsing with water is not required.

END OF SECTION

SECTION 33 31 11
GRAVITY SEWER PIPELINE AND MANHOLE CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Installation and testing of sewer pipes, manholes, structures and appurtenances.
   2. Connections to existing sewers.
   3. Coordination and interface with existing facilities and utilities.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 31 23 00 - Earthwork.
   4. Section 31 23 33 - Trenching, Backfilling, and Compacting for Utilities.
   5. Section 32 13 13 - Concrete Pavement.
   6. Section 32 16 13 - Concrete Curb and Gutter.
   7. Section 32 91 13 - Topsoiling and Finished Grading.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. F1417, Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air.
   2. Occupational Safety and Health Administration (OSHA).

1.3 SUBMITTALS

A. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

B. Shop Drawings:
   1. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Catalog data sheets for all materials.
      c. Details of all piping system components confirming that the pipe, fittings, and appurtenances conform to the specified requirements.
      d. Manufacturers' written recommendations for material handling, delivery, storage, installation, and minor repair of materials damaged in shipping.
      e. Recommended details for buoyancy restraint and for manhole/pipe connections.
      f. Fabrication and/or layout drawings as specified in individual pipe material specifications.
   2. See individual pipe material specifications for additional required submittals.

C. Test Reports:
   1. Submit results of leakage tests including the following:
      a. Test procedure.
      b. Pipeline segment tested.
      c. Length of pipe tested.
      d. Test pressure.
      e. Test duration
      f. Amount of leakage.
      g. Corrective action, if any.

1.4 DELIVERY, STORAGE, AND HANDLING OF PRODUCTS

A. Deliver, handle and store products in accordance with manufacturer's instructions.

B. Protect pipeline sections stored at the site from damage.

C. Store all products above the ground upon platforms, pallets, skids, or other supports supplied by the Contractor.
   1. Store in a way to permit ready access for identification and inspection by the Engineer.

D. Keep products free from dirt and other foreign matter.

E. Provide suitable quantities of all lifting equipment to handle the pipe.
   1. Do not utilize any equipment that is not rated to handle the intended loading or conditions of use to which it will be subjected, or which will damage or gouge the pipe.
   2. Do not drag or drop pipe.

F. Place pipe lain directly on the ground prior to placement on an area free of loose stones or sharp objects.

G. Repair or replace any new pipe and fittings damaged before or during installation at Contractor's expense, before proceeding further.
   1. Utilize repairs methods as recommended by the manufacturer.
   2. Replace damaged materials as directed by County project representative.

H. Protect PVC pipe from UV degradation if stored outside for more than 60 days.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pipe:
   1. See individual pipe material specifications listed in Paragraph 1.1 B above.

B. Embedment and Bedding Materials for pipelines: See Section Specification 31 23 33.

C. Size mandrels to meet deflection requirements specified herein or in the individual pipe material specifications.

D. Pipe Joint Testing Equipment:
   1. Utilize joint testing equipment capable of providing sufficient sealing pressure for air bladder to prevent leakage through bladder seals.
   2. Include pressure gage to aid in verification of adequate applied pressure and joints ability to withstand the applied pressure without leaking.
   3. Utilize joint testing equipment that encapsulates the full 360 DEG circumference of the joint and at least 6 IN each side of the joint.
   4. Pipes furnished with an integral "testable" joint, consisting of two gaskets with fittings to pressure test between the two gaskets, will be tested using the test equipment and fittings recommended by the pipe manufacturer.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Install products in accordance with manufacturer's instructions.

B. Furnish all construction materials and equipment required for installation and backfill.

C. Install the pipeline complete, including other associated work and appurtenances, as shown on the Drawings or as herein specified.

D. Make all necessary connections to sewer lines shown on the Drawings and in accordance with the Specifications.

E. Construct all sewer piping, cleanouts and accessories to be free of visible ground water inflow.
   1. Install sanitary sewer cleanouts and accessories that are watertight.
   2. Install pipe with water tight pipe joints.
      a. Repair or replace any joint showing infiltration of ground water through pipe joints or pipe to cleanout connections.

F. Alignment: Lay gravity sewer lines in straight alignment and uniform grade between cleanouts.
   1. Install at grade as shown on drawings.

G. Brace and protect pipe sections to prevent deformation during installation and backfill.

H. Deflection: Pipe deflection after final backfill shall not exceed the specified limits detailed in the individual pipe specifications.
   1. Remove and replace any pipe observed to be deflecting in excess of the specified limits.

I. Perform testing in accordance with requirements of this Section.

J. Provide Engineer with free access to work for inspection.
   1. Such inspection shall not relieve the Contractor of his responsibility for performing Work in accordance with the Contract Documents.

3.2 PIPELINE INSTALLATION

A. Lateral shoring of the trench walls or other similar construction methods may be required.
   1. Design and implement all such methods.
   2. When required, install shoring in accordance with all applicable local, State and OSHA regulations.
   3. Remove shoring prior to backfilling.

B. Grade bottoms of trenches such that when bedding is placed between the trench bottom and the pipe, each section of pipe is installed to the specified depth or elevation with uniform support.

C. Determine and fix alignment and grade or elevation of each pipeline from offset stakes or calibrated laser instruments.

D. Install pipelines on the line and grade shown on the Drawings.
   1. Calculate required elevation of each pipe joint and survey installed elevation at each joint prior to stabbing the next joint to verify grade.
   2. Relay pipe to proper grade if any joint elevation deviates from the calculation by more than 0.01 FT.

E. Remove material at the bottom of the trench if determined to be unsuitable by the Engineer.
   1. Backfill trench with approved subgrade material or bedding material to the specified depth or elevation as described in Specification Section 31 23 33.

F. Install only clean pipe and fittings.
   1. Provide physical barriers to protect open ends of sections of pipe in place from the entrance of trench water, mud, dirt, or other foreign substances with when pipe installation is not in progress.

G. Begin pipe laying at the lowest elevation with bell ends facing the direction of laying, except when reverse laying is permitted by Engineer.

H. Where the drawings require concrete encasement or flowable fill embedment and backfill, anchor pipe as required to prevent floatation.
   1. Alternatively, Contractor may place concrete or flow fill materials in staged lifts allowing each lift to reach initial set prior to placing the subsequent lift to limit buoyancy effects and prevent floatation of the pipeline.

I. Pipeline may be backfilled as it is installed, provided all inspection and testing requirements are met.

J. Pipe, fittings, and special pieces will be subject to inspection by Engineer, prior to installation.

1. Report all damages not detected by Engineer but discovered by Contractor during installation to Engineer for corrective action or replacement.

K. Repair of pipe damaged during installation shall conform to the manufacturer's repair procedures; with the concurrence of Engineer.

3.3 RESTORATION

A. Restore all existing structures or services damaged by Contractor's operations at no cost to County.
   1. Repair or replace culverts that are damaged, removed or interfere with the work as part of restoration at no additional cost to County.

B. Restore all area disturbed by installation of the pipelined in accordance with the Specifications, the Drawings,
   1. Provide slope protection, re-vegetation, and road restoration as necessary.

C. Driveway Removal and Replacement:
   1. All Portland cement concrete and asphalt noted for removal and replacement shall be cut prior to removal.
      a. Cut by sawing, vertical cut to be 1 IN minimum.
      b. The remaining depth of section may be broken out in a manner subject to Engineer's approval.
      c. Width of section removed to be either a width not greater than the outside diameter of the sewer plus 4 FT-0 IN or broken out to the nearest joint.
   2. Replace Portland cement concrete and asphalt equal to or better than original paving.
   3. Debris resulting from the above operations shall be removed and disposed offsite.
   4. Include driveway removal and replacement in cost of the bid unit price of the sewer pipe.

D. Trees:
   1. Do not remove trees without written instructions from the Engineer unless tree removal is shown on drawings.
   2. No separate payment will be made for tree removal and the cost shall be included in the bid unit price sewer pipe.

E. Fences, Signs, etc.:
   1. Restore all damaged fences, signs, etc., to their original conditions.
      a. No separate payment will be made for these items.

3.4 PROTECTION OF EXISTING UTILITIES

A. Verify the location of all underground utilities.
   1. Omission from, or the inclusion of utility locations on the plans is not to be considered as the nonexistence of or a definite location of existing underground utilities.

B. Notify utility representative prior to construction to obtain available information on location of existing utilities.
   1. Contractor shall be responsible for locating all utilities.

C. Notify representative of the underground utilities 24 HRS in advance of crossings.

D. Existing sewer services:
   1. Repair damage to existing sewer laterals with pipe of same size and material as damaged pipe.

3.5 INTERRUPTION OF SERVICE

A. Notify County of any interruption in service a minimum of 24 HRS in advance.

3.6 FIELD QUALITY CONTROL

A. General Testing Requirements:

1. Furnish necessary personnel, materials, and equipment, including bulkheads, restraints, anchors, temporary connections, pumps, water, pressure gauges, and other means and facilities required to perform tests.
2. Obtain Engineer's approval of methods and the equipment used for the tests prior to testing.
3. Provide reasonable facilities and access for Engineer to inspect, test and obtain such information as required with respect to the materials used and the progress and condition of the Work and the results obtained.
    a. Work that is not performed in accordance with the procedure or does not comply with the requirements of the Specifications will be rejected.
4. Coordinate testing schedules with Engineer.
    a. Perform all specified tests under observation of Engineer.
    b. Provide a minimum of 24 HRS advance notice prior to commencing any testing.
5. Perform testing as work progresses and as required to facilitate connections with existing sewers.
6. Obtain water for testing and cleaning at no additional cost to the County.
7. Test only those portions of pipes that have been installed as part of this Contract.
    a. Test new pipe sections prior to making final connections to existing piping.
    b. Furnish and install plugs, bulkheads, and restraints required to isolate new pipe sections.
8. Unsuccessful Tests:
    a. Where tests are not successful, correct defects or remove defective piping and appurtenances and install piping and appurtenances that comply with the specified requirements.
    b. Repeat testing until tests are successful at no additional cost to County.
9. Deflection:
    a. Check each section of pipe after backfilling for deflection by pulling a mandrel through the pipe.
    b. Conduct test after the final backfill has been in place at least 30 days.
    c. Maximum long term deflection: less than 5 PCT of the initial diameter.

B. Low Pressure Air Testing:
1. Test all gravity sewer pipes with a low pressure air test.
    a. Comply with ASTM F1417.
    b. Time elapsed for a 1 PSI drop in air pressure: Per ASTM F1417.
    c. Maximum air loss: Per ASTM F1417.
2. Submit schedule to Engineer for approval prior to starting the tests.
3. Conduct air test after the final backfill has been in place for a minimum of 30 days.
4. Correct pipes failing air test and conduct second test after final backfill has been in place an additional 30 days.
5. If the length of sewer to be tested is fully or partially submerged in groundwater, increase test pressure as necessary to overcome the actual static pressure exerted by the groundwater.
    a. If a test pressure greater than 8 psi results, utilize water infiltration testing in lieu of air testing.
6. Locate leaks by testing short sections of pipe.
    a. Repair leaks and retest affected reach of sewer.

C. Exfiltration/Infiltration Testing:
1. Hydrostatic exfiltration and infiltration for gravity sewers (groundwater level is below the top of pipe):
    a. Leakage rate: 200 GAL per inch diameter per mile of pipe per day at average head on test section of 3 FT.
    b. Average head is defined from groundwater elevation to average pipe crown.
    c. Acceptable test head leakage rate for heads greater than 3 FT: Acceptable leakage rate (gallons per inch diameter per mile per day) equals 115 times actual test head to the 1/2 power ($LR_{acceptable} = 115 * H^{1/2}$).
2. Hydrostatic infiltration test for gravity sewers (groundwater level is above the top of pipe):

a. Allowable leakage (infiltration) rate: 200 GAL per inch diameter per mile of pipe per day when depth of groundwater over top of pipe is 2 to 6 FT.
b. Leakage rate at heads greater than 6 FT: Allowable leakage rate (gallons per inch diameter per mile of pipe per day) equals 82 times actual head to the 1/2 power ($LR_{acceptable} = 82 * H^{1/2}$).

D. Deflection Testing: Test all flexible sewer pipes for deflection.
1. Perform the mandrel test with the Engineer in observance for all pipe sizes.
2. Deflection limits: as indicated in the individual pipe sections or as specified in article titled "General Testing Requirements" above, whichever is more stringent.
3. Conduct test after the final backfill has been in place at least 30 days.
4. Correct pipes failing deflection test and conduct second test after final backfill has been in place an additional 30 days.

E. Joint Testing:
1. Test all sewer pipe joints
2. Conduct test after final backfill has been in place for at least 30 days.
3. Supply pressure gages of type, calibration, accuracy acceptable to the Engineer.
   a. Engineer may request certification of the gages by a reliable testing firm and may compare these gages with an Owner's gage at any time.
4. Repair or replace pipe joints that do not pass joint test and retest.
   a. Conduct retests after repairs have been made and final backfill has been in place for 30 days.
5. Test procedure:
   a. Center joint tester over joint to be tested and inflate seals.
   b. Apply 3.5 PSIG pressure to joint and allow pressure to stabilize.
   c. If the pressure holds or drops less than 1 PSI in 30 SEC, joint is acceptable.
6. When pipe materials are provided with a "testable joint", cap testing tube securely with a plug at testing port following successful completion of joint test and acceptance by Engineer.

END OF SECTION

SECTION 33 40 00
STORM DRAINAGE SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Storm drainage systems.
   2. Storm drainage pipe.
   3. Inlets, headwalls, flumes and flared end sections.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 31 23 33 - Trenching, Backfilling, and Compacting for Utilities.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. F1216 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube
      b. C76, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
      c. F2510/F2510M, Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures and Corrugated Dual- and Triple-Wall Polyethylene and Polypropylene Pipes.
      d. F2648/F2648M, Standard Specification for 2 to 60 IN (50 to 1500 MM) Annular Corrugated Profile Wall Polyethylene (PE) Pipe and Fittings for Land Drainage Applications.
   2. Standard Specifications for Road and Bridge Construction for the State of California:
      a. Standard Details.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
   3. Certifications.
   4. Test reports.
   5. Submit all tests and certification in a single coordinated submittal.
      a. Partial submittals will not be accepted.

B. Submit schedules and details for structures and joints.

1.4 WARRANTY

A. Warrant that the infiltration will not exceed the amount specified in the Exfiltration Test paragraph in the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section during the one year correction period.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Reinforced Concrete Pipe (RCP):

1. Reinforced concrete culvert, storm drain and sewer pipe: ASTM C76, Class III.

B. RCP Joint Sealer:
   1. Rubber gasket: ASTM C361.

C. Flared End Sections:
   1. Conform to State of California Specifications.
   2. Jointing: Same as pipe.

D. High Density Polyethylene Pipe (HDPE):
   1. ASTM F2648/F2648M.
   2. ASTM F2510/F2510M.

E. Concrete and Reinforcement for Inlets, Manholes, Junction Boxes, Headwalls, and Flumes:
   1. Conform to Drawings and Details.

F. CIPP (Cured in Place Pipe)
   1. Cleaning of existing pipe ASTM F1216.
   2. Rehabilitation and installation ASTM F1216

PART 3 - EXECUTION

3.1 PREPARATION

A. Comply with Specification Section 31 23 33.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Comply with Specification Section 31 23 33.

3.3 FIELD QUALITY CONTROL

A. Verify and coordinate installation.

B. Exfiltration Test:
   1. Perform an exfiltration test on each reach of sewer between manholes.
      a. Test the first reach after backfilling and prior to installing any of the remaining pipe, or any additional reach.
      b. Single or multiple reaches may be tested thereafter, at Contractor's option.
      c. Subject each manhole to at least one test.
      d. Provide all necessary piping between the reach to be tested and the water supply, and other necessary materials and equipment.
      e. Air testing may be allowed.
         1) Submit complete information to Engineer for review describing the proposed test method, scheduling, and duration, including the method of testing manholes before beginning testing.
   2. Procedure:
      a. Block off all manhole openings, except those connecting with the reach being tested.
      b. Fill the line.
         1) Average depth: 10 FT above invert, except as required by manhole depth.
         2) Depth at lower end: 25 FT maximum above crown.
         3) Depth at upper end: 5 FT minimum above crown.
      c. Add and measure water as required to maintain a constant level.
         1) Exfiltration: 100 GAL maximum per inch of nominal diameter per mile per day.
         2) Manholes are considered section of 48 IN pipe.
      d. Maintain test for at least 2 HRS, or as long as necessary in Engineer's opinion, to locate all leaks.
   3. Repair and retest any reach that exceeds the allowable exfiltration.

C. Infiltration Test:

1. If at any time prior to expiration of the correction or warranty period infiltration exceeds 100 GAL/IN of nominal diameter/mile/day, locate the leaks and make repairs.

D. In case of conflict, do not relocate piping without prior approval from the Engineer.

END OF SECTION

Designation: F1216 – 16

Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube[1,2]

This standard is issued under the fixed designation F1216; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This practice describes the procedures for the reconstruction of pipelines and conduits (2 to 108-in. diameter) by the installation of a resin-impregnated, flexible tube which is inverted into the existing conduit by use of a hydrostatic head or air pressure. The resin is cured by circulating hot water or introducing controlled steam within the tube. When cured, the finished pipe will be continuous and tight-fitting. This reconstruction process can be used in a variety of gravity and pressure applications such as sanitary sewers, storm sewers, process piping, electrical conduits, and ventilation systems.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* For specific precautionary statements, see 7.4.2.

2. Referenced Documents

2.1 *ASTM Standards:*[3]

D543 Practices for Evaluating the Resistance of Plastics to Chemical Reagents

D638 Test Method for Tensile Properties of Plastics

D790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

D903 Test Method for Peel or Stripping Strength of Adhesive Bonds

D1600 Terminology for Abbreviated Terms Relating to Plastics

D3567 Practice for Determining Dimensions of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fittings

D3839 Guide for Underground Installation of "Fiberglass" (Glass-Fiber Reinforced Thermosetting-Resin) Pipe

D5813 Specification for Cured-In-Place Thermosetting Resin Sewer Piping Systems

E797/E797M Practice for Measuring Thickness by Manual Ultrasonic Pulse-Echo Contact Method

F412 Terminology Relating to Plastic Piping Systems

2.2 *AWWA Standard:*

Manual on Cleaning and Lining Water Mains, M 28[4]

2.3 *NASSCO Standard:*

Recommended Specifications for Sewer Collection System Rehabilitation[5]

3. Terminology

3.1 Definitions are in accordance with Terminology F412 and abbreviations are in accordance with Terminology D1600, unless otherwise specified.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *cured-in-place pipe (CIPP)*—a hollow cylinder containing a nonwoven or a woven material, or a combination of nonwoven and woven material surrounded by a cured thermosetting resin. Plastic coatings may be included. This pipe is formed within an existing pipe. Therefore, it takes the shape of and fits tightly to the existing pipe.

3.2.2 *inversion*—the process of turning the resin-impregnated tube inside out by the use of water pressure or air pressure.

[1] This practice is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.67 on Trenchless Plastic Pipeline Technology.

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[2] The following report has been published on one of the processes: Driver, F. T., and Olson, M. R., "*Demonstration of Sewer Relining by the Insituform Process, Northbrook, Illinois*," EPA-600/2-83-064, Environmental Protection Agency, 1983. Interested parties can obtain copies from the Environmental Protection Agency or from a local technical library.

[3] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[4] Available from American Water Works Association (AWWA), 6666 W. Quincy Ave., Denver, CO 80235, http://www.awwa.org.

[5] Available from the National Association of Sewer Service Companies, 2470 Longstone Lane, Suite M Marriottsville, MD 21104. http://www.nassco.org/

***A Summary of Changes section appears at the end of this standard**

3.2.3 *lift*—a portion of the CIPP that has cured in a position such that it has pulled away from the existing pipe wall.

4. Significance and Use

4.1 This practice is for use by designers and specifiers, regulatory agencies, owners, and inspection organizations who are involved in the rehabilitation of conduits through the use of a resin-impregnated tube inverted through the existing conduit. As for any practice, modifications may be required for specific job conditions.

5. Materials

5.1 *Tube*—The tube should consist of one or more layers of flexible needled felt or an equivalent nonwoven or woven material, or a combination of nonwoven and woven materials, capable of carrying resin, withstanding installation pressures and curing temperatures. The tube should be compatible with the resin system used. The material should be able to stretch to fit irregular pipe sections and negotiate bends. The outside layer of the tube should be plastic coated with a material that is compatible with the resin system used. The tube should be fabricated to a size that, when installed, will tightly fit the internal circumference and the length of the original conduit. Allowance should be made for circumferential stretching during inversion.

5.2 *Resin*—A general purpose, unsaturated, styrene-based, thermoset resin and catalyst system or an epoxy resin and hardener that is compatible with the inversion process should be used. The resin must be able to cure in the presence of water and the initiation temperature for cure should be less than 180°F (82.2°C). The CIPP system can be expected to have as a minimum the initial structural properties given in Table 1. These physical strength properties should be determined in accordance with Section 8.

6. Design Considerations

6.1 *General Guidelines*—The design thickness of the CIPP is largely a function of the condition of the existing pipe. Design equations and details are given in Appendix X1.

7. Installation

7.1 *Cleaning and Inspection:*

7.1.1 Prior to entering access areas such as manholes, and performing inspection or cleaning operations, an evaluation of the atmosphere to determine the presence of toxic or flammable vapors or lack of oxygen must be undertaken in accordance with local, state, or federal safety regulations.

TABLE 1 CIPP Initial Structural Properties[A]

Property	Test Method	Minimum Value	
		psi	(MPa)
Flexural strength	D790	4 500	(31)
Flexural modulus	D790	250 000	(1 724)
Tensile strength (for pressure pipes only)	D638	3 000	(21)

[A]The values in Table 1 are for field inspection. The purchaser should consult the manufacturer for the long-term structural properties.

7.1.2 *Cleaning of Pipeline*—All internal debris should be removed from the original pipeline. Gravity pipes should be cleaned with hydraulically powered equipment, high-velocity jet cleaners, or mechanically powered equipment (see NASSCO Recommended Specifications for Sewer Collection System Rehabilitation). Pressure pipelines should be cleaned with cable-attached devices or fluid-propelled devices as shown in AWWA Manual on Cleaning and Lining Water Mains, M 28.

7.1.3 *Inspection of Pipelines*—Inspection of pipelines should be performed by experienced personnel trained in locating breaks, obstacles, and service connections by closed-circuit television or man entry. The interior of the pipeline should be carefully inspected to determine the location of any conditions that may prevent proper installation of the impregnated tube, such as protruding service taps, collapsed or crushed pipe, and reductions in the cross-sectional area of more than 40 %. These conditions should be noted so that they can be corrected.

7.1.4 *Line Obstructions*—The original pipeline should be clear of obstructions such as solids, dropped joints, protruding service connections, crushed or collapsed pipe, and reductions in the cross-sectional area of more than 40 % that will prevent the insertion of the resin-impregnated tube. If inspection reveals an obstruction that cannot be removed by conventional sewer cleaning equipment, then a point repair excavation should be made to uncover and remove or repair the obstruction.

7.2 *Resin Impregnation*—The tube should be vacuum-impregnated with resin (wet-out) under controlled conditions. The volume of resin used should be sufficient to fill all voids in the tube material at nominal thickness and diameter. The volume should be adjusted by adding 5 to 10 % excess resin for the change in resin volume due to polymerization and to allow for any migration of resin into the cracks and joints in the original pipe.

7.3 *Bypassing*—If bypassing of the flow is required around the sections of pipe designated for reconstruction, the bypass should be made by plugging the line at a point upstream of the pipe to be reconstructed and pumping the flow to a downstream point or adjacent system. The pump and bypass lines should be of adequate capacity and size to handle the flow. Services within this reach will be temporarily out of service.

7.3.1 Public advisory services will be required to notify all parties whose service laterals will be out of commission and to advise against water usage until the mainline is back in service.

7.4 *Inversion:*

7.4.1 *Using Hydrostatic Head*—The wet-out tube should be inserted through an existing manhole or other approved access by means of an inversion process and the application of a hydrostatic head sufficient to fully extend it to the next designated manhole or termination point. The tube should be inserted into the vertical inversion standpipe with the impermeable plastic membrane side out. At the lower end of the inversion standpipe, the tube should be turned inside out and attached to the standpipe so that a leakproof seal is created. The inversion head should be adjusted to be of sufficient height to

cause the impregnated tube to invert from point of inversion to point of termination and hold the tube tight to the pipe wall, producing dimples at side connections. Care should be taken during the inversion so as not to over-stress the felt fiber.

7.4.1.1 An alternative method of installation is a top inversion. In this case, the tube is attached to a top ring and is inverted to form a standpipe from the tube itself or another method accepted by the engineer.

NOTE 1—The tube manufacturer should provide information on the maximum allowable tensile stress for the tube.

7.4.2 *Using Air Pressure*—The wet-out tube should be inserted through an existing manhole or other approved access by means of an inversion process and the application of air pressure sufficient to fully extend it to the next designated manhole or termination point. The tube should be connected by an attachment at the upper end of the guide chute so that a leakproof seal is created and with the impermeable plastic membranes side out. As the tube enters the guide chute, the tube should be turned inside out. The inversion air pressure should be adjusted to be of sufficient pressure to cause the impregnated tube to invert from point of inversion to point of termination and hold the tube tight to the pipe wall, producing dimples at side connections. Care should be taken during the inversion so as not to overstress the woven and nonwoven materials. **Warning—**Suitable precautions should be taken to eliminate hazards to personnel in the proximity of the construction when pressurized air is being use.

7.4.3 *Required Pressures*—Before the inversion begins, the tube manufacturer shall provide the minimum pressure required to hold the tube tight against the existing conduit, and the maximum allowable pressure so as not to damage the tube. Once the inversion has started, the pressure shall be maintained between the minimum and maximum pressures until the inversion has been completed.

7.5 *Lubricant*—The use of a lubricant during inversion is recommended to reduce friction during inversion. This lubricant should be poured into the inversion water in the downtube or applied directly to the tube. The lubricant used should be a nontoxic, oil-based product that has no detrimental effects on the tube or boiler and pump system, will not support the growth of bacteria, and will not adversely affect the fluid to be transported.

7.6 *Curing:*

7.6.1 *Using Circulating Heated Water*—After inversion is completed, a suitable heat source and water recirculation equipment are required to circulate heated water throughout the pipe. The equipment should be capable of delivering hot water throughout the section to uniformly raise the water temperature above the temperature required to effect a cure of the resin. Water temperature in the line during the cure period should be as recommended by the resin manufacturer.

7.6.1.1 The heat source should be fitted with suitable monitors to gage the temperature of the incoming and outgoing water supply. Another such gage should be placed between the impregnated tube and the pipe invert at the termination to determine the temperatures during cure.

7.6.1.2 Initial cure will occur during temperature heat-up and is completed when exposed portions of the new pipe appear to be hard and sound and the remote temperature sensor indicates that the temperature is of a magnitude to realize an exotherm or cure in the resin. After initial cure is reached, the temperature should be raised to the post-cure temperature recommended by the resin manufacturer. The post-cure temperature should be held for a period as recommended by the resin manufacturer, during which time the recirculation of the water and cycling of the boiler to maintain the temperature continues. The curing of the CIPP must take into account the existing pipe material, the resin system, and ground conditions (temperature, moisture level, and thermal conductivity of soil).

7.6.2 *Using Steam*—After inversion is completed, suitable steam-generating equipment is required to distribute steam throughout the pipe. The equipment should be capable of delivering steam throughout the section to uniformly raise the temperature within the pipe above the temperature required to effect a cure of the resin. The temperature in the line during the cure period should be as recommended by the resin manufacturer.

7.6.2.1 The steam-generating equipment should be fitted with a suitable monitor to gage the temperature of the outgoing steam. The temperature of the resin being cured should be monitored by placing gages between the impregnated tube and the existing pipe at both ends to determine the temperature during cure.

7.6.2.2 Initial cure will occur during temperature heat-up and is completed when exposed portions of the new pipe appear to be hard and sound and the remote temperature sensor indicates that the temperature is of a magnitude to realize an exotherm or cure in the resin. After initial cure is reached, the temperature should be raised to post-cure temperatures recommended by the resin manufacturer. The post-cure temperature should be held for a period as recommended by the resin manufacturer, during which time the distribution and control of steam to maintain the temperature continues. The curing of the CIPP must take into account the existing pipe material, the resin system, and ground conditions (temperature, moisture level, and thermal conductivity of soil).

7.6.3 *Required Pressures*—As required by the purchase agreement, the estimated maximum and minimum pressure required to hold the flexible tube tight against the existing conduit during the curing process should be provided by the seller and shall be increased to include consideration of the external ground water, if present. Once the cure has started and dimpling for laterals is completed, the required pressures should be maintained until the cure has been completed. For water or steam, the pressure should be maintained within the estimated maximum and minimum pressure during the curing process. If the steam pressure or hydrostatic head drops below the recommended minimum during the cure, the CIPP should be inspected for lifts or delaminations and evaluated for its ability to fully meet the applicable requirements of 7.8 and Section 8.

7.7 *Cool-Down:*

7.7.1 *Using Cool Water After Heated Water Cure*—The new pipe should be cooled to a temperature below 100°F (38°C) before relieving the static head in the inversion standpipe. Cool-down may be accomplished by the introduction of cool

water into the inversion standpipe to replace water being drained from a small hole made in the downstream end. Care should be taken in the release of the static head so that a vacuum will not be developed that could damage the newly installed pipe.

7.7.2 *Using Cool Water After Steam Cure*—The new pipe should be cooled to a temperature below 113°F (45°C) before relieving the internal pressure within the section. Cool-down may be accomplished by the introduction of cool water into the section to replace the mixture of air and steam being drained from a small hole made in the downstream end. Care should be taken in the release of the air pressure so that a vacuum will not be developed that could damage the newly installed pipe.

7.8 *Workmanship*—The finished pipe should be continuous over the entire length of an inversion run and be free of dry spots, lifts, and delaminations. If these conditions are present, remove and replace the CIPP in these areas.

7.8.1 If the CIPP does not fit tightly against the original pipe at its termination point(s), the space between the pipes should be sealed by filling with a resin mixture compatible with the CIPP.

7.9 *Service Connections*—After the new pipe has been cured in place, the existing active service connections should be reconnected. This should generally be done without excavation, and in the case of non-man entry pipes, from the interior of the pipeline by means of a television camera and a remote-control cutting device.

8. Inspection Practices

8.1 For each inversion length designated by the owner in the Contract documents or purchase order, the preparation of a CIPP sample is required, using one of the following two methods, depending on the size of the host pipe.

8.1.1 For pipe sizes of 18 in. or less, the sample should be cut from a section of cured CIPP at an intermediate manhole or at the termination point that has been inverted through a like diameter pipe which has been held in place by a suitable heat sink, such as sandbags.

8.1.2 In medium and large-diameter applications and areas with limited access, the sample should be fabricated from material taken from the tube and the resin/catalyst system used and cured in a clamped mold placed in the downtube when circulating heated water is used and in the silencer when steam is used. This method can also be used for sizes 18 in. or less, in situations where preparing samples in accordance with 8.1.1 can not be obtained due to physical constrains, if approved by the owner.

8.1.3 The samples for each of these cases should be large enough to provide a minimum of three specimens and a recommended five specimens for flexural testing and also for tensile testing, if applicable. The following test procedures should be followed after the sample is cured and removed.

8.1.3.1 *Short-Term Flexural (Bending) Properties*—The initial tangent flexural modulus of elasticity and flexural stress should be measured for gravity and pressure pipe applications in accordance with Test Methods D790 and should meet the requirements of Table 1.

8.1.3.2 *Tensile Properties*—The tensile strength should be measured for pressure pipe applications in accordance with Test Method D638 and must meet the requirements of Table 1.

8.2 *Gravity Pipe Leakage Testing*—If required by the owner in the contract documents or purchase order, gravity pipes should be tested using an exfiltration test method where the CIPP is plugged at both ends and filled with water. This test should take place after the CIPP has cooled down to ambient temperature. This test is limited to pipe lengths with no service laterals and diameters of 36 in. or less. The allowable water exfiltration for any length of pipe between termination points should not exceed 50 U.S. gallons per inch of internal pipe diameter per mile per day, providing that all air has been bled from the line. During exfiltration testing, the maximum internal pipe pressure at the lowest end should not exceed 10 ft (3.0 m) of water or 4.3 psi (29.7 kPA) and the water level inside of the inversion standpipe should be 2 ft (0.6 m) higher than the top of the pipe or 2 ft higher than the groundwater level, whichever is greater. The leakage quantity should be gaged by the water level in a temporary standpipe placed in the upstream plug. The test should be conducted for a minimum of one hour.

NOTE 2—It is impractical to test pipes above 36-in. diameter for leakage due to the technology available in the pipe rehabilitation industry. Post inspection of larger pipes will detect major leaks or blockages.

8.3 *Pressure Pipe Testing*—If required by the owner in the contract documents or purchase order, pressure pipes should be subjected to a hydrostatic pressure test. A recommended pressure and leakage test would be at twice the known working pressure or at the working pressure plus 50 psi, whichever is less. Hold this pressure for a period of two to three hours to allow for stabilization of the CIPP. After this period, the pressure test will begin for a minimum of one hour. The allowable leakage during the pressure test should be 20 U.S. gallons per inch of internal pipe diameter per mile per day, providing that all air has been evacuated from the line prior to testing and the CIPP has cooled down to ambient temperature.

NOTE 3—The allowable leakage for gravity and pressure pipe testing is a function of water loss at the end seals and trapped air in the pipe.

8.4 *Delamination Test*—If required by the owner in the contract documents or purchase order, a delamination test should be performed on each inversion length specified. The CIPP samples should be prepared in accordance with 8.1.2, except that a portion of the tube material in the sample should be dry and isolated from the resin in order to separate tube layers for testing. (Consult the tube manufacturer for further information.) Delamination testing shall be in accordance with Test Method D903, with the following exceptions:

8.4.1 The rate of travel of the power-actuated grip shall be 1 in. (25 mm)/min.

8.4.2 Five test specimens shall be tested for each inversion specified.

8.4.3 The thickness of the test specimen shall be minimized, but should be sufficient to adequately test delamination of nonhomogeneous CIPP layers.

8.5 The peel or stripping strength between any nonhomogeneous layers of the CIPP laminate should be a minimum of 10 lb/in. (178.60 g/mm) of width for typical CIPP applications.

NOTE 4—The purchaser may designate the dissimilar layers between which the delamination test will be conducted.

NOTE 5—For additional details on conducting the delamination test, contact the CIPP contractor.

8.6 *CIPP Wall Thickness*—The method of obtaining CIPP wall thickness measurements should be determined in a manner consistent with 8.1.2 of Specification D5813. Thickness measurements should be made in accordance with Practice D3567 for samples prepared in accordance with 8.1. Make a minimum of eight measurements at evenly spaced intervals around the circumference of the pipe to ensure that minimum and maximum thicknesses have been determined. Deduct from the measured values the thickness of any plastic coatings or CIPP layers not included in the structural design of the CIPP. The average thickness should be calculated using all measured values and shall meet or exceed minimum design thickness as agreed upon between purchaser and seller. The minimum wall thickness at any point shall not be less than 87.5% of the specified design thickness as agreed upon between purchase and seller.

8.6.1 *Ultrasonic Testing of Wall Thickness*—An alternative method to 8.6 for measuring the wall thickness may be performed within the installed CIPP at either end of the pipe by the ultrasonic pulse echo method as described in Practice E797/E797M. A minimum of eight (8) evenly spaced measurements should be made around the internal circumference of the installed CIPP within the host pipe at a distance of 12 to 18 in. from the end of the pipe. For pipe diameters of fifteen (15) in. or greater, a minimum of sixteen (16) evenly spaced measurements shall be recorded. The ultrasonic method to be used is the flaw detector with A-scan display and direct thickness readout as defined in 6.1.2 of E797/E797M. A calibration block shall be manufactured from the identical materials used in the installed CIPP to calibrate sound velocity through the liner. Calibration of the transducer shall be performed daily in accordance with the equipment manufacturer's recommendations. The average thickness should be calculated using all measured values and shall meet or exceed minimum design thickness as agreed upon between purchaser and seller. The minimum wall thickness at any point shall not be less than 87.5 % of the specified design thickness as agreed upon between purchaser and seller.

8.7 *Inspection and Acceptance*—The installation may be inspected visually if appropriate, or by closed-circuit television if visual inspection cannot be accomplished. Variations from true line and grade may be inherent because of the conditions of the original piping. No infiltration of groundwater should be observed. All service entrances should be accounted for and be unobstructed.

APPENDIXES

(Nonmandatory Information)

X1. DESIGN CONSIDERATIONS

X1.1 *Terminology*:

X1.1.1 *partially deteriorated pipe*—the original pipe can support the soil and surcharge loads throughout the design life of the rehabilitated pipe. The soil adjacent to the existing pipe must provide adequate side support. The pipe may have longitudinal cracks and up to 10.0% distortion of the diameter. If the distortion of the diameter is greater than 10.0%, alternative design methods are required (see Note 1).

X1.1.2 *fully deteriorated pipe*—the original pipe is not structurally sound and cannot support soil and live loads or is expected to reach this condition over the design life of the rehabilitated pipe. This condition is evident when sections of the original pipe are missing, the pipe has lost its original shape, or the pipe has corroded due to the effects of the fluid, atmosphere, soil, or applied loads.

X1.2 *Gravity Pipe*:

X1.2.1 *Partially Deteriorated Gravity Pipe Condition*—The CIPP is designed to support the hydraulic loads due to groundwater, since the soil and surcharge loads can be supported by the original pipe. The groundwater level should be determined by the purchaser and the thickness of the CIPP should be sufficient to withstand this hydrostatic pressure without collapsing. The following equation may be used to determine the thickness required:

$$P = \frac{2KE_L}{(1-\nu^2)} \cdot \frac{1}{(DR-1)^3} \cdot \frac{C}{N} \qquad (X1.1)$$

where:

P = groundwater load, psi (MPa), measured from the invert of the pipe

K = enhancement factor of the soil and existing pipe adjacent to the new pipe (a minimum value of 7.0 is recommended where there is full support of the existing pipe),

E_L = long-term (time corrected) modulus of elasticity for CIPP, psi (MPa) (see Note X1.1),

ν = Poisson's ratio (0.3 average),

DR = dimension ratio of CIPP,

C = ovality reduction factor =

$$\left(\left[1-\frac{\Delta}{100}\right]/\left[1+\frac{\Delta}{100}\right]^2\right)^3$$

Δ = percentage ovality of original pipe equals

$$100 \times \frac{(\textit{Mean Inside Diameter} - \textit{Minimum Inside Diameter})}{\textit{Mean Inside Diameter}}$$

or

$$100 \times \frac{(\textit{Maximum Inside Diameter} - \textit{Mean Inside Diameter})}{\textit{Mean Inside Diameter}}$$

and

N = factor of safety.

NOTE X1.1—The choice of value (from manufacturer's literature) of E_L will depend on the estimated duration of the application of the load, P, in relation to the design life of the structure. For example, if the total duration of the load, P, is estimated to be 50 years, either continuously applied, or the sum of intermittent periods of loading, the appropriately conservative choice of value for E_L will be that given for 50 years of continuous loading at the maximum ground or fluid temperature expected to be reached over the life of the structure.

NOTE X1.2—If there is no groundwater above the pipe invert, the CIPP should typically have a maximum *SDR* of 100, dependent upon design conditions.

X1.2.1.1 If the original pipe is oval, the CIPP design from Eq X1.1 shall have a minimum thickness as calculated by the following formula:

$$1.5\frac{\Delta}{100}\left(1+\frac{\Delta}{100}\right)DR^2 - 0.5\left(1+\frac{\Delta}{100}\right)DR = \frac{\sigma_L}{PN} \quad \text{(X1.2)}$$

where:

σ_L = long-term (time corrected) flexural strength for CIPP, psi (MPa) (see Note X1.5).

X1.2.1.2 See Table X1.1 for typical design calculations.

X1.2.2 *Fully Deteriorated Gravity Pipe Condition*—The CIPP is designed to support hydraulic, soil, and live loads. The groundwater level, soil type and depth, and live load should be determined by the purchaser, and the following equation should be used to calculate the CIPP thickness required to withstand these loads without collapsing:

$$q_t = \frac{1}{N}\left[32\,R_w\,B'\,E'_s \cdot C\,(E_L I/D^3)\right]^{1/2} \quad \text{(X1.3)}$$

TABLE X1.1 Maximum Groundwater Loads for Partially Deteriorated Gravity Pipe Condition

Diameter, in. (Inside Diameter of Original Pipe)	Nominal CIPP Thickness, mm	CIPP Thickness, *t*, in.	Maximum Allowable Groundwater Load[A] (above invert)	
			ft	m
8	6	0.236	40.0	12.2
10	6	0.236	20.1	6.1
12	6	0.236	11.5	3.5
15	9	0.354	20.1	6.1
18	9	0.354	11.5	3.5
18	12	0.472	27.8	8.5
24	12	0.472	11.5	3.5
24	15	0.591	22.8	6.9
30	15	0.591	11.5	3.5
30	18	0.709	20.1	6.1

[A]Assumes K = 7.0, E = 125 000 psi (862 MPa) (50-year strength), ν = 0.30, C = 0.64 (5 % ovality), and N = 2.0

where:

q_t = total external pressure on pipe, psi (MPa),
= $0.433H_w + wHR_w/144 + W_s$, (English Units),
$0.00981H_w + wHR_w/1000 + W_s$, (Metric Units)
R_w = water buoyancy factor (0.67 min) = 1 − 0.33 (H_w/H),
w = soil density, lb.ft^3 (KN/m^3),
W_s = live load, psi (Mpa),
H_w = height of water above top of pipe, ft (m)
H = height of soil above top of pipe, ft (m),
B' = coefficient of elastic support = $1/(1 + 4e^{-0.065H})$ inch-pound units, $(1/(1 + 4e^{-0.213H})$ SI units
I = moment of inertia of CIPP, in.^{4}/in. (mm^4/mm) = $t^3/12$,
t = thickness of CIPP, in. (mm),
C = ovality reduction factor (see X1.2.1),
N = factor of safety,
E'_s = modulus of soil reaction, psi (MPa) (see Note X1.4),
E_L = long-term modulus of elasticity for CIPP, psi (MPa), and
D = mean inside diameter of original pipe, in. (mm)

X1.2.2.1 The CIPP design from Eq X1.3 should have a minimum thickness as calculated by the following formula:

$$\frac{EI}{D^3} = \frac{E}{12(DR)^3} \geq 0.093\ (inch-pound\ units), \quad \text{(X1.4)}$$

or

$$\frac{E}{12(DR)^3} \geq 0.00064\ (SI\ units)$$

where:

E = initial modulus of elasticity, psi (MPa)

NOTE X1.3—For pipelines at depth not subject to construction disturbance, or if the pipeline was originally installed using tunneling method, the soil load may be calculated using a tunnel load analysis. Finite element analysis is an alternative design method for noncircular pipes.

NOTE X1.4—For definition of modulus of soil reaction, see Practice D3839.

X1.2.2.2 The minimum CIPP design thickness for a fully deteriorated condition should also meet the requirements of Eq X1.1 and X1.2.

X1.3 *Pressure Pipe*:

X1.3.1 *Partially Deteriorated Pressure Condition*—A CIPP installed in an existing underground pipe is designed to support external hydrostatic loads due to groundwater as well as withstand the internal pressure in spanning across any holes in the original pipe wall. The results of Eq X1.1 are compared to those from Eq X1.6 or Eq X1.7, as directed by Eq X1.5, and the largest of the thicknesses is selected. In an above-ground design condition, the CIPP is designed to withstand the internal pressure only by using Eq X1.5-X1.7 as applicable.

X1.3.1.1 If the ratio of the hole in the original pipe wall to the pipe diameter does not exceed the quantity shown in Eq X1.5, then the CIPP is assumed to be a circular flat plate fixed at the edge and subjected to transverse pressure only. In this case, Eq X1.6 is used for design. For holes larger than the d/D value in Eq X1.5, the liner cannot be considered in flat plate loading, but rather in ring tension or hoop stress, and Eq X1.7 is used.

$$\frac{d}{D} \leq 1.83 \left(\frac{t}{D} \right)^{1/2} \quad \text{(X1.5)}$$

where:

d = diameter of hole or opening in original pipe wall, in. (mm),
D = mean inside diameter of original pipe, in. (mm), and
t = thickness of CIPP, in. (mm).

$$P = \frac{5.33}{(DR-1)^2} \left(\frac{D}{d} \right)^2 \frac{\sigma_L}{N} \quad \text{(X1.6)}$$

where:

DR = dimension ratio of CIPP,
D = mean inside diameter of original pipe, in. (mm),
d = diameter of hole or opening in original pipe wall, in. (mm),
σ_L = long-term (time corrected) flexural strength for CIPP, psi (MPa) (see Note X1.5), and
N = factor of safety.

NOTE X1.5—The choice of value (from manufacturer's literature) of σ_L will depend on the estimated duration of the application of the load, P, in relation to the design life of the structure. For example, if the total duration of the load, P, is estimated to be 50 years, either continuously applied, or the sum of intermittent periods of loading, the appropriately conservative choice of value of σ_L will be that given for 50 years of continuous loading at the maximum ground or fluid temperature expected to be reached over the life of the structure.

X1.3.2 *Fully Deteriorated Pressure Pipe Condition*—A CIPP to be installed in an underground condition is designed to withstand all external loads and the full internal pressure. The design thicknesses are calculated from Eq X1.1, Eq X1.3, Eq X1.4, and Eq X1.7, and the largest thickness is selected. If the pipe is above ground, the CIPP is designed to withstand internal pressure only by using Eq X1.7.

$$P = \frac{2\sigma_{TL}}{(DR-2)\,N} \quad \text{(X1.7)}$$

where:

P = internal pressure, psi (MPa),
σ_{TL} = long-term (time corrected) tensile strength for CIPP, psi (MPa) (see Note 12),
DR = dimension ratio of CIPP, and
N = factor of safety.

NOTE X1.6—The choice of value (from manufacturer's literature) of σ_{TL} will depend on the estimated duration of the application of the load, P, in relation to the design life of the structure. For example, if the total duration of the load, P, is estimated to be 50 years, either continuously applied, or the sum of intermittent periods of loading, the appropriately conservative choice of value of σ_{TL} will be that given for 50 years of continuous loading at the maximum ground or fluid temperature expected to be reached over the life of the structure.

X1.4 *Negative Pressure*—Where the pipe is subject to a vacuum, the CIPP should be designed as a gravity pipe with the external hydrostatic pressure increased by an amount equal to the negative pressure.

NOTE X1.7—Table X1.1 presents maximum groundwater loads for partially deteriorated pipes for selected typical nominal pipe sizes. CIPP is custom made to fit the original pipe and can be fabricated to a variety of sizes from 2 to 108-in. diameter which would be impractical to list here.

X2. CHEMICAL-RESISTANCE TESTS

X2.1 *Scope*:

X2.1.1 This appendix covers the test procedures for chemical-resistance properties of CIPP. Minimum standards are presented for standard domestic sewer applications.

X2.2 *Procedure for Chemical-Resistance Testing*:

X2.2.1 Chemical resistance tests should be completed in accordance with Practices D543. Exposure should be for a minimum of one month at 73.4°F (23°C). During this period, the CIPP test specimens should lose no more than 20 % of their initial flexural strength and flexural modulus when tested in accordance with Section 8 of this practice.

X2.2.2 Table X2.1 presents a list of chemical solutions that serve as a recommended minimum requirement for the chemical-resistant properties of CIPP in standard domestic sanitary sewer applications.

X2.2.3 For applications other than standard domestic sewage, it is recommended that chemical-resistance tests be conducted with actual samples of the fluid flowing in the pipe. These tests can also be accomplished by depositing CIPP test specimens in the active pipe.

TABLE X2.1 Minimum Chemical Resistance Requirements for Domestic Sanitary Sewer Applications

Chemical Solution	Concentration, %
Tap water (pH 6–9)	100
Nitric acid	5
Phosphoric acid	10
Sulfuric acid	10
Gasoline	100
Vegetable oil	100
Detergent	0.1
Soap	0.1

SUMMARY OF CHANGES

Committee F17 has identified the location of selected changes to this standard since the last issue (F1217–09) that may impact the use of this standard.

(1) Revised 1.1 and Note X1.7 to include pipe diameter sizes 2-in. to 108-in.

DIVISION 40

PROCESS INTERCONNECTIONS

SECTION 40 05 00
PIPE AND PIPE FITTINGS - BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Utility piping systems.
   2. Plumbing piping systems.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 09 96 00 - High Performance Industrial Coatings.
   4. Section 10 14 00 - Identification Devices.
   5. Section 31 23 33 - Trenching, Backfilling, and Compacting for Utilities.
   6. Section 40 05 51 - Valves - Basic Requirements.
   7. Section 40 42 00 - Pipe, Duct and Equipment Insulation.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Iron and Steel Institute (AISI).
   2. American Society of Mechanical Engineers (ASME):
      a. B16.3, Malleable Iron Threaded Fittings.
      b. B16.5, Pipe Flanges and Flanged Fittings.
      c. B16.9, Factory-Made Wrought Steel Butt-Welding Fittings.
      d. B16.22, Wrought Copper and Bronze Solder - Joint Pressure Fittings.
      e. B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
      f. B36.19, Stainless Steel Pipe.
      g. B40.100, Pressure Gauges and Gauge Attachments.
   3. ASTM International (ASTM):
      a. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
      b. A74, Standard Specification for Cast Iron Soil Pipe and Fittings.
      c. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
      d. A182, Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
      e. A536, Standard Specification for Ductile Iron Castings.
      f. A760, Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains.
      g. B88, Standard Specification for Seamless Copper Water Tube.
      a. B280, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
      b. C443, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
      c. C564, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
      d. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
      e. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
      f. D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
   4. American Water Works Association (AWWA):

a. B300, Standard for Hypochlorites.
b. C200, Standard for Steel Water Pipe - 6 IN and Larger.
c. C207, Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 IN through 144 IN.
d. C208, Standard for Dimensions for Fabricated Steel Water Pipe Fittings.
e. C606, Standard for Grooved and Shouldered Joints.
f. C651, Standard for Disinfecting Water Mains.
g. C800, Standard for Underground Service Line Valves and Fittings.

5. American Water Works Association/American National Standards Institute (AWWA/ANSI):
   a. C110/A21.10, Standard for Ductile-Iron and Gray-Iron Fittings.
   b. C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   c. C115/A21.15, Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
   d. C151/A21.51, Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
   e. C153/A21.53, Standard for Ductile-Iron Compact Fittings for Water Service.
6. Chlorine Institute, Inc. (CI):
   a. Pamphlet 6, Piping Systems for Dry Chlorine.
7. Cast Iron Soil Pipe Institute (CISPI):
   a. 301, Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
8. Underwriters Laboratories, Inc. (UL).

B. Coordinate flange dimensions, bolt patterns and drillings between piping, valves, and equipment.

1.3 SYSTEM DESCRIPTION

A. Piping Systems Organization and Definition:
1. Piping services are grouped into designated systems according to the chemical and physical properties of the fluid conveyed, system pressure, piping size and system materials of construction.
2. See PIPING SPECIFICATION SCHEDULES in PART 3.

1.4 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Product technical data including:
   a. Acknowledgement that products submitted meet requirements of standards referenced.
   b. Copies of manufacturer's written directions regarding material handling, delivery, storage and installation.
   c. Separate schedule sheet for each piping system scheduled in this Specification Section showing compliance of all system components.
      1) Attach technical product data on gaskets, pipe, fittings, and other components.
3. Fabrication and/or Layout Drawings:
   a. Exterior yard piping drawings (minimum scale 1 IN equals 10 FT) with information including:
      1) Dimensions of piping lengths.
      2) Invert or centerline elevations of piping crossings.
      3) Acknowledgement of bury depth requirements.
      4) Details of fittings, tapping locations, thrust blocks, restrained joint segments, harnessed joint segments, hydrants, and related appurtenances.
      5) Acknowledge designated valve or gate tag numbers, manhole numbers, instrument tag numbers, pipe and line numbers.
      6) Line slopes and vents.

b. Interior piping drawings (minimum scale 1/8 IN equals 1 FT) with information including:
    1) Dimensions of piping from column lines or wall surfaces.
    2) Centerline dimensions of piping.
    3) Centerline elevation and size of intersecting ductwork, conduit/conduit racks, or other potential interferences requiring coordination.
    4) Location and type of pipe supports and anchors.
    5) Locations of valves and valve actuator type.
    6) Details of fittings, tapping locations, equipment connections, flexible expansion joints, connections to equipment, and related appurtenances.
    7) Acknowledgement of valve, equipment and instrument tag numbers.
    8) Provisions for expansion and contraction.
    9) Line slopes and air release vents.
    10) Rough-in data for plumbing fixtures.
c. Schedule of interconnections to existing piping and method of connection.

B. Contract Closeout Information:
1. Operation and Maintenance Data:
    a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

C. Informational Submittals:
1. Qualifications of lab performing disinfection analysis on water systems.
2. Test reports:
    a. Copies of pressure test results on all piping systems.
    b. Reports defining results of dielectric testing and corrective action taken.
    c. Disinfection test report.
    d. Notification of time and date of piping pressure tests.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect pipe coating during handling using methods recommended by manufacturer.
1. Use of bare cables, chains, hooks, metal bars or narrow skids in contact with coated pipe is not permitted.

B. Prevent damage to pipe during transit.
1. Repair abrasions, scars, and blemishes.
2. If repair of satisfactory quality cannot be achieved, replace damaged material immediately.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Insulating unions:
    a. "Dielectric" by Epco.
2. Dirt strainers (Y type):
    a. Mueller (#351M).
    b. Sarco.
    c. Armstrong.
3. Dielectric flange kit:
    a. PSI.
    b. Maloney.
    c. Central Plastics.

2.2 PIPING SPECIFICATION SCHEDULES

A. Piping system materials, fittings and appurtenances are subject to requirements of specific piping specification schedules located at the end of PART 3 of this Specification Section.

2.3 COMPONENTS AND ACCESSORIES

A. Insulating Components:
   1. Dielectric flange kits:
      a. Flat faced.
      b. 1/8 IN thick dielectric gasket, phenolic, non-asbestos.
      c. Suitable for 175 PSI, 210 DEGF.
      d. 1/32 IN wall thickness bolt sleeves.
      e. 1/8 IN thick phenolic insulating washers.
   2. Dielectric unions:
      a. Screwed end connections.
      b. Rated at 175 PSI, 210 DEGF.
      c. Provide dielectric gaskets suitable for continuous operation at union rated temperature and pressure.

B. Dirt Strainers:
   1. Y-type.
   2. Composition bronze.
   3. Rated for test pressure and temperature of system in which they are installed.
   4. 20 mesh Monel screen.
   5. Threaded bronze plug in the blowoff outlet.
   6. Threaded NPT end connections.

C. Reducers:
   1. Furnish appropriate size reducers and reducing fittings to mate pipe to equipment connections.
   2. Connection size requirements may change from those shown on Drawings depending on equipment furnished.

D. Protective Coating and Lining:
   1. Include pipe, fittings, and appurtenances where coatings, linings, coating, tests and other items are specified.
   2. Field coat piping in accordance with Specification Section 09 96 00.

E. Underground Warning Tape:
   1. See Specification Section 10 14 00.

F. Valves:
   1. See Specification Section 40 05 51.
   2. See Specification Section 22 05 23 for valves used in plumbing piping systems.

G. Flexible Expansion Joints
   1. See Section 3.3

PART 3 - EXECUTION

3.1 EXTERIOR BURIED PIPING INSTALLATION

A. Unless otherwise shown on the Drawings, provide a minimum of 4 FT and maximum of 8 FT earth cover over exterior buried piping systems and appurtenances conveying water, fluids, or solutions subject to freezing.

B. Enter and exit through structure walls, floors, and ceilings by using penetrations and seals specified in Specification Section 01 73 20 and as shown on Drawings.

C. When entering or leaving structures with buried mechanical joint piping, install joint within 2 FT of point where pipe enters or leaves structure.
   1. Install second joint not more than 6 FT nor less than 4 FT from first joint.

D. Install expansion devices as necessary to allow expansion and contraction movement.

E. Laying Pipe In Trench:
   1. Excavate and backfill trench in accordance with Specification Section 31 23 33.
   2. Clean each pipe length thoroughly and inspect for compliance to specifications.
   3. Grade trench bottom and excavate for pipe bell and lay pipe on trench bottom.
   4. Install gasket or joint material according to manufacturer's directions after joints have been thoroughly cleaned and examined.
   5. Except for first two joints, before making final connections of joints, install two full sections of pipe with earth tamped along side of pipe or final with bedding material placed.
   6. Lay pipe in only suitable weather with good trench conditions.
      a. Never lay pipe in water except where approved by Engineer.
   7. Seal open end of line with watertight plug if pipe laying stopped.
   8. Remove water in trench before removal of plug.

F. Lining Up Push-On Joint Piping:
   1. Lay piping on route lines shown on Drawings.
   2. Deflect from straight alignments or grades by vertical or horizontal curves or offsets.
   3. Observe maximum deflection values stated in manufacturer's written literature.
   4. Provide special bends when specified or where required alignment exceeds allowable deflections stipulated.
   5. Install shorter lengths of pipe in such length and number that angular deflection of any joint, as represented by specified maximum deflection, is not exceeded.

G. Anchorage and Blocking:
   1. Provide reaction blocking, anchors, joint harnesses, or other acceptable means for preventing movement of piping caused by forces in or on buried piping tees, wye branches, plugs, or bends.
   2. Place concrete blocking so that it extends from fitting into solid undisturbed earth wall.
      a. Concrete blocks shall not cover pipe joints.
   3. Provide bearing area of concrete in accordance with drawing detail.

H. Install underground hazard warning tape per Specification Section 10 14 00.

I. Install insulating components where dissimilar metals are joined together.

3.2 INTERIOR AND EXPOSED EXTERIOR PIPING INSTALLATION

A. Install piping in vertical and horizontal alignment as shown on Drawings.

B. Alignment of piping smaller than 4 IN may not be shown; however, install according to Drawing intent and with clearance and allowance for:
   1. Expansion and contraction.
   2. Operation and access to equipment, doors, windows, hoists, moving equipment.
   3. Headroom and walking space for working areas and aisles.
   4. System drainage and air removal.

C. Enter and exit through structure walls, floor and ceilings using penetrations and seals specified in Specification Section 01 73 20 and as shown on the Drawings.

D. Install vertical piping runs plumb and horizontal piping runs parallel with structure walls.

E. Pipe Support:
   1. Use methods of piping support as shown on Drawings and as required in Specification Section 22 05 29.
   2. Where pipes run parallel and at same elevation or grade, they may be grouped and supported from common trapeze-type hanger, provided hanger rods are increased in size as specified for total supported weight.

a. The pipe in the group requiring the least maximum distance between supports shall set the distance between trapeze hangers.
3. Size pipe supports with consideration to specific gravity of liquid being piped.

F. Locate and size sleeves and castings required for piping system.
1. Arrange for chases, recesses, inserts or anchors at proper elevation and location.

G. Use reducing fittings throughout piping systems.
1. Bushings will not be allowed unless specifically approved.

H. Equipment Drainage and Miscellaneous Piping:
1. Provide drip pans and drain piping at equipment where condensation may occur.
2. Avoid piping over electrical components such as motor control centers, panelboards, etc.
a. If piping must be so routed, utilize 16 GA, 304 stainless steel drip pan under piping and over full length of electrical equipment.
b. Hard pipe drainage to nearest floor drain.
3. Provide drainage for process piping at locations shown on Drawings in accordance with Drawing details.
4. For applications defined herein and for other miscellaneous piping which is not addressed by a specific piping service category, provide ASTM B88 copper piping and fittings.
a. Size to handle application with 3/4 IN being minimum size provided.

I. Unions:
1. Install in position which will permit valve or equipment to be removed without dismantling adjacent piping.
2. Mechanical type couplings may serve as unions.
3. Additional flange unions are not required at flanged connections.

J. Install expansion devices as necessary to allow expansion/contraction movement.

K. Provide full face gaskets on all systems.

L. Anchorage and Blocking:
1. Block, anchor, or harness exposed piping subjected to forces in which joints are installed to prevent separation of joints and transmission of stress into equipment or structural components not designed to resist those stresses.

M. Equipment Pipe Connections:
1. Equipment - General:
a. Exercise care in bolting flanged joints so that there is no restraint on the opposite end of pipe or fitting which would prevent uniform gasket pressure at connection or would cause unnecessary stresses to be transmitted to equipment flanges.
b. Where push-on joints are used in conjunction with flanged joints, final positioning of push-on joints shall not be made until flange joints have been tightened without strain.
c. Tighten flange bolts at uniform rate which will result in uniform gasket compression over entire area of joint.
1) Provide tightening torque in accordance with manufacturer's recommendations.
d. Support and match flange faces to uniform contact over their entire face area prior to installation of any bolt between the piping flange and equipment connecting flange.
e. Permit piping connected to equipment to freely move in directions parallel to longitudinal centerline when and while bolts in connection flange are tightened.
f. Align, level, and wedge equipment into place during fitting and alignment of connecting piping.
g. Grout equipment into place prior to final bolting of piping but not before initial fitting and alignment.
h. To provide maximum flexibility and ease of alignment, assemble connecting piping with gaskets in place and minimum of four bolts per joint installed and tightened.
1) Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange.
2) Realign as necessary, install flange bolts and make equipment connection.

i. Provide utility connections to equipment shown on Drawings, scheduled or specified.

2. Plumbing and HVAC equipment:
   a. Make piping connections to plumbing and HVAC equipment, including but not limited to installation of fittings, strainers and valves provided with or as integral part of equipment.
   b. Furnish and install sinks, fittings, strainers, valves and shock absorbers which are not specified to be provided with or as an integral part of equipment, but are required for a complete installation.
   c. For each water supply piping connection to equipment, furnish and install union and isolation gate or ball valve.
      1) Provide wheel handle stop valve at each sink water supply.
      2) Minimum size: 1/2 IN.
   d. Furnish and install "P" trap for each waste piping connection to equipment if waste is connected directly to a sanitary sewer system.
      1) Size trap as required by the applicable Plumbing Code.
   e. Stub piping for equipment, sinks, lavatories, supply and drain fittings, key stops, "P" traps, miscellaneous traps and miscellaneous brass through wall or floor and cap and protect until such time when later installation is performed.

N. Provide dielectric union or dielectric flange kit where dissimilar piping metals are joined together.

3.3 FLEXIBLE EXPANSION JOINTS

1. Flexible expansion joints shall be installed in the locations indicated on the drawings and shall be manufactured of ductile iron conforming to the material requirements of ASTM A536 and ANSI/AWWA C153/A21.5s3. Foundry certification of mechanical testing and spectrographic analysis shall be readily available upon request.

2. All surfaces shall be fusion bonded epoxy coating conforming to the applicable requirements of ANSI/AWWA C213, and epoxy coating shall be certified and listed to meet the requirements of NSF Standard 61.

3. Flexible expansion joints shall incorporate integral expansion and contraction in their design, shall provide for continued expansion and contraction in the deflected state, shall be a boltless design and no fasteners will be required for assembly of the expansion joint itself.

4. Rubber sealing rings will be suitable for water and wastewater service, and shall require no maintenance. The rubber sealing ring materials and lubricant shall be certified and listed to meet the requirements of NSF Standard 61.

5. Flexible expansion joints will include removable tie rods to prevent axial movement during shipping, handling and installation.

6. Suitably sized, 8 mil thick polyethylene sleeves shall be provided for direct bury applications. These PE sleeve materials will meet the requirements of ANSI/AWWA C105/A21.16.

7. Working / Test Pressures:

SIZE / CONFIGURATION	WORKING PRESSURE (PSI)	TEST PRESSURE (PSI)
3” – 16” MJ & FLANGED	350	438
18 - 24” MJ & FLANGED	250	313

8. A manufacturer’s certification of compliance on the above standards and requirements shall be readily available upon request. The consultant, purchaser or utility owner shall reserve the right to inspect the manufacturer’s facility for compliance.

3.4 CONNECTIONS WITH EXISTING PIPING

A. Where connection between new work and existing work is made, use suitable and proper fittings to suit conditions encountered.

B. Perform connections with existing piping at time and under conditions which will least interfere with existing facility operations.

C. Undertake connections in fashion which will disturb system as little as possible.

D. Provide suitable equipment and facilities to dewater, drain, and dispose of liquid removed without damage to adjacent property.

E. Where connections to existing systems necessitate employment of past installation methods not currently part of trade practice, utilize necessary special piping components.

F. Where connection involves potable water systems, provide disinfection methods as prescribed in this Specification Section.

G. Once tie-in to each existing system is initiated, continue work continuously until tie-in is made and tested.

3.5 PRESSURE GAGES

A. Provide at locations shown on the Drawings and specified.

B. See Specification Section 01 61 03.

3.6 FIELD QUALITY CONTROL

A. Pipe Testing - General:
   1. Test piping systems as follows:
      a. Test exposed, non-insulated piping systems upon completion of system.
      b. Test exposed, insulated piping systems upon completion of system but prior to application of insulation.
      c. Test concealed interior piping systems prior to concealment and, if system is insulated, prior to application of insulation.
      d. Test buried piping (insulated and non-insulated) prior to backfilling and, if insulated, prior to application of insulation.
   2. Utilize pressures, media and pressure test durations as specified in the Piping Specification Schedules in Part 3.
   3. Isolate equipment which may be damaged by the specified pressure test conditions.
   4. Perform pressure test using calibrated pressure gages and calibrated volumetric measuring equipment to determine leakage rates.
      a. Select each gage so that the specified test pressure falls within the upper half of the gage's range.
      b. Notify the Engineer a minimum of 24 HRS prior to each test.
   5. Completely assemble and test new piping systems prior to connection to existing pipe systems.
   6. Acknowledge satisfactory performance of tests and inspections in writing to Engineer prior to final acceptance.
   7. Bear the cost of all testing and inspecting, locating and remedying of leaks and any necessary retesting and re-examination.

B. Pressure Testing:
   1. Testing medium: Unless otherwise specified in the Piping Specification Schedules in Part 3, utilize the following test media.
      a. Liquid systems:

PIPE LINE SIZE (DIA)	GRAVITY OR PUMPED	SPECIFIED TEST PRESSURE	TESTING MEDIUM
Up to and including 48 IN	Gravity	20 PSIG	Water
Up to and including 12 IN	Pumped	80 PSIG	Water

2. Allowable leakage rates:
   a. All exposed piping systems, all pressure piping systems and all buried, insulated piping systems which are hydrostatically pressure tested shall have zero leakage goal at the specified test pressure throughout the duration of the test.
   b. Hydrostatic exfiltration and infiltration for sanitary and storm water sewers (groundwater level is below the top of pipe):
      1) Leakage rate: 200 GAL per inch diameter per mile of pipe per day at average head on test section of 3 FT.
      2) Average head is defined from groundwater elevation to average pipe crown.
      3) Acceptable test head leakage rate for heads greater than 3 FT: Acceptable leakage rate (gallons per inch diameter per mile per day) equals 115 by (actual test head to the 1/2 power).
   c. Hydrostatic infiltration test for sanitary and stormwater sewers (groundwater level is above the top of pipe):
      1) Allowable leakage rate: 200 GAL per inch diameter per mile of pipe per day when depth of groundwater over top of pipe is 2 to 6 FT.
      2) Leakage rate at heads greater than 6 FT: Allowable leakage rate (gallons per inch diameter per mile of pipe per day) equals 82 by (actual head to the 1/2 power).
3. Hydrostatic pressure testing methodology:
   a. General:
      1) All joints, including welds, are to be left exposed for examination during the test.
      2) Provide additional temporary supports for piping systems designed for vapor or gas to support the weight of the test water.
      3) Provide temporary restraints for expansion joints for additional pressure load under test.
      4) Isolate equipment in piping system with rated pressure lower than pipe test pressure.
      5) Do not coat or insulate exposed piping until successful performance of pressure test.
   b. Soil, waste, drain and vent systems:
      1) Test at completion of installation of each stack or section of piping by filling system with water and checking joints and fittings for leaks.
      2) Eliminate leaks before proceeding with work or concealing piping.
      3) Minimum test heights shall be 10 FT above highest stack inlet.

C. Dielectric Testing Methods and Criteria:
   1. Provide electrical check between metallic non-ferrous pipe or appurtenances and ferrous elements of construction to assure discontinuity has been maintained.
   2. Wherever electrical contact is demonstrated by such test, locate the point or points of continuity and correct the condition.

3.7 CLEANING, DISINFECTION AND PURGING

A. Cleaning:
   1. Clean interior of piping systems thoroughly before installing.
   2. Maintain pipe in clean condition during installation.
   3. Before joining piping, thoroughly clean and wipe joint contact surfaces and then properly dress and make joint.
      a. Pig high pressure air piping before connecting to valves or instruments.
   4. At completion of work and prior to Final Acceptance, thoroughly clean work installed under these Specifications.

a. Clean equipment, fixtures, pipe, valves, and fittings of grease, metal cuttings, and sludge which may have accumulated by operation of system, from testing, or from other causes.
b. Repair any stoppage or discoloration or other damage to parts of building, its finish, or furnishings, due to failure to properly clean piping system, without cost to Owner.

B. Disinfection of Potable Water Systems:
1. After favorable performance of pressure test and prior to Final Acceptance, thoroughly flush entire potable water piping system including supply, source and any appurtenant devices and perform disinfection as prescribed.
2. Perform work, including preventative measures during construction, in full compliance with AWWA C651.
3. Perform disinfection using sodium hypochlorite complying with AWWA B300.
4. Flush each segment of system to provide flushing velocity of not less than 2.5 FT per second.
5. Drain flushing water to sanitary sewer.
a. Do not drain flushing water to receiving stream.
6. Use continuous feed method of application.
a. Tag system during disinfection procedure to prevent use.
7. After required contact period, flush system to remove traces of heavily chlorinated water.
8. After final flushing and before placing water in service, obtain an independent laboratory approved by the Owner to collect samples and test for bacteriological quality.
a. Repeat entire disinfection procedures until satisfactory results are obtained.
9. Secure and deliver to Owner, satisfactory bacteriological reports on samples taken from system.
a. Ensure sampling and testing procedures are in full compliance to AWWA C651, local water purveyor and applicable requirements of the State of California.

3.8 LOCATION OF BURIED OBSTACLES

A. Furnish exact location and description of buried utilities encountered and thrust block placement.

B. Reference items to definitive reference point locations such as found property corners, entrances to buildings, existing structure lines, fire hydrants and related fixed structures.

C. Include such information as location, elevation, coverage, supports and additional pertinent information.

D. Incorporate information on "As-Recorded" Drawings.

3.9 PIPE INSULATION

A. Insulate pipe and pipe fittings in accordance with Specification Section 40 42 00.

3.10 PIPING SYSTEM SCHEDULES

A. SPECIFICATION SCHEDULE - SYSTEM 1

1. General:
a. Piping symbol and service:
1) DCW – Potable Domestic Cold Water.
2) DHW – Potable Domestic Hot Water.
3) IW – Industrial Water.
b. Test requirements:
1) Test medium: Water.
2) Pressure: 80 psig.
3) Duration: 4 HRS.
c. Gaskets and O-rings:
1) O-rings: Neoprene or rubber.
2) Flanged, push-on and mechanical joints: EPDM rubber, NSF-61 approved for potable water applications.
2. System components:

a. Pipe size up to 3 IN:
    1) Exposed service:
        a) Material: Copper tubing, Type L hard temper.
        b) Reference: ASTM B88.
        c) Solder: ASTM B32, cadmium and lead-free, 95-5 tin/antimony solder compatible with tubing and fittings materials and non-corrosive flux.
        d) Lining: None.
        e) Coating: None.
        f) Fittings: Wrought copper or bronze per ASME B16.22.
        g) Joints: Soldered.
    2) Buried Service (Option 1):
        a) Material: Polyethylene (PE), with pressure class of 200 psi.
        b) Reference: AWWA C901.
        c) Lining: None.
        d) Coating: None.
        e) Fittings: Fusion bonded, complying with ASTM D2683 and ASTM D3261.
        f) Joints: Fusion bonded, complying with ASTM D2683 and ASTM D3261.
    3) Buried service (Option 2):
        a) Material: PVC, Type 1, Grade 1, Schedule 80.
        b) Reference: ASTM D1785.
        c) Lining: None.
        d) Coating: None.
        e) Fittings: Solvent weld socket type, schedule 80, complying with ASTM D2467.
        f) Joints: Solvent weld socket type complying with ASTM D2467.

3. Install drain tees with capped nipples of IPS brass 3 IN long at low points.
    a. If low point occurs in concealed piping, provide approved flush access panel.
    b. These drains are not shown on Drawings.
4. Slope water lines down to drain points not less than 1 IN in 60 FT.
5. Install all threaded piping with clean-cut tapered threads and with ends thoroughly reamed after cutting to remove burrs.
    a. Pipe joint cement permitted only on external threads.
6. For screwed nipples for connections to flush valves, lavatory supplies, and other equipment with threaded connections use iron, copper, or brass pipe.
7. Install ball valves or gate valves where indicated or required to adequately service all parts of system and equipment.
    a. Install valves on each branch serving restroom.
    b. Install valves on inlet and outlet of equipment connected to water lines.
8. Install unions between valves and connections to each piece of equipment, and install sufficient number of unions throughout piping system to facilitate installation and servicing.
    a. On copper pipe lines, install wrought, solder-joint, copper to copper unions for lines 2 IN and smaller and, for lines 2-1/2 IN and over install brass flange unions.
9. Construct and equip plumbing fixtures and equipment with anti-siphon devices as to entirely eliminate any danger of siphoning waste material into potable water supply system.
10. Where exposed pipes 6 IN in size and smaller pass through floors, finished walls, or finished ceilings, fit with nickel or chrome-plated escutcheon plates large enough to completely close hole around pipes.
    a. Secure plates to pipe by set screw in approved manner.
11. Size supply branches to individual fixtures as scheduled or indicated on Drawings.
12. Install piping so as to be free to expand with proper loops, anchors and joints without injury to system or structure.

B. SPECIFICATION SCHEDULE - SYSTEM 2

1. General:
    a. Piping symbol and service:
        1) SAN – Sanitary Sewer.

2) V – Vent.
3) DR – Drain.
4) MV – Methane Vent.

b. Test requirements:
1) Test medium: Water.
2) Pressure: 10 FT head pressure above stack termination height.
3) Duration: 6 HRS.

2. System components: (SAN, V, DR)
a. All pipe sizes:
1) Exposed and buried service (beneath building slabs to 5 ft outside of structure).
a) Material: PVC, Schedule 40.
b) Reference: ASTM D1784.
c) Lining: None.
d) Coating: None.
e) Fittings: Solvent welded, DWV, socket type complying with ASTM D2665.
f) Joints: Solvent weld.

3. System Components: (Methane Vent, MV)
a. All pipe sizes:
1) Buried service:
a) Material: Perforated Polyvinyl Chloride (PVC), Schedule 80.
b) Reference: ASTM D1785
c) Lining: None
d) Coating: None
e) Fittings: Socket type complying with ASTM D2467.
f) Joints: Solvent weld, socket type complying with ASTM D2467.
2) Exposed service:
a) Material: Galvanized Steel, Schedule 40.
b) Reference: ASTM A53.
c) Lining: None.
d) Coating: Galvanized, with primer coat.
e) Fittings: Galvanized malleable iron, threaded connections, ASTM A197
f) Joints: Threaded.

4. Soil, Drain and Waste Piping Installation:
a. Install horizontal soil or waste lines 4 IN diameter and less with a slope of not less than 1/4 IN per foot or 2 PCT toward the point of disposal, unless noted otherwise on the drawings.
b. Piping larger than 4 IN may be sloped at 1/8 IN per foot or 1 PCT, where first approved by the Authority Having Jurisdiction.
c. Install as close to construction as possible to maintain maximum head room.
d. Make changes of direction with 1/8 bends and junctions with wye fittings.
e. Use short wye fittings in vertical pipe only.
f. Install handhole test tee at base of each stack.
g. Install cleanouts at dead ends, at changes of direction and at 100 FT intervals on horizontal runs.
1) Where cleanouts occur in concealed spaces, provide with extensions to floors above or to walls as required.
h. Install piping true to grade and alignment.
1) Begin at the system low point.
i. Locate vertical extensions of underground piping below partition walls for concealment in wall.
1) In locations where hubs are wider than partition, set hubs 1 IN below final floor.
j. For hub and spigot joints, install hub facing flow.

5. Vent Piping Installation:
a. Run vent stack parallel to each soil or waste stack to receive branch vents from fixtures.
b. Originate each vent stack from soil or waste pipe at its base.

c. Where possible, combine soil, waste or vent stacks before passing through roof so as to minimize roof openings.
d. Offset pipes running close to exterior walls away from such walls before passing through roof to permit proper flashing.
e. Terminate each vent with approved frostproof jacket.
f. Carry vent stacks 4 IN and larger full size through roof.
1) Extend vent stacks at least 12 IN above roofing.

C. SPECIFICATION SCHEDULE - SYSTEM 3

1. General:
   a. Piping symbol and service:
      1) REF – Refrigerant liquid and suction lines.
   b. Test requirements:
      1) Follow general testing guidelines of ASHRAE 15, except as modified herein.
      2) Pressurize the high and low pressure sides of the piping system after completion of the refrigerant piping.
      3) Pressurize at the test pressures specified in ASHRAE 15 for the refrigerant type to be used in the system.
      4) Repair any leaks and repeat tests until no further leaks are found and the system passes a static leak test at test pressure for a duration of 4 HRS.
      5) After tests and cleaning have been completed and system proved tight, charge each circuit with dry clean refrigerant to gas pressure as recommended by the equipment manufacturer.
2. System components:
   a. Pipe size up to 2 IN:
      1) Exposed service:
         a) Material: Copper tubing, type L, conforming to ASTM B280, dehydrated for refrigerant use, with high-temperature soldered joints and wrought copper (400 PSIG) fittings. Factory pre-charged line sets sized per manufacturer recommendations.
         b) Brazing: High temperature silver solder, melting point not less than 1000 DEGF, solder alloys compatible with tubing and fitting materials.
         c) Lining: None.
         d) Coating: None
         e) Fittings: Copper, 400 PSIG, as required to adapt line sets to equipment.
         f) Joints: Brazed.

D. SPECIFICATION SCHEDULE - SYSTEM 4

1. General:
   a. Piping symbol and service:
      1) Well Water Piping.
   b. Test requirements:
      1) Test medium: Water.
      2) Pressure: Operating pressure plus 30%.
      3) Duration: 6 HRS.
2. System components: (Well Pump Piping)
   a. All pipe sizes:
      1) Exposed service (inside well casing and outside of well head):
         a) Material: Galvanized Steel, Schedule 40.
         b) Reference: ASTM A53.
         c) Lining: None.
         d) Coating: Galvanized.
         e) Fittings: Galvanized malleable iron, threaded connections, ASTM A197
         f) Joints: Threaded.

E.

3.11 SERVICE SYSTEM SUMMARY

A. Piping systems summary is provided in Table A:

TABLE A - SERVICE SYSTEM SUMMARY						
SYMBOL	SERVICE	SYSTEM NO	CONSTRUCTION	SIZE (IN)	PIPE MATERIAL	TEST PRESSURE (PSI)
DCW	Domestic Cold Water (Plumbing Piping)	1	Exposed	3" and less	Copper	-
			Buried	3" and less	PVC or C901 PE	-
DHW	Domestic Hot Water (Plumbing Piping)	1	Exposed	3" and less	Copper	-
IW	Industrial Water (Plumbing Piping)	1	Exposed	3" and less	Copper	-
			Buried	3" and less	PVC or C901 PE	-
DR	Drain (Plumbing Piping)	2	Exposed and Buried	All sizes	PVC	-
SAN	Sanitary Sewer (Plumbing Piping)	2	Exposed and Buried	All sizes	PVC	-
V	Vent (Plumbing Piping)	2	Exposed and Buried	All sizes	PVC	-
MV	Methane Vent (Plumbing Piping)	2	Buried	All sizes	PVC (Perforated)	-
		2	Exposed	All sizes	Galvanized Steel	-
W	Water (Yard Piping)	-	Buried	Per Drawings	Per Drawings	-
	Well Water Piping	4	Exposed at well and well head	All sizes	Steel	-
SS	Sanitary Sewer (Yard Piping)	-	Buried	Per Drawings	Per Drawings	-
ST	Storm Water (Yard Piping)	-	Buried	Per Drawings	Per Drawings	-
REF	Refrigerant	3	Exposed	Up to 2"	Copper	-
NOTES:	1) Refer to piping system descriptions for test pressure.					

END OF SECTION

SECTION 40 05 17
PIPE - COPPER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Copper piping, fittings, and appurtenances.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 31 23 33 - Trenching, Backfilling, and Compacting for Utilities.
   4. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.
   5. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment.

C. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. B16.22, Wrought Copper and Bronze Solder - Joint Pressure Fittings.
      b. B16.23, Cast Bronze Solder Joint Drainage Fittings - DWV.
      c. B16.26, Cast Bronze Alloy Fittings for Flared Copper Tubes.
      d. B16.50, Wrought Copper and Copper Alloy Braze Joint Pressure Fittings.
   2. ASTM International (ASTM):
      a. B32, Standard Specification for Solder Metal.
      b. B42, Standard Specification for Seamless Copper Pipe, Standard Sizes.
      c. B88, Standard Specification for Seamless Copper Water Tube.
      d. B306, Standard Specification for Copper Drainage Tube (DWV).
   3. American Welding Society (AWS):
      a. A5.8M/A5.8, Specification for Filler Metals for Brazing and Braze Welding.

1.2 SUBMITTALS

A. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

B. See Specification Section 40 05 00.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Copper Tubing:
   1. Exposed (non-buried) pressurized liquid service: ASTM B88, Type L hard.
   2. Buried pressurized liquid service: ASTM B88, Type K hard.
   3. Non-pressurized liquid service: ASTM B306.

B. Copper Pipe: ASTM B42, regular strength.

C. Fittings:
   1. Pressure non-buried: ASME B16.22.
   2. Pressure buried: ASME B16.50 or ASME B16.26.
   3. Non-pressure: ASME B16.23

D. Soldering and Brazing:
   1. Non-buried:
      a. ASTM B32 solder with a tin/antimony ratio of 95/5 and non-corrosive flux up to 180 DEGF water temperature.

b. At 180 DEGF and above, use brazing alloy with melting temperature above 1000 DEGF and suitable flux.

2. Buried: Silver brazing filler metal per AWS A5.8M/A5.8, with 1000°F melting point.

E. See Piping Schedules in Specification Section 40 05 00.

F. Unions:
1. Pipe sizes 2-1/2 IN and smaller: Copper, ground joint.
2. Pipe sizes 3 IN and larger: Brass flanged unions.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with Specification Section 40 05 00.

3.2 FIELD QUALITY CONTROL

A. Test piping systems in accordance with Specification Section 40 05 00.

B. Utilize only annealed (soft) type tubing where flared joints are used and drawn temper (hard) type tubing where soldered or brazed joints are used.

C. Support exposed piping in accordance with Specification Section 40 05 00 and Specification Section 22 05 29.

D. Install buried piping in accordance with Specification Section 31 23 33 and Specification Section 40 05 00.

END OF SECTION

SECTION 40 05 26
PIPE - CAST-IRON SOIL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Cast-iron soil piping, fittings, and appurtenances.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.

1.2 QUALITY ASSURANCE

A. See Section 40 05 00.

B. Provide joint type specifically approved by applicable plumbing code.

C. Referenced Standards:
   1. ASTM International (ASTM):
      a. A74, Standard Specification for Cast-Iron Soil Pipe and Fittings.
      b. C564, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
   2. Cast Iron Soil Pipe Institute (CISPI):
      a. 301, Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
      b. 310, Standard for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. See Section 40 05 00.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pipe (General Application):
   1. ASTM A74.
      a. SV service.

B. Joints (General Application):
   1. Below ground: Service hub and spigot compression joint with neoprene gasket, ASTM C564.
   2. Above ground: No-hub couplings, conforming to CISPI 301 and 310.

C. See Piping Schedules in Section 40 05 00.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Observe manufacturer's recommendation for handling, cutting, jointing, installing, and testing.

B. Install products in accordance with CISPI standards.

C. Support exposed piping in accordance with Section 40 05 00 and 22 05 29.

D. Install buried piping in accordance with Section 40 05 00.

3.2 FIELD QUALITY CONTROL

A. Test piping systems in accordance with Section 40 05 00.

END OF SECTION

SECTION 40 05 31
PIPE - PLASTIC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Plastic pipe.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.

1.2 QUALITY ASSURANCE

A. See Specification Section 40 05 00.

B. Referenced Standards:
   1. ASTM International (ASTM):
      a. PVC (polyvinyl chloride) materials:
         1) D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
         2) D1785, Standard Specification for Poly(Vinyl Chloride) PVC Plastic Pipe, Schedules 40, 80 and 120.
         3) D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
         4) D3034, Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
         5) D3139, Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
         6) D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
         7) F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
         8) F679, Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
         9) F794, Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
         10) F949, Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings.
      b. Installation:
         1) D2321, Standard Practice for Underground Installation of Thermosplastic Pipe for Sewers and Other Gravity-Flow Applications.
   2. American Water Works Association (AWWA):
      a. PVC (polyvinyl chloride) materials:
         1) C900, Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 IN Through 12 IN, for Water Distribution.
         2) C905, Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 IN through 48 IN, for Water Transmission and Distribution.
      b. Polyethylene (PE) materials:
         1) C901, Standard for Polyethylene (PE) Pressure Pipe and Tubing, 1/2 IN through 3 IN, for Water Service.
   3. NSF International (NSF).

1.3 SUBMITTALS

A. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

B. See Specification Section 40 05 00.

PART 2 - PRODUCTS

2.1 PVC PRESSURE PIPING (EXPOSED)

A. General:
   1. Provide Schedule 80 pipe with Schedule 80 fittings and appurtenances to locations shown on Drawings.
   2. Furnish materials in full compliance to following material specifications:
      a. Manufacture pipe, fittings and appurtenances from polyvinyl chloride (PVC) compound which meets the requirements of Type 1, Grade 1 (12454-B) Polyvinyl Chloride as outlined in ASTM D1784.
      b. Manufacture pipe, fittings and valves from materials that have been tested and approved for conveying potable water by the NSF.

B. Pipe:
   1. Furnish pipe meeting requirements of ASTM D1785.
   2. Pipe 2 IN and less to be solvent welded.
   3. Pipe larger than 2 IN may be either flanged or solvent welded unless shown otherwise on Drawings.

C. Fittings: Provide ASTM D2467 PVC socket type fittings having the same pressure and temperature rating as the pipe.

D. Flanges/Unions:
   1. Furnish flanges and unions at locations shown on Drawings.
   2. Provide either flanges or unions at valves, penetrations through structures and equipment connections.
   3. For pipe larger than 2 IN, provide 150 LB socket type PVC flange.
   4. For pipe 2 IN and less, provide socket type PVC union with Buna O-rings.
   5. Use flat, full faced natural rubber gaskets at flanged connections.
      a. Furnish heavy hex head bolts, each with one heavy hex nut, ASTM F593 Type 316 stainless steel.
   6. Use spacers supplied by pipe manufacturer when mating raised-faced flanges to other flanges.

E. Flexible Couplings:
   1. Provide flexible couplings at locations shown on the Drawings for pipe flexibility and expansion/contraction purposes.
   2. Unless otherwise specified provide rubber expansion joints as manufactured by General Rubber Corporation, South Hackensack, New Jersey.

F. Installation:
   1. Field threading PVC will not be permitted.
      a. Perform required threaded connections or attachments by the use of factory molded socket by threaded adapters.
      b. Female adapters are not acceptable.
   2. Employ installation and pipe support practices and solvent welding all in compliance to the manufacturer's printed recommendation.
      a. Continuously support PVC piping at liquid operating temperatures in excess of 100 DEGF.
      b. For vertical piping, band the pipe at intervals to rigidly support load of twice vertical load.

c. Support riser clamps on spring hangers.
d. Do not clamp PVC tightly or restrict movement for expansion and contraction.

2.2 PRESSURE PIPING (UNDERGROUND)

A. Materials: Furnish materials in full compliance with following requirements:
1. 1/2-3 IN: AWWA C901 PE with Pressure Class of 160 PSI.
2. 4-12 IN: AWWA C900 PVC with Pressure Class of 150 PSI.
3. 14-36 IN: AWWA C905 PVC DR-18.
4. Joints for polyethylene pipe shall be fusion type in accordance with AWWA C901.
5. Joints for PVC pipe shall be the elastomeric-gasket type with a pressure rating not less than pipe pressure rating meeting performance requirements of ASTM D3139.

B. Installation:
1. Field threading of PVC pipe will not be permitted.
2. Perform installation procedures, handling, thrust blocking, connections, and other appurtenant operations in full compliance to the manufacturer's printed recommendations and in full observance to plan details when more stringent.

2.3 PVC DRAINAGE AND SEWER PIPING

A. Materials:
1. Furnish materials in full compliance to the following material specification.
2. PVC pipe shall be rigid, unplasticized polyvinyl chloride (PVC) made of PVC plastic having a cell classification of 12454-B or 12454-C as described in specification ASTM D1784.
3. The requirements of this Specification are intended to provide for pipe and fittings suitable for non-pressure drainage of wastewater and surface water.
4. Joining systems shall consist of an elastomeric gasket joint meeting requirements of ASTM D3212.
5. Supply to the Engineer all information and sample of joining method for his evaluation.
a. Only jointing methods acceptable to the Engineer will be permitted.
6. Provide pipe and fittings meeting or exceeding the following requirements:
a. 4-27 IN DIA: ASTM D3034 and ASTM F679, SDR 35.
7. Ensure impact strengths and pipe stiffnesses in full compliance to these Specifications.

B. Installation: Install pipe and fittings in accordance with ASTM D2321 and as recommended by the manufacturer.
1. Provide for a maximum deflection of not more than 3 PCT.

2.4 PVC TUBING

A. General: Provide nylon tubing with fittings and appurtenances as shown on Drawings.

B. Materials:
1. Furnish clear outer braided tubing with braid outside the walls.
2. Have tubing manufactured of nylon with working temperatures from 5 to 180 DEGF.
3. Design tubing with a minimum safety factor of 4 to 1 ratio of burst pressure to working pressure at maximum temperature.
4. Provide tubing with working pressure of 75 PSI at 180 DEGF.
5. Ensure that tubing is self-extinguishing and fire resistant.

C. Fittings:
1. Install tubing with nylon fittings and connectors.
2. Use barbed type adapters with stainless steel clamps.
3. Provide fittings capable of withstanding temperatures from a -70 to 250 DEGF.
4. Ensure fittings have the same pressure and temperature rating as the tubing.

PART 3 - EXECUTION

3.1 IDENTIFICATION

A. Identify each length of pipe clearly at intervals of 5 FT or less.
   1. Include manufacturer's name and trademark.
   2. Nominal size of pipe, appurtenant information regarding polymer cell classification and critical identifications regarding performance specifications and NSF approvals when applicable.

3.2 PRESSURE PIPING (UNDERGROUND)

A. Installation:
   1. Field threading of PVC pipe will not be permitted.
   2. Perform installation procedures, handling, thrust blocking, connections, and other appurtenant operations in full compliance to the manufacturer's printed recommendations and in full observance to plan details when more stringent.

3.3 PVC DRAINAGE AND SEWER PIPING

A. Installation: Install pipe and fittings in accordance with ASTM D2321 and as recommended by the manufacturer.
   1. Provide for a maximum deflection of not more than 3 PCT.

B. Infiltration and Exfiltration:
   1. The maximum allowable infiltration measured by test shall not exceed 100 GAL per inch of pipe diameter per mile per 24 HRS.
   2. For exfiltration, all the pipe and fittings shall exceed performance requirements by the test procedure as specified in Section 40 05 00.
   3. Observe full instructions of the Engineer for carrying of testing procedures.
      a. Perform tests only during presence of the Engineer or his authorized representative.
   4. Should any test on any section of pipe line disclose either infiltration rates greater than allowed or disclose air loss rate greater than that permitted, locate and repair the defective joints or pipes at no cost to Owner and retest until requirements stated are met.

C. Deflection:
   1. After backfilling, each section of pipe shall be checked for deflection by pulling a mandrel through the pipe.
   2. Pipe with deflection exceeding 5 PCT of the inside diameter shall have backfill removed and replaced to provide a deflection of less than 5 PCT.
   3. Any repaired pipe shall be retested.

3.4 PVC TUBING

A. Fittings:
   1. Install tubing with nylon fittings and connectors.
   2. Use barbed type adapters with stainless steel clamps.
   3. Provide fittings capable of withstanding temperatures from a -70 to 250 DEGF.
   4. Ensure fittings have the same pressure and temperature rating as the tubing.

B. Trays:
   1. Flat smoothed bottom tray for supporting flexible hoses when there is a chance that the hoses may pulse or move; specify a flat smoothed bottom tray.

END OF SECTION

SECTION 40 05 51
VALVES - BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Valves, actuators, and valve appurtenances.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 22 05 23 - General Duty Valves for Plumbing Piping.
   4. Section 40 05 00 - Pipe and Pipe Fittings: Basic Requirements.
   5. Section 40 05 61 - Gate Valves.
   6. Section 40 05 63 - Ball Valves.
   7. Section 40 05 66 - Check Valves.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. B1.20.1, Pipe Threads, General Purpose.
   2. ASTM International (ASTM):
      a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
      b. D256, Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
      c. D638, Standard Test Method for Tensile Properties of Plastics.
      d. D648, Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
      e. D695, Standard Test Method for Compressive Properties of Rigid Plastics.
      f. D2240, Standard Test Method for Rubber Property-Durometer Hardness.
   3. American Water Works Association (AWWA):
      a. C509, Standard for Resilient-Seated Gate Valves for Water Supply Service.
      b.
      c. C550, Standard for Protective Coatings for Valves and Hydrants.
   4. American Water Works Association/American National Standards Institute (AWWA/ANSI):
      a. C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   5. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Valve pressure and temperature rating.
      d. Valve material of construction.
      e. Special linings.
      f. Valve dimensions and weight.

g. Valve flow coefficient.

B. Contract Closeout Information:
1. Operation and Maintenance Data:
a. See Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, refer to individual valve Specification Sections for acceptable manufacturers.

2.2 MATERIALS

A. Refer to individual valve Specification Sections.

B. Exposed Valve Manual Actuators:
1. Provide for all exposed valves not having electric or cylinder actuators.
2. Provide handwheels for gate and globe valves.
a. Size handwheels for valves in accordance with AWWA C500.
3. Provide lever actuators for plug valves, butterfly valves and ball valves 3 IN DIA and smaller.
a. Lever actuators for butterfly valves shall have a minimum of 5 intermediate lock positions between full open and full close.
b. Provide at least two (2) levers for each type and size of valve furnished.
4. Gear actuators required for plug valves, butterfly valves, and ball valves 4 IN DIA and larger.

2.3 FABRICATION

A. End Connections:
1. Provide the type of end connections for valves as required by the Piping Systems presented in Section 40 05 00 or as indicated in the individual valve specification sections.
2. Comply with the following standards:
a. Threaded: ASME B1.20.1.
b. Flanged: ASME B16.1, Class 125 unless otherwise noted or AWWA C207.
c. Soldered: ASME B16.18.
d. Grooved: Rigid joints per Table 5 of AWWA C606.

B. Refer to individual valve Specification Sections for specifications of each type of valve used on Project.

C. Nuts, Bolts, and Washers:
1. Wetted or internal to be bronze or stainless steel.
a. Exposed to be zinc or cadmium plated.

D. On Insulated Piping: Provide valves with extended stems to permit proper insulation application without interference from handle.

E. Epoxy Interior Coating: Provide epoxy interior coating for all ferrous surfaces in accordance with AWWA C550.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Painting Requirements: Comply with Section 09 96 00 for High Performance Industrial Coatings.

C. Setting Buried Valves:
   1. Locate valves installed in pipe trenches where buried pipe is indicated on Drawings.
   2. Set valves and valve boxes plumb.
   3. Place valve boxes directly over valves with top of box being brought to surface of finished grade.
   4. Install in closed position.
   5. Place valve on firm footing in trench to prevent settling and excessive strain on connection to pipe.
   6. After installation, backfill up to top of box for a minimum distance of 4 FT on each side of box.

D. Support exposed valves and piping adjacent to valves independently to eliminate pipe loads being transferred to valve and valve loads being transferred to the piping.

E. For threaded valves, provide union on one (1) side within 2 FT of valve to allow valve removal.

F. Install valves accessible for operation, inspection, and maintenance.

3.2 ADJUSTMENT

A. Adjust valves, actuators and appurtenant equipment to comply with Section 01 75 00.

END OF SECTION

SECTION 40 05 61
GATE VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Gate valves.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 40 05 51 - Valves: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
   2. American Water Works Association (AWWA):
      a. C509, Standard for Resilient-Seated Gate Valves for Water Supply Service.
      b. C515, Standards for Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Systems.
      c. C550, Standard for Protective Epoxy Interior Coatings for Valves and Hydrants.
   3. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
      a. SP-9, Spot Facing for Bronze, Iron and Steel Flanges.
      b. SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.
      c. SP-80, Bronze Gate, Globe, Angle and Check Valves.
      d. NSF International (NSF):
         1) 61, Drinking Water System Components - Health Effects.

1.3 DEFINITIONS

A. NRS: Non-rising Stem.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. See Specification Section 40 05 51.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 VALVES: WATER (POTABLE, NONPOTABLE) AND WASTEWATER

A. Gate valve sizes: 2 IN and smaller.

B. Comply with:
   1. NSF 61.
   2. MSS SP-80.

C. Materials:
   1. Body, bonnet, wedge: Bronze.
   2. Stem: Silicon bronze.
   3. Packing: Aramid fibers with graphite (Kevlar®).
   4. Lead free construction.

D. Design Requirements:
   1. Pressure rating: 125 PSI steam, 200 PSI nonshock WOG.
   2. Screw in bonnet, non-rising stem, solid wedge.

E. Acceptable Manufacturers:
   1. Nibco.
   2. Apollo.
   3. Stockham.

2.3 VALVES: WATER (POTABLE, NON-POTABLE) AND WASTEWATER

A. Resilient Wedge Gate Valves, 2-1/2 to 48 IN:
   1. Comply with either AWWA C509 or AWWA C515 .
   2. Materials:
      a. Stem and stem nut: Bronze.
         1) Wetted bronze parts in low zinc bronze.
         2) Aluminum bronze components: Heat treated per AWWA C504.
      b. Body, gate: Cast iron or Ductile iron.
      c. Resilient wedge: Fully encapsulated rubber wedge. Ethylene Propylene Diene Monomer (EPDM).
      d. Lead free construction.
   3. Design requirements:
      a. Minimum 200 PSI working pressure.
      b. Buried: NRS, O-ring stem seal, 2 IN square operating nut.
      c. Unless otherwise required by the County, Counter clockwise open rotation.
      d. Fusion bonded epoxy coating interior and exterior except stainless steel and bearing surfaces.
         1) Comply with AWWA C550.
         2) Comply with NSF 61.
         3) Wetted bronze parts in low zinc bronze.
         4) Aluminum bronze components: Heat treated per AWWA C504.
   4. Acceptable manufacturers:
      a. Clow.
      b. Mueller.
      c. American Flow Control.
      d. M & H.

2.4 FABRICATION

A. General:
   1. Provide valves with clear waterways the full diameter of the valve.

B. Spot valves in accordance with MSS SP-9.

2.5 SOURCE QUALITY CONTROL

A. Perform following tests, in accordance with AWWA C509 or AWWA C515, on valves constructed in accordance with AWWA C509 or AWWA C515:

1. Operation test.
2. Shell test.
3. Seal test.
4. Hydrostatic test.
5. Torque test.
6. Leakage test.
7. Pressure test.

PART 3 - EXECUTION

3.1 INSTALLATION

A. See Specification Section 40 05 51.

B. Do not install gate valves inverted or with the stems sloped more than 45 DEG from the upright unless the valve was ordered and manufactured specifically for this orientation.

END OF SECTION

SECTION 40 05 63
BALL VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Ball valves.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 40 05 51 - Valves: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. A48, Standard Specification for Gray Iron Castings.
      b. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
      c. A276, Standard Specification for Stainless Steel Bars and Shapes.
      d. A351, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
      e. A536 Standard Specification for Ductile Iron Castings.
      f. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
   2. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
      a. SP-110, Ball Valves; Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.3 DEFINITIONS

A. PTFE: Polytetrafluoroethylene.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. See Specification Section 40 05 51.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 METALLIC BALL VALVES 1/4 TO 3 IN DIA (FOR POTABLE AND NONPOTABLE WATER AND WELL PUMP WATER)

A. Acceptable Manufacturers:

1. Apollo.
2. Watts.
3. Stockham.
4. Nibco.
5. Or equal.

A. Comply with:
   1. NSF 61.
   2. MSS SP-110.

B. Materials of Construction:
   1. Full port, two piece bronze body.
   2. Chrome plated brass ball.
   3. Teflon seats.
   4. Blow-out proof stem.
   5. Threaded or sweat end connections.
   6. Quarter turn, lever-actuator. Provide lever standoff when installed in insulated piping.
   7. Working pressure rating: 400 psig WOG

2.3 METALLIC BALL VALVES 2 IN TO 4 IN DIA (FOR DRAINAGE OR FORCE MAIN APPLICATIONS)

A. Comply with MSS SP-72.

B. Acceptable Manufacturers:
   1. Apollo.
   2. American Valve.
   3. Watts.
   4. Or equal.

C. Materials of Construction:
   1. Body: 2-Piece, ductile iron, full port, ASTM A536; Or cast iron ASTM A126 Class B.
   2. Handle: Steel.
   3. Ball, Stem and Trim: Stainless steel.
   4. Seats: RPTFE.
   5. Body Gasket and Packing: PTFE
   6. Flanged end connections, ANSI Class 125.
   7. Rated for 200 psi CWP.

2.4 PLASTIC BALL VALVES: 1/2 IN TO 4 IN DIA

A. Acceptable Manufacturers:
   1. Chemtrol/NIBCO.
   2. Spears.
   3. ASAHI/America.

B. Materials:
   1. Body, stem, ball, handle, end connectors:
      a. PVC ASTM D1784-12454B .
   2. Ball Seat: Teflon.
   3. O-rings: Viton PTFE encapsulated fluorocarbon.

C. Design Requirements:
   1. Rated at 150 PSI at 75 DEGF.
   2. Double or "true union" design.
   3. Blocks both directions, upstream and downstream.
   4. Union nut capable of compensating for seat wear.
   5. Body with mounting pad for actuators where required.
   6. Capable of being disconnected at downstream end under full line pressure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. See Specification Section 40 05 51.
   1. Provide Owner with a written statement that manufacturer's equipment has been installed properly, has been started up, and is ready for operation by Owner's personnel.

END OF SECTION

SECTION 40 05 66
CHECK VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Check valves.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 40 05 51 - Valves: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
   2. American Water Works Association (AWWA):
      a. C508, Standard for Swing-Check Valves for Waterworks Service, 2 IN through 24 IN NPS.
   3. American Society for Testing and Materials
      a. A536 Standard Specification for Ductile Iron Castings.
   4. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
      a. SP-71, Cast Iron Swing Check Valves, Flanged and Threaded Ends.
      b. SP-80, Bronze Gate, Globe, Angle and Check Valves.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. See Specification Section 40 05 51.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, manufacturers listed under the valve with types are acceptable.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 CHECK VALVES: 2.5 IN AND SMALLER

A. Class 125 Bronze Swing Check Valves (Potable, Non-potable Water, and Well Pump Water):
   1. Comply with MSS SP-80.
   2. Acceptable manufacturers:
      a. Nibco T413-Y-LF, lead free.
      b. Stockham LFB-319Y, lead free.
   3. Materials:
      a. Body, bonnet, disc: Bronze.

4. Design requirements:
    a. 125 PSI steam to 400 DEGF, 200 PSI WOG.
    b. Horizontal swing, renewable disc.

2.3 SWING CHECK VALVES: 3 IN TO 24 IN

A. Swing Check Valves (Water, Wastewater):
1. Comply with AWWA C508.
2. Acceptable manufacturers:
    a. Clow.
    b. American Darling.
    c. Golden Anderson.
3. Materials:
    a. Body and cover: Cast iron.
    b. Seat ring, hinge: Bronze.
    c. Disc:
        1) 3 to 4 IN: Bronze.
        2) 6 to 24 IN: Cast iron with bronze face.
        3) 6 to 24 IN: Cast iron with rubber face.
    d. Hinge shaft: Stainless steel.
    e. Bearings, connecting hardware: Bronze.
4. Design requirements:
    a. 175 PSI working pressure (3 to 12 IN).
    b. 150 PSI working pressure (14 to 24 IN).
    c. Furnish with outside weight and lever or lever and spring.

2.4 RUBBER FLAPPER CHECK VALVES: 2 IN TO 24 IN

A. For force main applications, at drainage and storm water pump stations.

B. ASME B16.1, flanged connections, Class 125 (175 PSI).

C. Acceptable Manufacturer:
1. GA Industries Figure 200-D.
2. APCO Series 100.
3. Or equal.

D. Materials:
1. Body and cover: ASTM A536 ductile iron. Internally and externally lined for corrosion protection.
2. Flapper: Buna-N, steel reinforced.
3. Stainless steel fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. See Specification Section 40 05 51.

B. Install in accordance with manufacturer's instructions.

END OF SECTION

SECTION 40 42 00
PIPE, DUCT AND EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Insulation:
      a. Piping insulation.
   2. Adhesives, mastics, sealants, and finishes.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. C553, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
      b. D1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
      c. E96, Standard Test Methods for Water Vapor Transmission of Materials.
      d. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
      e. E2336: Standard Test Methods Fire Resistive Grease Duct Enclosure Systems.
   2. Underwriters Laboratories, Inc. (UL):
      a. 723, Standard for Test for Surface Burning Characteristics of Building Materials.
   3. National Commercial and Industrial Insulation Standards (2013 seventh edition).
      a. Published by Midwest Insulation Contractors Association (MICA).
      b. Endorsed by National Insulation Association (NIA).
      c. MICA plate numbers listed in this specification reference this document.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Submit complete specification of all insulation materials, adhesives, cement, jacketing, together with manufacturer's recommended methods of application and coverage for coatings and adhesives.
   3. Submit itemized schedule by building of proposed insulation systems showing density, thermal conductivity, thickness, adhesive, jackets and vapor barriers.
   4. Certifications indicating products will meet the requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Elastomeric insulation:

a. Rubatex.
b. Armstrong.

2. Fiberglass insulation:
   a. CertainTeed Corporation.
   b. Johns Manville.
   c. Owens Corning.
   d. Knauf.
3. PVC jacket:
   a. Ceel-Co.
   b. PIC Plastics.
4. Adhesives, mastics, sealants, and finishes:
   a. Foster Products.
   b. Childers.
   c. Dow Corning.
   d. Johns Manville.
   e. Knauf.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 PIPING INSULATION - ELASTOMERIC

A. General:
1. Insulation fire and smoke hazard ratings for composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to the insulation), as tested by procedure ASTM E84, NFPA 255 and UL 723, not exceeding:
   a. Flame spread: 25.
   b. Smoke developed: 50.
2. Accessories (adhesives, mastics, cements, and tapes: Same component ratings as listed above.
3. Indicate on product labels or their shipping cartons: Flame and smoke ratings do not exceed above requirements.
4. Permanent treatment of jackets or facings to impart flame and smoke safety is required.
   a. Water-soluble treatments are prohibited.
5. Insulated shields at pipe support points.

B. Pipe, Fitting, and Valve Insulation:
1. Flexible elastomeric closed cell pipe insulation.
   a. Average thermal conductivity not to exceed 0.27 (BTU-IN)/(HR-FT^2-DEGF) at mean temperature of 75 DEGF, temperature range -40 to 220 DEGF; permeability not to exceed 0.20 by ASTM E96; water absorption 3 PCT by ASTM D1056 and ozone resistance.
2. Piping Insulation jacket:
   a. Aluminum: 16 MIL embossed aluminum.
   b. Piping jacket not required on concealed piping.
3. Provide minimum insulation thickness conforming to schedules in Part 3, or as shown on the Drawings.

2.3 PIPING INSULATION - FIBERGLASS

A. Pipe and Fitting Insulation:
1. Preformed fiberglass pipe insulation:
   a. Density: 4 LBS/CUFT.
   b. Temperature rated: 650 DEGF.
   c. Average thermal conductivity not to exceed 0.23 (BTU-IN)/(HR-FT^2-DEGF) at mean temperature of 75 DEGF.
   d. Fire hazard rating:
      1) UL 723, ASTM E84, NFPA 255.
      2) Flame spread not exceeding 25 and smoke developed not exceeding 50.
2. Moisture adsorption:

a. ASTM C553.
b. Not greater than 5 PCT moisture by volume when exposed to moisture laden air at 120 DEGF and 96 PCT RH.

3. Fungi and bacteria resistance:
   a. ASTM C665.
   b. Does not breed or promote growth.
   c. Flame attenuated glass fibers bonded with thermosetting resin.
4. Piping jackets (general applications):
   a. Aluminum: 16 MIL embossed aluminum.
   b. PVC: Preformed 0.028 IN thick PVC jackets fabricated from B.F. Goodrich PVC sheeting V-66 with proven resistance to ultraviolet degradation when temperatures do not exceed the limits of PVC.
   c. Piping jacket not required on concealed piping.
5. Provide minimum insulation thickness conforming to schedules in Part 3, or as shown on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. General:
1. Consider piping and equipment as exposed, except as otherwise indicated.
2. Consider piping and equipment in walls, partitions, floors, pipe chases and pipe shafts as concealed.
   a. Consider piping and equipment above ceilings as concealed.
3. Provide release for insulation application after piping installation and testing is complete.
   a. Apply insulation on clean, dry surfaces after inspection.
4. Provide insulation continuous through wall, roof and ceiling openings, pipe hangers, supports and sleeves.
5. Provide insulation with vapor barrier for piping, ductwork and equipment where surfaces may be cooler than surrounding air temperatures.
   a. Provide vapor barrier (0.17 perm-IN; ASTM C553) continuous and unbroken.
   b. Hangers, supports, anchors, and related items that are secured directly to cold surfaces must be adequately insulated and vapor-sealed to prevent condensation.
6. Apply specified adhesives, mastics and coatings at the manufacturer's recommended coverage per unit volume.

C. Piping Insulation - Elastomeric:
1. Do not insulate until satisfactory completion of required pressure testing.
2. Apply insulation to clean, dry surfaces.
3. Slip insulation on pipe prior to connection.
   a. Whenever the slip-on technique is not possible provide insulation neatly slit and snapped over the pipe.
4. Fabricate and install fitting cover insulation according to manufacturer's recommendations.
5. Seal joints, slits, miter-cuts and other exposed edges of insulation with adhesive, recommended by the insulation manufacturer, to ensure complete vapor barrier.

D. Piping Insulation - Fiberglass:
1. Apply over clean dry pipe.
   a. Butt all joints together firmly.
2. Seal joints, slits, miter-cuts and other exposed edges of insulation as recommended by the insulation manufacturer.
3. Insulate fittings, valves, and flanges with insulation thickness equal to adjacent pipe.
4. PVC pipe jacket:
   a. Apply jacketing with a minimum of 1 IN overlap.

1) Weld longitudinal and circumferential seams with adhesives as recommended by manufacturer.

b. Provide slip-joints every 30 FT and between fittings if distance exceeds 8 FT.
   1) Construct slip-joints by overlapping jacket sections 6 to 10 IN.

c. Provide pre-molded PVC covers of same material and manufacturer as jacket for fittings, valves, flanges, and related items in insulated piping systems.

5. Aluminum pipe jacket:
   a. Field-applied aluminum jacket with vapor-sealed longitudinal and butt joints.
   b. Provide smooth and straight joint with a minimum 2 IN overlap.
   c. Secure joints with corrosion-resistant screws spaced 0.25 to 0.50 IN back from edge.
   d. Center spacing of screws 5 IN maximum or as required to provide smooth tight-fitted joints.
   e. Place joints on least exposed side of piping to obtain neat appearance.

E. Equipment: Install per manufacturer's instructions.

3.2 REPAIR

A. Whenever any factory applied insulation or job-applied insulation is removed or damaged, replace with the same quality of material and workmanship.

3.3 SCHEDULES

1. Piping Insulation and Jacketing Schedule:

APPLICATION	PIPE SIZE	INSULATION MATERIAL	THICKNESS	JACKET
Domestic Cold Water, Located Outdoors and in Tunnel Level	All sizes	Fiberglass	1 IN	Aluminum
Domestic Hot Water (100 - 150 DEGF), Located Indoors	1-1/2 IN and less	Fiberglass	1-1/2 IN	PVC
	Over 1-1/2 IN	Fiberglass	2 IN	PVC
Refrigeration Suction Lines (35 - 60 DEGF)	All	Elastomeric	1 IN	Aluminum (Note 1)
NOTES:				
1) Aluminum jacketing is only required for exposed insulated refrigerant piping located outdoors, and indoor exposed insulated refrigerant piping within 8 ft of finished floor.				

END OF SECTION

SECTION 40 71 00
FLOW INSTRUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Flow Transmitters:
      a. Magnetic Flow Meters (Inline).

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
      b. A240, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
      c. B16.5, Pipe Flanges and Flanged Fittings.
      d. B626, Standard Specification for Welded Nickel and Nickel-Cobalt Alloy Tube.
      e. PTC 19.5, Application of Fluid Meters, Part 2.
   2. ASTM International (ASTM):
      a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
   3. American Water Works Association (AWWA).
   4. National Sanitation Foundation (NSF).
   5. US Department of Interior Bureau of Reclamation (USDIBR):
      a. Water Measurement Manual.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Submit manufacturer catalog cut sheets indicating technical specifications of flow devices, materials of construction, installation details, temperature and pressure ratings and acceptable velocity range for each device.

B. Operation and Maintenance Manuals:
   1. See Specification Section 01 33 00 and 01 33 04 for requirements for:
      a. The mechanics and administration of the submittal process.
      b. The content of Operation and Maintenance Manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the Articles describing the elements are acceptable.

2.2 FLOW TRANSMITTERS

A. Magnetic Flow Meters (Inline):
   1. Acceptable manufacturers:
      a. ABB (WaterMaster).
      b. Endress + Hauser (ProMag).
      c. Krohne (OPTIFLUX).
      d. Rosemount (8700 Series).
      e. Siemens (SITRANS F M).

2. Accessories:
3. Design and fabrication:
   a. Utilize characterized field principle of electromagnetic induction to produce signal directly proportional to flow rate.
   b. High input impedance pre-amplifiers.
      1) Minimum impedance: 10^{10} ohms.
   c. Provide type 304 stainless steel Class 150 flanged end connections per ASME B16.5. Meter body shall be rated to same pressure as the flanges.
   d. Provide polyurethane internal lining.
   e. Provide type 316 stainless steel electrodes.
   f. Grounding requirements:
      1) Nonmetallic or lined pipe:
         a) Inlet and outlet grounding rings of same material as electrode or as recommended by manufacturer to meet process requirements.
      2) Conductive piping:
         a) Conductive path between the meter and the piping flanges.
   g. Provide remote transmitter where noted on the drawings. Provide cable between flow meter and transmitter.
      1) Cable shall be potted and fitted by manufacturer at the factory.
   h. Pulsed DC magnetic field excitation.
   i. Automatic zero.
   j. Adjustable low flow cutoff.
   k. Minimum signal lock (empty tube zero) to prevent false measurement when tube is empty.
   l. Inaccuracy: ±0.4% of rate.
   m. 4-20 mA DC isolated output into maximum 800 ohms.
   n. Power supply: 117 V ±10%, 60 Hz.
   o. Indication of flow rate and totalized flow at transmitter.
   p. Meter operable as specified in liquids with 5.0 micro mho/cm or more conductivity.
   q. Transmitter electronics shall use microprocessor based architecture and be configured using parameters.

LOCATION	SERVICE	FLOW RANGE (GPM)	METER SIZE (IN)	NEMA (IP) RATING
PS-1, PS-2	Leachate drain water	50-100 gpm	3	4X

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

3.2 TRAINING

A. Provide on-site testing and training in accordance with Specification Section 01 75 00.

END OF SECTION

DIVISION 43

PROCESS GAS AND LIQUID HANDLING, PURIFICATION, AND STORAGE EQUIPMENT

SECTION 43 21 00
PUMPING EQUIPMENT - BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Pumping equipment.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 09 96 00 – High Performance Industrial Coatings.
   4. Section 01 61 03 – Equipment - Basic Requirements.
   5. Section 22 11 26 – Packaged Domestic Water Pressure Booster System.
   6. Section 43 23 77 – Pumping Equipment – Packaged Wastewater Pump Station.
   7. Section 43 24 05 – Vertically Suspended Centrifugal Pumps.
   8. Section 44 11 13 – Misting System.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ANSI/Hydraulic Institute (ANSI/HI):
      a. 9.6.3, Rotodynamic (Centrifugal and Vertical) Pumps – Guideline for Allowable Operating Region.
      b. 9.6.6, Rotodynamic Pumps for Pump Piping.
      c. 11.6, Rotodynamic Submersible Pump for Hydraulic Performance, Hydrostatic Pressure, Mechanical, and Electrical Acceptance Tests.
      d. 14.6, Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.

B. Pump/motor and VFD coordination: See Specification Section 01 61 03.

1.3 DEFINITIONS

A. The abbreviations used in this section are defined as follows:
   1. AOR: Allowable Operating Range.
   2. BEP: Best Efficiency Point.
   3. IPS: Iron Pipe Size.
   4. NPSH3: Net Positive Suction Head for 3 PCT head loss.
   5. POR: Preferred Operating Range.
   6. TDH: Total Dynamic Head.
   7. TEFC: Totally Enclosed Fan Cooled.
   8. VFD: Variable Frequency Drive.

B. Pump Service Category: Pump or pumps having identical names (not tag numbers) used for specific pumping service.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. See Specification Section 01 61 03.
   3. Product technical data including:
      a. Performance data and pump curves indicating flow (GPM), head (FT), horsepower, hydraulic efficiency, rotating speed (RPM), AOR, BEP, POR and NPSH requirements.
      b. Pump accessory data.
      c. Bearing supports, shafting details and lubrication provisions.

1) Bearing life calculations.
2) Critical speed calculations.

d. Solids passage information.

B. Contract Closeout Information:
1. Operation and Maintenance Data:
a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

C. Informational Submittals:
1. Certifications:
a. Provide a written statement that manufacturer's equipment has been installed properly, started up and is ready for operation by Owner's personnel.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Pumps:
a. See individual pump Specification Sections.
2. Mechanical seals:
a. See individual pump Specification Sections.

2.2 ACCESSORIES

A. Refer to individual pump system specification sections.

B. Each Unit:
1. Lifting eye bolts or lugs.
2. Plugged gage cock connection at suction and discharge nozzles.
3. Tapped and plugged openings for casing and bearing housing vents and drains.
4. Fittings for properly adding flushing lubricant.
5. Pressure relief fittings for grease lubrication.

2.3 FABRICATION

A. Pump Support:
1. Design base to support weight of drive, shafting and pump.
2. Comply with HI vibration limitations.
3. Mount horizontal pump, motor and coupling on single piece drip lip type baseplate.
4. Mount vertical pumps on single piece pedestal baseplate.
5. Fabricate to withstand all operating loads transmitted from the pump and drive.

2.4 SOURCE QUALITY CONTROL

A. Verification of primary design condition in POR.

B. Factory hydrostatic test all pumps at 150 PCT of shut-off head for a minimum of five minutes.

C. If specifically required in the individual pump specification sections, provide factory tests:
1. All pumps:
a. Head (FT) versus flow (GPM) pump curves:
1) Efficiencies along curve.
2) Brake horsepower along each curve.

D. Statically and dynamically balance each pump per ANSI/HI standards.

PART 3 - EXECUTION

3.1 INSTALLATION

A. See Specification Section 01 61 03.

B. Floor or Pad-Mounted Units (Non-Submersible):
   1. Align vertically and horizontally level, wedge and plumb units to match piping interfaces.
   2. Assure no unnecessary stresses are transmitted to equipment flanges.
   3. Tighten flange bolts at uniform rate and manufacturer's recommended torque for uniform gasket compression.
   4. Support and match flange faces to uniform contact over entire face area prior to bolting pipe flange and equipment.
   5. Permit piping connecting to equipment to freely move in directions parallel to longitudinal centerline when and while bolts in connection flange are tightened.
   6. Assemble connecting piping with gaskets in place and minimum of four bolts per joint installed and tightened.
      a. Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange.
      b. Realign as necessary, install flange bolts and make equipment connection.
   7. Provide pressure gage, visible from grade or operating floor, on discharge of all pumps and on suction and discharge of all non-submersible units.

C. Submersible Units:
   1. Assemble connecting piping with gaskets in place and minimum of four bolts per joint installed and tightened.
      a. Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange.
      b. Realign as necessary, install flange bolts and make equipment connection.
   2. Provide discharge pressure gage visible from grade or operating floor.

3.2 FIELD QUALITY CONTROL

A. Provide services of equipment manufacturer's field service representative(s) to:
   1. Inspect equipment covered by this Specification Section.
   2. Supervise pre-start adjustments and installation checks.
   3. Conduct initial start-up of equipment and perform operational checks.
   4. Instruct Owner's personnel for the specified minimum number of hours at the jobsite on operation and maintenance of each pumping system. Refer to the individual equipment specification sections for the minimum time required for training.

END OF SECTION

SECTION 43 23 77

PUMPING EQUIPMENT - PACKAGED WASTEWATER PUMP STATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes specifications for a packaged wastewater pump station which includes the following components:
   1. Submersible pumps.
   2. Fiberglass wetwell.
   3. Rail system to lift/lower pumps.
   4. Interconnecting piping within the basin.
   5. Valves.
   6. Float Switches.
   7. Control Panel.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 01 61 03 - Equipment - Basic Requirements
   4. Section 09 96 00 – High Performance Industrial Coatings.
   5. Division 26 - Electrical.
   6. Division 40 - Process Interconnections.
   7. Section 43 21 00 - Pumping Equipment - Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Iron and Steel Institute (AISI):
      a. Steel Products Manual.
   2. American National Standard Institute (ANSI).
      a. B16.3, Malleable Iron Threaded Fittings, Classes 150 and 300.
      b. B16.5, Pipe Flanges and Flanged Fittings.
   3. American Society for Testing and Materials (ASTM):
      a. A48, Standard Specification for Gray Iron Castings.
      b. D3299, Specification for Filament-Wound-Glass Fiber-Reinforced Thermoset Resin Chemical-Resistant Tanks.
      c. D3753, Specification for Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Manholes and Wetwells.
      d. D4097, Specification for Contact Molded Glass-Fiber-Reinforced Thermoset Resin Chemical-Resistant Tanks.
      e. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   4. Factory Mutual (FM).
   5. Hydraulic Institute Standards for Centrifugal, Rotary and Reciprocating Pumps (HI).
   6. National Electrical Manufacturer's Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. ICS 6, Enclosures for Industrial Controls.
   7. National Fire Protection Agency (NFPA):
      a. 70, National Electrical Code (NEC).
   8. Underwriters Laboratories, Inc. (UL).

B. Qualifications:
   1. Manufacturers shall be regularly engaged in the manufacture and assembly of packaged pumping stations for not less than five (5) years.

2. Structural design of the wet well shall be accomplished by a structural engineer registered in the state where the Project is located.

C. Single Source Responsibility:
   1. Provide single source responsibility for all pump station components and systems. All components of the pump station shall be furnished through a single supplier.

1.3 SYSTEM DESCRIPTION

A. The package wastewater pump station shall consist of the following major components:
   1. Self-contained fiberglass wetwell.
   2. Process equipment: Duplex submersible pumps, with non-clog vortex impellers.
   3. Interior piping, valving and pipe supports.
   4. Rail removal system to lift/lower pumps onto discharge piping.
   5. Electrical and control system:
      a. Pump control panel, including motor starters, circuit breakers, control transformers, relays, terminal strips, electrical and control wiring, conduit, lights and switches.
      b. Submersible float switches.
      c. Interconnecting wiring and conduit between field-installed panel and equipment shall be installed by the Division 26 Contractor.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Submit product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's delivery, storage, handling and installation instructions.
      c. Clearly identify all optional accessories that are included with the packaged system.
      d. Acknowledgement that products submitted comply with the requirements of the standards referenced.
      e. Shipping and operating weight.
      f. Manufacturer performance data for pumps including pump curves indicating flow (gpm) vs. pump head (ft), operating horsepower, motor horsepower, pump speed and efficiency.
      g. Manufacturer spec sheets for pumps indicating pump type, model number, electrical requirements and materials of construction.
      h. Manufacturer data for the fiberglass wetwell including:
         1) Methods and materials of construction, applied linings and/or coatings, lid type, and manufacturer installation instructions.
         2) Physical dimensions of the well including diameter, depth, wall thickness, pipe connection sizes, and size of manway or access hatch.
         3) Indicate accessories to be provided, including rail removal system.
      i. Manufacturer data sheets for all electrical and control components including control panel and float switches.
      j. Electrical and control wiring diagrams.
      k. Interior and exterior panel elevations.
      l. Provide written sequences of operation.
      m. Equipment factory primer and paint data.
      n. Manufacturers recommended spare parts list.
      o. Equipment lining and coatings.
      p. Equipment power requirements.
   3. Operation and Maintenance Manual:
      a. See Specification Section 01 33 04 for requirements for the contents of the Operations and Maintenance Manual.

1.5 ENVIRONMENTAL CONDITIONS

A. The wetwells will receive contact drain water and storm water from the new Transfer Station Building and the existing PRA building. The wetwell will not receive solid sanitary waste from toilets or bathrooms. However, solid debris in the form of trash from the dump trucks (such as wood, plastic or rubber) could make its way into the drainage system and into the wetwells. Pumps furnished under this section shall be of a vortex style or non-clogging design to allow the passage of solid debris to minimize the risk of clogging or pump failure.

1.6 WARRANTY

A. The manufacturer will warrant against any defects in material or workmanship for the equipment included under this specification section. This warranty will commence upon delivery of the products and will expire two (2) years from substantial completion of the installation of the product.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Packaged Pump Station Suppliers:
      a. Triple D Pump Company.
      b. Weil Pumps.
      c. Zoeller Pump Company.
      d. Or equal.
   2. Pump Manufacturers:
      a. HCP Pumps.
      b. Homa Pump Technology.
      c. Weil Pumps.
      d. Flygt.
      e. Zoeller Pump Company.
      f. Or equal.

2.2 EQUIPMENT

A. Submersible Vortex Pumps.
   1. Impeller: Vortex, non-clogging design, bronze or cast iron construction.
   2. Capable of passing spherical solids up to 2-inch in diameter.
   3. Drive type: Constant speed. Impeller coupled directly to the motor shaft and direct-driven by a single, one piece shaft.
   4. Double mechanical seals: Silicon carbide or ceramic.
   5. Pump casing: Cast iron, epoxy coated 8-10 mils nominal dry thickness.
   6. Hermetically sealed oil-filled motor compartment.
   7. Motor shaft: Stainless steel
   8. Motor Protection: Thermal overload with automatic reset.

B. Design criteria for each pump station is noted in the following schedule:

PUMP STATION SCHEDULE			
TAG NO.	PS-1	PS-2	PS-3
PUMP TAG NO.	SP-1, SP-2	SP-3, SP-4	SP-5, SP-6
TYPE	DUPLEX	DUPLEX	DUPLEX
PUMP FLOW (GPM OF EACH PUMP)	90	50	50
TDH (FT)	45	65	55

WET WELL DIAMETER (FT)	4'-0"	4'-0"	4'-0"
WET WELL DEPTH (FT)	12'-0"	16'-0"	16'-0"
PUMP MOTOR (HP)	5	5	5
MOTOR RPM	3450	3450	3450
ELECTRICAL (V/PH)	460/3	460/3	460/3
SERVICE	STORM WATER	CONTACT DRAIN WATER FROM NEW TRANSFER STATION BLDG	CONTACT DRAIN WATER FROM EXISTING PRA BLDG
NOTES: 1) PROVIDE HS-20 TRAFFIC RATED LID FOR EACH WET WELL. 2) PROVIDE CONTROL PANEL AND FLOAT SWITCHES FOR AUTOMATIC LEAD/LAG OPERATION OF EACH PUMP STATION.			

2.3 VALVES

A. Provide a rubber flap type check valve with cast iron body and full-port passageway on the discharge of each pump. Refer to Specification Section 40 05 66.

B. Provide a full port ball valve on the discharge of each pump for isolation. Refer to Specification Section 40 05 63.

C. Valves shall be located outside of the wetwell in a separate valve box, such that Operations staff does not need to enter the well to access the valves.

2.4 FIBERGLASS REINFORCED WETWELL

A. Wetwell design, fabrication and testing shall comply with ASTM D3753 and ASTM D3299.

B. Fiberglass reinforced wetwells shall be manufactured from commercial grade unsaturated polyester resin or vinyl ester resin, with fiberglass reinforcements. The resin system shall be suitable for atmospheres containing low concentrations of hydrogen sulfide and dilute sulfuric acid as well as other gases associated with wastewater collection systems.

C. Reinforcing materials shall be commercial Grade “E” type glass in the form of mat, continuous roving, chopped roving, roving fabric or a combination of the above, having a coupling agent that will provide a suitable bond between the glass reinforcement and the resin.

D. If reinforcing materials are used on the surface exposed to the contained substance, it shall be a commercial grade chemical-resistant glass that will provide a suitable bond with the resin and leave a resin rich surface.

E. The exterior surface shall be relatively smooth with no sharp projections. Handwork finish is acceptable if enough resin is present to eliminate fiber show. The exterior surface shall be free of blisters larger than 1/2 inch in diameter, delamination and fiber show. For a UV inhibitor the resin on the exterior surface of the manhole shall have gray pigment added for a minimum thickness of 0.125 inches.

F. The interior surface shall be resin rich with no exposed fibers. The surface shall be free of grazing, delamination, and blisters larger than 1/2 inch in diameter, and wrinkles of 1/8 inch or greater in depth.

G. Installation of Stubouts:
   1. Effluent, service, or discharge lines may be factory installed. Approved methods are PVC sewer pipe, Inserta-Tee fittings, or Kor-N-Seal boots. Installation of stubouts shall be completed using fiberglass layup complying with ASTM-D3299 specifications.

H. Flanged Piping Connections:
   1. Conically gusseted to tank, withstand 1,500 LBS bending, 2,000 FT/LBS torque.
   2. Flange diameter and drilling per ANSI B16.5, for 150 lb pressure class.

3. Offset flange face at least 4 IN from outside tank surface.
4. Same material as tank.
5. Location and sizes as shown on Drawings.

I. Provide lifting lugs or handles on the outside of the wetwell for installation or removal.

J. Factory installed anchor studs inside the basin for mounting the rail removal system.

K. Cover:
1. Lid must have HS-20 traffic rating.
2. Lockable access hatch with heavy duty stainless steel hinges for removing pumps.
3. 24-inch x 24-inch minimum manway size with steel lid.

L. Wetwell shall be vented with a mushroom cap or gooseneck type vent with insect screen.

M. All hardware shall be stainless steel.

N. Defects Not Permitted:
1. Exposed fibers: glass fibers not wet out with resin.
2. Resin runs: runs of resin and sand on the surface.
3. Dry areas: areas with glass not wet out with resin.
4. Delamination: separation in the laminate.
5. Blisters: light colored areas larger than 1/2 inch in diameter.
6. Crazing: cracks caused by sharp objects.
7. Pits or Voids: air pockets.
8. Wrinkles: smooth irregularities in the surface.
9. Sharp projection: fiber or resin projections necessitating gloves for handling.

O. Wetwell testing shall be performed as specified in ASTM-D3753, the latest edition.

2.5 PIPING

1. Discharge Piping:
   a. Schedule 80 PVC per ASTM D1785.
   b. Fittings:
      1) Pipe sizes 2” and less: Socket type, ASTM D2467, Schedule 80.
      2) Pipe sizes 2-1/2” and greater: Socket type or flanged ANSI Class 150.
   c. Solvent: ASTM 2564.
   d. Primer: ASTM F656.
   e. Refer to Specification Section 40 05 31 for additional detail.

2.6 ACCESSORIES

A. Provide stainless steel guide rails, mounting brackets and lifting mechanism for each pump, such that pumps can be removed without entering the wetwell.

B. Provide quick disconnects on discharge piping between pump and connection to force main to allow ease of pump removal.

2.7 CONTROLS

A. Provide a control panel with the packaged pump station for automatic control of the duplex pumps based on liquid level within the basin.

B. Pump operation shall be automatically controlled by multiple float switches set at different elevations within the wetwell. Refer to the Drawings for sequences of operation.

C. The control panel shall include the following features and components:
1. NEMA 4X enclosure for outdoor installation, UL-listed for wall or pole mounting.
2. Hinged, lockable access cover.
3. Mounting hardware.
4. Entry hub for wiring at bottom of panel.
5. Magnetic starter for each pump.
6. Motor overload protection.

7. Numbered terminal strips for connecting pump and float switch wiring.
8. Control transformer and fusing for low voltage controls.
9. Panel ON/OFF disconnect.
10. HAND-OFF-AUTO switch for each pump.
11. Alternating mechanism that alternates the LEAD pump after each operating cycle.
12. Pump RUN light for each pump that illuminates when the respective pump is running.
13. Alarm contacts for high water level alarm.
14. LED alarm light for each pump.
15. Audible alarm horn.
16. Manual alarm reset pushbutton.

D. Variable Level Float Switches:
   1. Provide float switches for: pump stop, lead start, lag start and high liquid level alarm.
   2. Constructed of PVC or polypropylene casing around the switch.
   3. Switching action operates on approximately 1/2" liquid level differential.

E. Length of cable connecting the pumps and float switches to the control panel shall be coordinated with the final location of the control panel. Splicing of this cable is not allowed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the package pump station and control panel in the location designated on the Drawings.

B. Install backfill in accordance with the wetwell manufacturer recommendations and Division 31 specifications.

C. Connect and seal the drain inlet and discharge lines to the wetwell.

D. Install the control panel at a height of 4 FT above finished grade. Panel shall be free standing. Coordinate location of the panel with the Electrical Contractor.

E. Install conduit and wiring from the control panel to the submersible pumps and float switches in accordance with Division 26 specifications and electrical drawings.

F. Install the wetwell, submersible pumps, controls, piping and appurtenances per the manufacturer's instructions. Provide a written statement from the manufacturer's qualified representative that the installation was performed properly and the system is ready for operation.

3.2 STARTUP AND TESTING

A. The pumps and control systems shall be tested to ensure proper operation and compliance with the specifications, control sequences and manufacturer instructions. Acceptance testing shall be completed to the satisfaction of the Engineer and Owner's representative.

B. The Engineer and Owner's representative reserve the right to witness final acceptance testing and shall be notified a minimum of 48 hrs prior to conducting testing of each pump station.

C. An Owner's representative must be present to witness testing of each system in order to obtain final acceptance.

D. The Contractor shall obtain water for testing. The Contractor shall abide by all requirements for metering and cross connection protection of potable water supply systems. It is the Contractor's responsibility to transport water to the pump station for testing.

E. Provide the services of a qualified factory-trained representative for a period of 3 hours to instruct Owner's personnel in the proper operation and maintenance of the pump stations.

F. The wetwell cover shall be installed and securely fastened to the top of the wetwell.

END OF SECTION

SECTION 43 24 05
VERTICALLY SUSPENDED CENTRIFUGAL PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Vertically suspended centrifugal pumps, also termed "vertical turbine well pumps", configured as required in this Section and as shown on the Drawings.

B. Related Sections include but are not necessarily limited to:
   1. Section 01 61 03 - Equipment: Basic Requirements.
   2. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.
   3. Section 43 21 00 - Pump Equipment - Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
   2. American Iron and Steel Institute (AISI)
      a. 1045 Medium Carbon Steel

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. See Section 40 05 00.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

1.4 WARRANTY

A. The pump, motor, and drive manufacturer to warrant the equipment against defects in workmanship and materials for a period of one year from the date of substantial completion.

B. Warranty document to be issued by manufacturer and submitted by Contractor prior to final acceptance of the project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Floway.
   2. Flowserve.
   3. Byron Jackson.
   4. Layne-Bowler.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. Performance Parameters:
   1. Well Pump (WP-1):

a. Primary design conditions: 40 GPM at 715 FT TDH and 80% efficiency.
b. Maximum speed: 1200 RPM.
c. Maximum horsepower: 10 HP.
d. Minimum shutoff condition: 0 GPM at 750 FT.
e. Column size: 6 IN.
f. Discharge flange: 2 IN.

B. Provide pumps with increasing head characteristics from secondary design conditions to shutoff condition. Provide pumps with net positive suction head requirements (NPSHR) less than the net positive suction head available (NPSHA) at all operating conditions.

2.3 ACCESSORIES

A. See Section 01 61 03 and Section 43 21 00.

2.4 COMPONENTS

A. General:
1. Furnish units consisting of a vertical shaft submersible turbine pump, direct connected to a vertical hollow shaft submersible motor. Design unit with non-reversing ratchets.
2. Weight of revolving parts of pump including unbalanced hydraulic thrust of impeller is carried by thrust bearing in driver.
3. Make provision at driver shaft for adjusting impeller with reference to bowls.
4. All connecting hardware for all components to be Type 316 stainless steel, unless noted otherwise.

B. Column:
1. Construct discharge column pipe of steel and supply with threaded connections conforming to ASTM A120 or ASTM A53 Grade B.
2. Provide top and bottom sections of column pipes to 5 FT lengths.
3. Provide intermediate column sections not exceeding 10 FT in length.
4. Abrasive blast column and coat with a minimum 15 mils dry film thickness epoxy system at the factory.
5. Provide coating recommended by Tnemec or Koppers and approved for use with potable water.

C. Open Line Shaft:
1. 416 stainless steel, rolled and ground.
2. Maximum length: 10 FT.
3. Furnish renewable shaft sleeves constructed from 416 stainless steel at each bearing location.
4. Undercutting of shafting at sleeve locations is not permitted.
5. Provide rubber bearings at each column connection supported by retainers butted between machined faces of discharge column.
6. Provide line shaft pre-lubrication system to water lubricate line shaft bearings prior to pump startup.
7. Bearing spacing shall be such that pump will not operate in a shaft critical speed.

D. Pump Bowl and Suction Bell:
1. Provide bowl and suction bell constructed of close grained cast iron, free from imperfections and accurately machined and fitted.
2. Coat pump bowl water passages with an abrasion-resistant baked enamel, phenolic or epoxy.
3. Provide coating suitable for potable water service.
4. Design to ensure easy removal of bearings and impeller.
5. Furnish suction bell with flared end to reduce entrance losses and with a sufficient number of vanes to support lower guide bearings and weight of impeller and pump shaft when dismantling pump.

E. Bearings:

1. Provide units with sleeve bearings of SAE 660 bronze in each bowl and in suction bell.
2. In bowl, provide main bronze bearing immediately above impeller and a lower bronze bearing immediately below impeller.
3. Provide for lubrication of bowl bearings with pumped liquid.
4. Furnish suction bell bearing having minimum length equal to five shaft diameters.
5. Ensure bell bearing is permanently packed type with packing to be a non-soluble grease.
6. Provide SAE 40 bronze collar for bell bearing to prevent abrasives from entering bearing.
7. Furnish double sleeve bearings in strainer.

F. Pump Shaft and Impeller:
1. Provide pump unit shaft constructed of rolled and ground 416 or 410 stainless steel.
2. Furnish enclosed type impellers constructed of bronze and securely attached to impeller shaft.
3. Ensure impeller is accurately fitted and statically and dynamically balanced.
4. Provide bronze replacement wear rings in each bowl to prevent wear on bowls.

G. Suction Strainer:
1. Supply basket type strainer constructed of stainless steel with net open area of not less than four times the throat area of the suction bell.
2. Maximum opening shall not be more than 75% of the minimum opening of the water passage through the bowls and impellers.

H. Motors:
1. Submersible type rated for continuous underwater operation.
2. 208V, 60 HZ, 3 PH.
3. 1.15 service factor.
4. Size motor to drive pump continuously over the complete head - capacity range without the load exceeding the nameplate rating.
5. Premium efficiency.
6. Water-filled, lubricated, and cooled type fitted with a segmented plate-type thrust bearing capable of continuous down thrust.
7. Motor leads shall be protected by a galvanized steel cable guard for the entire bowl length.
8. Comply with Section 01 61 03.

I. Power and control cable:
1. The power cable shall be sized such that the voltage drop will not exceed 5 percent at the motor rated full load current voltage. Cables shall be designed specifically for submersible pump service and shall consist of three individual conductors individually insulated and the whole covered with an outer jacket. Furnish wire power cable sized per manufacturer's recommendations and of length sufficient to reach the junction box on the top of the casing at the ground surface, and one additional foot for each 50 FT of total pump setting to compensate for possible twist or sag during installation.

J. Level Switch:
1. Provide low level cutout switch installed with pump.
2. Provide control cable.

K. Control Panel:
1. Furnish and install locally mounted control panel at location shown on Drawings and rated NEMA 4X, 316 Stainless steel.
2. Control panel shall be labeled by an approved organization and such as UL or ETL
3. Provide combination magnetic motor starter(s) with Motor Circuit Protector (MCP) type circuit breaker, NEMA full size contactor with three overload relays and control power transformer (CPT) with two fuses on the primary side and one fuse on the secondary side, for 120VAC control circuits.
4. Include a terminal board for connection of level sensors.
5. Provide the following features:
6. NEMA 4X stainless steel watertight enclosure with continuous hinge, neoprene gasket in cover and continuous seam weld. Include locking mechanism complete with padlock.

7. Hand-Off-Automatic selector switches.
8. Pump running light. See Specification Section 26 24 19 for running light colors.
9. Elapsed time meter.
10. Overload reset button to reset overload relays.
11. Transient Voltage Surge Suppression (TVSS):
12. UL 1449 listed.
13. Maximum lead length 6 IN.
14. Condensation heater.
15. Moisture detector alarm light and pump shutdown.
16. Motor over-temperature alarm and shutdown.
17. 120V, 20 AMP duplex outlet.
18. Float switch test pushbuttons.
19. Auxiliary contacts wired to terminal blocks.
20. Power ON control relay.
21. Remote telemetering contact.
22. Inner door in cabinet-mounted on a continuous vertical steel hinge; size to completely cover wiring and components mounted on the back panel; provide for mounting of controls and instruments on inner door.
23. Pedestal mounting.
24. Connect run and stop signals from the local RTU. RTU to be installed on the back side of the well pump control panel. The RTU will provide a signal from a remote tank to start and stop the well pump, automatically. Refer to typical control wiring diagram in contract drawings.
25. Provide pump protection module as specified on contract drawings. Provide with current transformers to work with the protection module.

2.5 MAINTENANCE MATERIALS

A. Extra Materials:
   1. Furnish the Owner the following extra parts for each pump service category:
      a. Provide (1) submersible motor assembly with motor leads.
      b. Provide (1) complete bowl assembly.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with Section 43 21 00.

B. Install products in accordance with manufacturer's instructions.

3.2 FIELD QUALITY CONTROL

A. See Section 43 21 00.

END OF SECTION

DIVISION 44

POLLUTION AND WASTE CONTROL EQUIPMENT

SECTION 44 11 13
MISTING SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Provide a complete and operational dust suppression system, including the following components:
      a. Atomized spray nozzles.
      b. Water filtration system.
      c. Piping, valves, and appurtenances.
      d. Misting Pumps.
      e. System controls.
      f. Miscellaneous accessories.

B. Related Sections include but are not necessarily limited to:
   1. Division 01 - General Requirements.
   2. Section 01 61 03 - Equipment - Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. A48, Standard Specification for Gray Iron Castings.
   2. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).

B. Qualifications:
   1. The misting systems supplier shall have at least five (5) years experience in the manufacture of dust control equipment, according to these general design concepts, and can provide evidence of continued successful operation with limited maintenance, limited replacement of parts, and a good record of acceptance by operators at other installations.
      a. The manufacturer shall have a least five (3) similar dust control systems in operation for at least two (2) years.
      b. Submit qualifications in Article 1.4.
   2. The manufacturer shall have available a local factory authorized service representative for service, emergency repair, and warranty work. Provide contact information including name, address, and phone number of local representative.

1.3 SYSTEM DESCRIPTION

A. The misting system shall control dust emission due to unloading, sorting, pushing and loading of municipal solid waste inside the Transfer Station.

B. Refer to the Drawings for locations of dust suppression zones and individual equipment.

C. Misting System manufacturer will be responsible for complete coordination of all equipment, piping, controls and conduit and wiring required for a complete system.
   1. The misting system may include but is not limited to the following items:
      a. Misting pump skids.
      b. Water filtration and water treatment equipment (if required).
      c. PH and ORP sensors and meter-controllers.
      d. Air compressor for system blowdown.
      e. Control panel(s).
      f. Pipes, valves, nozzles and other various fittings.
      g. Supports and attachments for piping, tubing, fittings and nozzles to structure.

D. The misting system supplier shall review the Contract Drawings and this Section of the Specifications to assure all equipment necessary for a fully operational system is provided.
   1. If additional equipment, piping, controls, conduit and wiring or miscellaneous items are required above those shown or specified, manufacturer shall design, furnish, and install such equipment.
   2. Additional equipment piping, controls, conduit and wiring or miscellaneous items required must be of a quality that is at least equal in terms of materials and efficiency as specified herein.

E. A Control Panel shall be provided with the misting system that allows for automatic or manual control of the misting system. Refer to drawings for control panel location.
   1. The misting system serving the building shall be divided up into separate zones to allow the operator to control the mist that is provided to different areas of the building.
   2. Each zone shall be provided with manual or automatic control. When in automatic mode, misting to the zone shall be provided based on programmable timer operated switches.
   3. The Operators shall be able to turn on/off the misting system serving each zone manually.
   4. Selector switches shall be provided accessible from the exterior of the panel for manual or automatic control with visual indication of system settings.
   5. A “Winter” switch shall be provided that activates the air compressor and air purge sequence when the system is shut down to avoid freezing of pipes and components. When this Winter switch is off, the air purge sequence shall be deactivated.

F. A remote Zone Control Panel shall be provided for operators to activate the misting system remote from the Main Control Panel. The remote control panel shall be equipped with manual on/off/auto switches for each zone.

G. All components of the misting system shall be furnished through a single supplier.

1.4 SUBMITTALS

A. Submittal Procedures: See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

B. Approval Submittals:
   1. Product data:
      a. Manufacturer's technical data and performance information on all equipment proposed including pumps, filters, piping, nozzles, compressed air system and control systems.
   2. Dimensioned to-scale drawings of piping systems, control panels, pump skids, filtration, air compressor, supports, and other equipment used.
      a. See Drawings for dimensional limitation of misting equipment area within the mechanical room.
      b. Provide details for tubing connection, fittings, nozzles and fabrication.
   3. Schematic Drawings to include itemized components, flow rates, pump horsepower, operating pressures, control panels and equipment tag numbers.
   4. Provide detailed information on the compressed air system including:
      a. Air compressor cut sheets, performance information and electrical power requirements.
      b. Provide to-scale layout drawings of compressed air system and pipe routing (at minimum scale of 1/8 INCH equals 1 FT).
   5. Control and power wiring diagrams.
   6. Ladder logic schematic control diagrams.
   7. Certifications: Qualifications cited in Paragraph 1.2B.
   8. It is the responsibility of the Contractor to review/conduct water quality testing deemed necessary to provide a functioning system.
      a. Contractor to provide documentation stating that the standard water filtration method with no further water treatment (including softening) of Paragraph 2.3.A.5 is acceptable for their system or provide recommendation of alternative water treatment.

C. Closeout Submittals:
   1. Operation & Maintenance (O&M) Manual Content: Provide O&M manual documentation as required by Division 01.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Fogco.
   2. MicroCool.
   3. MistAmerica.
   4. Big Fogg.
   5. BryCo Systems.
   6. Or approved equal.

B. Submit request for substitution in accordance with Specification Section 01 25 13 – Product Substitutions.

2.2 MATERIALS

A. As described in Article 2.3.

2.3 COMPONENTS

A. System Pumps and Components:
   1. Pumps:
      a. All pumps shall be mounted on common skid.
      b. Skid shall have a single electrical power supply termination points for all pumps and auxiliaries.
      c. Pump body shall be brass or cast iron, ASTM A48, Class 25.
      d. Stuffing box shall be cast iron, ASTM A48, Class 25.
      e. Shaft shall be steel with a minimum of 125,000 PSI yield strength.
      f. Pump shall be positive displacement or other type capable of meeting the design and system requirements, as well as the requirements of ASTM and locally enforced code.
      g. Provide totally enclosed motors, with motor shaft directly coupled to the pump.
      h. Provide an automatic high pressure safety shutoff switch.
      i. Base shall be fabricated steel, factory coated for corrosion protection.
      j. Pump performance and configuration requirements:
         1) Pumps shall be rated at 1,000 PSI.
         2) Pumps: 480V, 3PH, 60 Hz.
         3) Total pump flow rate provided shall be based on all misting zones operating simultaneously. The pump(s) may operate on VFD's such that they can efficiently meet part load demand, if less than the maximum number of zones are operating at any given time.
         4) Pumps operating with VFD's shall be designed such that the pump's speed does not drop below pump manufacturer's recommended minimum continuous speed.
         5) Pump flow rate shall be based on the following, or manufacturer's recommended nozzle flow rate may be submitted for approval, nozzle spacing and line spacing whichever is greater:
            a) Drop-Off Area:
               (1) Nozzle flowrate: 0.025 GPM to 0.036 GPM per nozzle.
               (2) Nozzle spacing: 10 FT OC.
               (3) Line spacing (maximum): 10 FT.
            b) Loadout Area:
               (1) Nozzle flowrate: 0.025 GPM to 0.036 GPM per nozzle.
               (2) Nozzle spacing: 5 FT OC.

(3) Line spacing (maximum): 5 FT.

k. Pressure gauges:
   1) 2-1/2 IN dial-type with type 304 stainless steel casing and scales to match operating pressures.
   2) Accuracy: 1 PCT of scale range, with recalibration screw in face of dial.

2. Tubing and Fittings:
   a. Tubing:
      1) Piping shall be 304 stainless steel.
      2) Wall thickness suitable for 3,000 PSI working pressure.
      3) Minimum burst pressure of 6,000 PSI.
      4) Supports:
         a) Type 304 stainless steel cable and tubing attachment clamps.
   b. Fittings:
      1) 304 stainless steel, double ferrule type.
      2) 3,000 PSI working pressure.
   c. Pump discharge shall use flexible line to connect to stainless steel header.
      1) Flexible line, nylon core with a spiraled fiber reinforcement and black urethane cover with stainless steel end connections.
         a) Minimum pressure rating: 1,500 PSI.
3. Valves:
   a. Provide isolation valves on each pump suction and discharge.
   b. Check valve balls shall be solid neoprene.
   c. Valve seats shall be stainless steel.
   d. Body shall be fabricated steel.
4. Atomization Nozzle:
   a. Droplet size range: 5 microns to 20 microns.
   b. Anti-drip, cleanable, corrosion and scale resistant.
   c. Material: 304 stainless steel.
   d. Use quick disconnect/nondestructive stainless steel compression fittings.
      1) Provide 5 PCT of total spare nozzles and mounting fittings for field replacement.
5. Water Filtering System:
   a. Base:
      1) Stainless steel industrial filter, 5 micron and 1 micron cartridges in series.
   b. If Misting System Vendor determines that base filtration does not provide adequate filtration based on local water quality, Vendor is responsible for proposing an alternative water treatment that would meet their system's required quality.

B. Main Control Panel:
1. Floor or wall or skid mounted.
2. Provide pump motor starters and VFDs within the panel or at the pump skids. Provide thermal overloads to protect the motors.
3. Provide control transformers as required for low voltage controls.
4. Provide fusing or circuit breakers on the power supply to the panel and on all control circuits.
5. Provide numbered terminal strips for connecting equipment and control wiring.
6. Pressure gages for panel mounting:
   a. 2-1/2 IN dial-type.
   b. Accuracy: 1 PCT of scale range, with recalibration screw in face of dial.
7. Status lights:
   a. Full voltage type, 120 V.
   b. Include equipment on and fault lights.
   c. Push-to-test.
   d. Heavy duty, oil tight for unclassified areas.
   e. Heavy duty, NEMA 4X for corrosive and wet areas.
   f. Lens color as specified.
8. Selector switches:

a. Full voltage type, 120 V.
b. Knob-operated.
c. Two or three-position and number of contact blocks as required.
d. Maintained contact.
e. Heavy duty, oil tight for unclassified areas.
f. Heavy duty, NEMA 4X for corrosive and wet areas.

9. Panel enclosures:
   a. NEMA 12 for unclassified areas with hinged door.
   b. NEMA 4X for corrosive and wet areas with hinged door.
      1) Furnish enclosures with windows for panels requiring gages.
10. Interconnecting conduit and wiring shall be installed in accordance with Division 26 specifications.

C. Remote Control Panel:
1. Floor or wall mounted.
2. Selector switches:
   a. Full voltage type, 120 V.
   b. Knob-operated.
   c. Two or three-position and number of contact blocks as required.
   d. Maintained contact.
   e. Heavy duty, oil tight for unclassified areas.
   f. Heavy duty, NEMA 4X for corrosive and wet areas.
3. Panel enclosures:
   a. NEMA 12 for unclassified areas with hinged door.
   b. NEMA 4X for corrosive and wet areas with hinged door.
      1) Furnish enclosures with windows for panels requiring gages.
4. Interconnecting conduit and wiring shall be installed in accordance with Division 26 specifications.

2.4 ACCESSORIES

A. Programmable timer switches for automatic operation of the misting system zones based on an operating schedule (operator adjustable).

B. Hour/meter indicates system use times for service, maintenance and oil changes.

C. Compressed Air System:
1. Rotary screw compressor with receiver tank, interconnecting piping and purge sequence solenoid valves.
2. Compressed air system piping shall be same material as the misting system piping.
3. The air compressor shall be controlled by the Misting System Control Panel. When the system is in WINTER mode, the Misting System Control Panel shall enable a purge sequence when the misting system is shut off, such that any remaining water in the piping and nozzles of all zones is purged as a form of freeze protection.
4. When the system is not in WINTER mode, this purge sequence shall be disabled.
5. The air compressor shall be sized to provide adequate pressure and flow to completely blow out the entire connected misting piping system.

D. Electric Zone Valve(s):
1. 1200 PSI minimum allowable pressure rating, normally open.
2. 120 VAC coil rating.
3. Two-position electric zone valves shall be controlled by the Misting System Control Panel to open when a zone is activated.

E. Drain Valves:
1. Provide manual drain valves at each pump skid and at low points in system piping.

2.5 FABRICATION

A. Control Panels:
   1. Surface mount switches and status lights such that they are accessible and visible from the exterior of the panel.
   2. Label all panels, switches and lights with their corresponding function or tag number.

2.6 SOURCE QUALITY CONTROL

A. Hydrostatic Test:
   1. Hydrostatically test each pump and misting piping system at 125 PCT of rated discharge pressure.
      a. Provide documentation of successful pressure test.

2.7 MAINTENANCE MATERIALS

A. Furnish the Owner's Representative with the following extra parts for each pump service category:
   1. One (1) set of replacement seals.
   2. One (1) set of replacement ball seats and ball bearings.

B. Five-Micron Water Cartridges: 24.

C. One-Micron Water Cartridges: 24.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install dust suppression system in accordance with manufacturer's recommendations. Provide complete misting coverage of the dust suppression zones as noted on the drawings.

B. Piping and Equipment - General:
   1. Utilize template for location of unit anchorage.
   2. Align, level, wedge and plumb units to match piping interfaces as shown on Contract Drawings.
   3. Prefabricate all stainless steel branch lines with nozzle bushings robotically welded to argon purged tubing as required by system design.
   4. System shall automatically drain / blow out when shutoff.
      a. Provide compressed air system to blow out system completely when shutoff.
         1) Compressed air system shall have the ability to independently blow out completely each zone individually as the zones are shutoff.
   5. Tubing support to include isolation-type clamps, threaded cushion-type hangers and/or stainless steel cabling.
   6. Install pump skids in location as shown on Drawings.
   7. Install pump skids and floor mounted equipment on concrete pads.
   8. Install control panels located as shown on Drawings so visual observation and necessary adjustments can be made from floor level.
   9. Provide permanent label for each line and pump to indicate which zone it feeds.

3.2 FIELD QUALITY CONTROL

A. Manufacturer's Services:
   1. A manufacturer's representative for the equipment specified herein shall be present at the jobsite and classroom designated by the Owner's Representative for the minimum man-day(s) listed below for work under this Section, travel time excluded:
      a. Pre-demonstration services, inspection and certification of installation:
         1) 8 HRS.
      b. Instruct Owner's personnel on operation and maintenance:
         1) 4 HRS.
      c. System testing:

1) Manufacturer shall provide to the Owner's Representative the results of:
    a) A nozzle flow test.
    b) Analysis of the droplet size.

2. A manufacturer's representative for the equipment specified herein shall inspect field assembled components and equipment installation, including piping and electrical connections.
    a. A manufacturer's representative must report results in writing including results for the following:
        1) Leak test:
            a) After installation of entire system, charge system and test for leaks.
                (1) All leaks must be repaired.
                (2) This test will be separate from hydrostatic test.
        2) Operational test:
            a) Observe all functions of the system.
                (1) All malfunctioning equipment must be repaired or replaced.
        3) Test all controls and safety appliances.
3. System must be flushed of any impurities prior to commissioning of the system.
4. A manufacturer's representative for the equipment specified shall be available for adjustment to systems post commissioning.
    a. If desired by the Owner's Representative, provide adjustment to the system (plugging / removal of nozzles, etc) so that the system provides the Owner's Representative's the desired level of misting.
    b. System Provider shall include one trip with a minimum of 16 HRS for field adjustment services.

END OF SECTION