STATE OF CALIFORNIA DEPARTMENT OF GENERAL SERVICES

REAL ESTATE SERVICES DIVISION
PROJECT MANAGEMENT AND DEVELOPMENT BRANCH

PROJECT MANUAL – Book II of III

SPECIFICATIONS

FOR:

DSH - COALINGA HYDRONIC LOOP REPLACEMENT

DEPARTMENT OF STATE HOSPITALS

COALINGA STATE HOSPITAL

COALINGA, FRESNO COUNTY, CALIFORNIA

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OCT 2024 000000000008666

SECTION 02 41 16

DEMOLITION

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Demolition and relocation of existing below-grade utilities (Water mains, Gas Lines)

2. Abandoning in-place below-grade construction.

3. Disconnecting, capping or sealing, and abandoning in-place site utilities.

4. Salvaging items for reuse by The State.

1.02 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to The State that may be uncovered during demolition remain the property of The State.

1. Carefully salvage in a manner to prevent damage and promptly return to The State.

1.03 PREINSTALLATION MEETINGS

A. Pre-demolition Conference: Conduct conference at Project site.

1.04 INFORMATIONAL SUBMITTALS

A. Engineering Survey: Submit engineering survey of condition of existing utilities.

B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for dust control, SWPPP, and for noise control. Indicate proposed locations and construction of barriers.

1. Adjacent Buildings: Detail special measures proposed to protect adjacent buildings to remain including means of egress from those buildings.

C. Schedule of utility demolition activities with starting and ending dates for each activity.

D. Pre-demolition photographs or video.

1.05 CLOSEOUT SUBMITTALS

A. Inventory of items that have been removed and salvaged.

1.06 FIELD CONDITIONS

A. Utilities to be demolished will be abandoned and their use discontinued before start of the work.

B. Conduct utility demolition so operations of occupied buildings will not be disrupted.

1. Provide not less than 72 hours' notice of activities that will affect operations of adjacent occupied buildings.

2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.

a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.

C. Conditions existing at time of inspection for bidding purpose will be maintained by The State as far as practical.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by The State before start of the Work.

2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify The State’s Representative. Hazardous materials will be removed by The State under a separate contract.

E. On-site storage or sale of removed items or materials is not permitted unless authorized by The State.

F. Arrange demolition schedule so as not to interfere with The State's on-site operations.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

C. ASTM B88 Specification for Seamless Copper Water Tubing.

D. ASTM D3350 Specification for Polyethylene Plastic Pipe and Fittings Materials.

E. Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for water.

F. AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 inch through 12 inch for Water Transmission and Distribution.

2.02 SOIL MATERIALS

A. Satisfactory Soils: Comply with requirements in Section 31 20 00, EARTH MOVING.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting demolition operations.

B. Refer to phasing plan for sequence of utility disconnections and demolition.

C. Inventory and record the condition of items to be removed and salvaged.

3.02 PREPARATION

A. Salvaged Items: Comply with the following:

1. Clean salvaged items of dirt and demolition debris.

2. Pack or crate items after cleaning. Identify contents of containers.

3. Store items in a secure area until delivery to the State.

4. Transport items to storage area designated by the State.

5. Protect items from damage during transport and storage.

3.03 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Utilities to be Disconnected: Locate, identify, disconnect, and seal or cap off utilities serving buildings and structures to be demolished.

1. The State will arrange to shut off utilities when requested by Contractor.

3.04 PROTECTION

A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.

B. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.

C. Existing Utilities to Remain: Maintain utility services to remain and protect from damage during demolition operations. Do not interrupt existing utilities serving

adjacent occupied or operating facilities unless authorized in writing by The State and authorities having jurisdiction.

D. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated.

1. Protect adjacent buildings and facilities from damage due to demolition activities.

2. Protect existing site improvements, appurtenances, and landscaping to remain.

3. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

4. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.

5. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.

6. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.

E. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.05 DEMOLITION

A. General: Demolish indicated utilities and site improvements completely as shown on the approved plans. Use methods required to complete the Work within limitations of governing regulations and as follows:

B. WATERMAIN DEMOLITION AND RELOCATION

1. Water service and mainline interruptions must be minimized. All planned interruptions require notifying the Hospital Staff and the STATE's Representative a minimum of seventy-two (72) hours and a maximum of one hundred forty-four (144) hours in advance of the interruption. Each interruption requires a separate notification.

2. The Work under this Section consists of providing all operations pertaining to relocating PVC water mains. In the preparation of the Drawings, efforts have been made to determine exact elevations of live utilities; however, elevations of utilities shown are not represented as exact and are shown to include approximate location only. The STATE's Representative shall have the final say as to whether the main is raised or lowered.

3. Where a water main crosses the location the new concrete vault, the water main shall be lowered sufficiently to permit a minimum (outside diameter) vertical distance of six inches (6") from the bottom of vault. The Contractor may employ

either of the following methods for lowering a water main. He may lower lengths of the water main as necessary on either side of the proposed vault to allow the main to pass under the vault, providing the deflection at any joint does not exceed the pipe manufacturer's recommendations, or the water main may be lowered using four (4) pipe bends at forty-five degree (45º) bends. The method of lowering and materials to be used shall be approved by the STATE's Representative prior to commencing Work. The Contractor shall give seventy-two (72) hours notice to the Hospital staff and the STATE's Representative prior to any planned water shutoff.

4. All PVC pipe must be blue in color. PVC water main and service connections must be installed with a bell protection device such as the EBAA Mega Stop Series 5000 or approved equal.

5. Unless otherwise indicated on the Drawings, rubber gaskets for ductile iron pipe joints shall conform to AWWA C111 and rubber gaskets for PVC pipe joints shall conform to ASTM F477. Fittings shall be a minimum of 250 pounds pressure rating, mechanical joint or bell, lined or unlined, either cast iron or ductile iron, unless otherwise required by the Contract Documents. All fittings must conform to the requirements of AWWA C110/ANSI A21.10 or C153 A21.53-06.

6. Polyvinyl Chloride pipe thrust restraint systems are heat fusion bonding, Certa-lok, Eagle-Loc, EBAA Iron MEGALUG®, EBAA Iron Tru-Dual®, EBAA Iron Restraint Harness, Romac PVC-RomaGripTM, Romac RFCA for PVC Pipe, Romac 600 Series, Romac 470, Romac GripRingTM, Foster Adaptor, Ford Uni-Flange Series 1500 or equal thrust restraint. Thrust blocks are required on all bends, tees and crosses.

7. Copper pipe must be soft-drawn Type K, seamless, annealed, polyethylene coated (minimum 26 mil), copper pipe, suitable for use as underground service water connections for general plumbing purposes, and ASTM B88 compliant. Damage to the polyethylene coating must be repaired with denso paste and tape or approved equal.

8. Flushing and Testing of the new water main shall be performed by the contractor. Water, sewer and storm drain main and service trenches are to be substantially filled and compacted prior to flushing and testing. The Contractor shall perform the flushing, hydrostatic testing, disinfection, and continuity testing. The Contractor is made aware that in the event repairs are made on the system in order to pass the hydrostatic test, and these repairs are made subsequent to disinfection of the system, then the open-bore flush and the disinfection will be null and void and shall be repeated to the satisfaction of the STATE's Representative after the repairs are made. Costs for repeat testing and flushing will be incidental to the bid item being tested. A request to supply water for flushing, testing, and disinfecting shall be scheduled in writing with the STATE's Representative at least forty-eight (48) hours prior to obtaining supplied water. The request for flushing, testing, and disinfecting will be subject to water availability.

9. PVC, DIP, Copper – Testing. The hydrostatic pressure shall be one hundred fifty (150) psi. The duration of each hydrostatic pressure test shall be thirty (30) minutes. After the required test pressure has been reached, pumping will be terminated. If the pressure remains constant for 30 minutes without the aid of a

pump, the results of the test shall be considered satisfactory as approved by the Engineer. The leakage allowance described in ANSI/AWWA 600 shall not be allowed. Fire lines must pass a pressure Page 14 R3 Standard Construction Specifications Rev 3 2009 MASS Division 60 – Water Systems 3/13 test at two hundred (200) psi for two hours in accordance with the Fire Underwriter's requirements as outlined in the National Fire Codes.

10. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.

11. Maintain fire watch during and for at least 1 hour after flame-cutting operations.

12. Maintain adequate ventilation when using cutting torches.

13. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

C. Site Access and Temporary Controls: Conduct demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from The State and authorities having jurisdiction. Provide alternate routes around closed or obstructed trafficways if required by authorities having jurisdiction.

2. Use water mist and other suitable methods from fire hydrants and sampling tees to limit spread of dust and dirt. Comply with governing environmental-protection regulations.

D. Explosives: Use of explosives is not permitted.

E. Existing Utilities: Demolish and relocate existing utilities and below-grade utility structures that are specified within the construction plans. Abandon existing hydronic loop piping in-place after new hydronic loop has been tested and in operation.

F. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

G. Promptly repair damage to adjacent buildings caused by demolition operations.

3.06 GAS MAIN RELOCATION

A. Applicable codes are listed below. If there is a conflict of rules, the STATE's Representative will make a final decision applicable to the situation.

ANSI Z-223.1 / NFPA 54 National Fuel Gas Code National Fire Protection Association www.nfpa.org

Department of Transportation Title 49 CFR Part 192 Code of Federal Regulations www.ecfr.gov.

ANSI B31.8 Code of Pressure Piping “Gas Transmission and Distribution Piping System” American National Standards Institute www.ansi.org.

1. Gas service and mainline interruptions must be minimized. All planned interruptions require notifying the Hospital Staff, the STATE’s Representative a minimum of seventy-two (72) hours and a maximum of one hundred forty-four (144) hours in advance of the interruption. Each interruption requires a separate notification.

2. CAUTION! CALL 811! BEFORE YOU DIG! All excavators shall be familiar with 16 NYCRR Part 753, “Protection of Underground Facilities”. Contractors are advised to exercise extreme caution when breaking ground. Before you dig, drill or excavate, be sure that your work area is clear of buried gas pipes or electric cables. An accidental break of these facilities can be dangerous! If facilities are not marked DO NOT ASSUME that there are no facilities present.

3. Prior to any demolition of the existing gas line, the gas supply must be shut off to the gas service line to be relocated. No gas line demolition shall be started until gas meters and regulators have been shut off and the gas line to be relocated has been cleared of all gases. Any excavation around high pressure must be supervised by Blue Stake personnel and/or the gas department at all times. Any high pressure line exposed needs to be inspected for damage before backfill.

4. Use Polyethylene Pipe, Tubing, Fittings and Joints. Polyethylene pipe, tubing, fittings and joints shall conform to ASTM D3350 and ASTM D2513, pipe designations PE 2306 and PE 3406, rated SDR 11 or less, as specified in ASME B31.8. Pipe sections shall be marked as required by ASTM D2513. Butt fittings shall conform to ASTM D3261 and socket fittings shall conform to ASTM D2683. Fittings shall match the service rating of the pipe.

5. Use Polyethylene Valves – One-Half Inch to Eight Inches. Polyethylene valves for underground installation only shall conform to ASME B16.40. Polyethylene valves in sizes one-half inch to eight inches may be used with polyethylene distribution and service lines.

6. Where a gas line crosses the location of the new concrete vault, the gas line shall be lowered sufficiently to permit a minimum (outside diameter) vertical distance of six inches (6”) from the bottom of vault. The Contractor may employ either of the following methods for lowering a water main. He may lower lengths of the gas line as necessary on either side of the proposed vault to allow the main to pass under the vault, providing the deflection at any joint does not exceed the pipe manufacturer’s recommendations, or the gas line may be lowered using four (4) pipe bends at forty-five degree (45º) bends. The method of lowering and materials to be used shall be approved by the STATE’s Representative prior to commencing Work. The Contractor shall give seventy-two (72) hours notice to the Hospital staff and the STATE’s Representative prior to any planned gas shutoff.

7. Gas appliances and gas piping installations on the Hospital’s premises shall be installed in compliance with the minimum safety requirements of these standards and the National Fuel Gas Code. These provisions shall be applicable to new

installations and to modifications of existing appliances or systems.

8. Installation of Pipe. Fusers must complete a written fusion test before any fusing can be done. Pipe needs to have slack left in pipe for expanding and contracting of pipe. No bolt-on, mechanical or permasert couplings or fittings will be accepted. However, socket, butt, saddle, and electrofusion are all approved. All riser brackets need to have at least three wedge anchors; no Hilti nails. Service lines on single- family dwellings cannot be split off of one line. All gas lines need to have a 14- gauge locate wire installed with pipe. Any pipe installed must be scratch-free and in good condition. All risers must be left locked and plugged until meter is set. Anyone welding or working on high pressure must provide proof of Division of Pipeline Safety certification before any work can be done on pipeline.

9. Marking Tape. All polyethylene lines shall be installed with locator wire and warning tape.

10. Testing. All pipe shall be tested at 100 psi with a median of air or nitrogen, for at least 15 minutes for every 100 feet. For example, 98 feet requires a 15-minute test; 101 feet requires a 30-minute test, and so on. The minimum test is 15 minutes regardless of length. Any fittings that can't be tested by air must be soap tested.

11. Installation of the gas distribution system, including all equipment, shall be in conformance with the manufacturer's recommendations and applicable sections of ASME B31.8, 49 CFR Part 192, and with AGA-01. Pipe cutting shall be done without damage to the pipe. Unless otherwise authorized, cutting shall be done by an approved type of mechanical cutter. Wheel cutters shall be used where practicable. On steel pipe six inches and larger, an approved gas-cutting-and-beveling machine may be used. Cutting of plastic pipe shall be in accordance with AGA-01.

12. Valve installation in plastic pipe shall be designed to protect the plastic pipe against excessive torsional or shearing loads when the valve is operated and from any other stresses which may be exerted through the valve or valve box.

13. Polyethylene Pipe Jointing Procedures. Jointing procedures shall conform to AGA-01. Indiscriminate heat fusion joining of plastic pipe or fitting made from different polyethylene resins by classification or by manufacturer shall be avoided if other alternative joining procedures are available. If heat fusion joining of dissimilar polyethylenes is required, special procedures are required. The method of heat fusion joining dissimilar polyethylene resins shall be shop- and field-tested prior to adoption.

14. Connections between Metallic and Plastic Piping. Connections shall be made only outside, underground and with the approved transition fittings.

3.07 CLEANING

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.

B. Do not burn demolished materials.

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

END OF SECTION 02 41 16

SECTION 02 42 00

ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes demolition of existing electrical, communication and signal systems.

1.02 APPLICABLE PUBLICATIONS

A. Environmental Protection Agency (EPA) Regulations.

1. 40 CFR 261: Identification and Listing of Hazardous Waste.

2. 40 CFR 262: Standards Applicable to Generators of Hazardous Waste.

3. 40 CFR 263: Standards Applicable to Transporters of Hazardous Waste.

4. Hazardous Waste Facilities.

B. U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Regulation:

1. 29 CFR 1910.94 Subpart G, Occupational Health and Environmental Control.

B. Department of Transportation (DOT):

1. 49 CFR 178: Specifications for Packaging.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 - EXECUTION

3.01 FIELD VERIFICATIONS

A. Verify field measurements and circuiting arrangements are as shown on Drawings. Trace existing circuits using electronic tracer to verify prior to disconnection. When existing circuits are required to be extended to feed equipment to remain, provide schedule for extended work prior to demolition to ensure continuity of existing equipment.

B. Verify that abandoned wiring and equipment serve only abandon facilities.

C. Demolition drawings are based on casual field observation and existing record documents. Report discrepancies to The State's Representative before disturbing existing installation.

D. Commencement of demolition means Contractor has verified and accepted existing conditions.

3.02 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal. Coordinate disconnection with The State's Representative. All shut-downs shall be done by the Hospital's personnel.

B. Coordinate electrical outage with The State's Representative, minimum 2 weeks prior to actual outage date.

C. Provide temporary wiring and connections to maintain existing systems in service during construction as shown on construction documents. Ensure that temporary wiring shall meet all safety requirements. When work must be performed on energized equipment or circuit, use personal experience in such operations.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Demolish and remove all equipment and devices including associated conduits, boxes and wires back to source as shown on drawings or indicated in contract documents. Provide blank cover plates to all abandoned flush mounted boxes which could not be removed or indicated to remain for future use.

B. When existing circuits or feeders are extended to equipment or devices to remain, work shall be performed under provisions of this Section and as indicated on the drawings. Minimum size of conductors and conduits shall comply with CEC.

C. Remove abandoned wiring back up to source of supply unless otherwise indicated. Removed all exposed abandoned conduit. When abandoned conduits are concealed in floors or walls, cut conduit flush with wall and floors and patch surfaces.

D. Remove, relocate and extend existing installations including low voltage communication and signal systems (Fire Alarm, Nurse Call, Security, etc.) to accommodate new construction.

E. Disconnect and remove abandoned devices and distribution equipment. Return equipment to The State unless otherwise indicated.

F. Repair adjacent construction and finishes damaged during demolition and extension work to original conditions.

G. Maintain access to existing electrical installations which remain in service. Modify installation or provide access panel as appropriate.

H. Extend existing installation using materials and methods that shall comply with CEC.

3.04 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment which remain or to be reused.

END OF SECTION 02 42 00

SECTION 02 50 00

SUBSURFACE UTILITY LOCATING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Codes, Standards & Definitions
2. SIM Prerequisite Qualifications
3. Investigation Scope
4. SIM Pre-Scan Investigation
5. SIM Scanning Procedures
6. SIM Methods for Complete Investigation
7. SIM Post Investigation Hand Off

1.02 CODES, STANDARDS & DEFINITIONS

A. Occupational Safety and Health Administration - Safety and Health Standards Digest Construction Industry (OSHA) - 3149/1996).

B. American Society for Nondestructive Testing, (ASNT). The ASNT is the world's largest technical society for nondestructive testing (NDT) professionals. The society provides a forum for exchange of NDT technical information, NDT educational materials and programs, as well as standards and services for the qualification and certification of NDT personnel.

C. ASNT Recommended Practice No. SNT-TC-1A Personnel Qualification and Certification in Nondestructive Testing. This Recommended Practice establishes the general framework for a qualification and certification program. In addition, the document provides the educational experience and training recommendations for the different test methods including use and application of ground penetrating RADAR. This recommended practice is not intended to be used as a strict specification. It is recognized, however, that contracts require programs which meet the intent of this document. For such contracts, purchaser and supplier must agree upon acceptability of an employer’s program.

D. American Society for Testing and Materials, (ASTM) ASTM International is an international standards organization that develops and publishes voluntary consensus technical standards for a wide range of materials, products, systems and services. Some 12,575 ASTM voluntary consensus standards operate globally. The organization's headquarters is in West Conshohocken, Pennsylvania, about 5 mi northwest of Philadelphia.

E. The Federal Communications Commission (FCC) is an independent United States government agency. The FCC was established by the Communications Act of 1934 and is charged with regulating interstate and international communications by radio, television, wire, satellite and cable.

F. Common Ground Alliance, (CGA). The CGA is a member-driven association of 1,700 individuals, organizations and sponsors in every facet of the underground utility industry. Established in 2000, CGA is committed to saving lives and preventing damage to underground infrastructure by promoting effective damage prevention practices. CGA has established itself as the leading organization in an effort to reduce damages to underground facilities in North America through shared responsibility among all stakeholders. The underground utility location contractor shall adhere to all applicable safety guidelines in accordance with federal, state, and local ordinances.

G. Definitions

1. Subsurface Investigation Methodology, (SIM): Set of methods, training/mentorship qualifications and necessary equipment required for a complete subsurface investigation of underground utilities resulting in mark out of critical targets. Examples: Power, communication, water and sewer, gas line and other commercial/industrial buried service lines.

2. Utility location: The process of identifying and labeling public and private utility lines that are underground. These lines may include telecommunication, electricity distribution, natural gas, cable television, fiber optics, traffic lights, street lights, storm drains, water mains and wastewater pipes.

3. Owner: Legal owner of the structure or property to be investigated.

4. Contracting agency: The contractor hired directly or indirectly by the Owner who is sub-letting the scanning requirements to a scanning contractor.

5. Scanning contractor: The contractor hired to perform the scanning operation resulting in location of underground utilities.

6. Ground Penetrating Radar (GPR): A geophysical method that uses pulses of electromagnetic wave energy to image the subsurface. Ground penetrating radar transmits energy in the microwave band of the of the electromagnetic spectrum.

7. Frequency: The frequency describes the number of waveforms transmitted from a GPR antenna per second. Frequency is measured in cycles per second, or Hertz (Hz).

8. Line Scan: Collection of one straight line of GPR data resulting in the display of a cross-sectional depth representation of the RADAR signal moving through the material scanned.

9. Electromagnetic locator (EM): Also known as a pipe and cable locator, EM is used for tracing utility lines and metallic pipes, and clearing excavation and drilling locations. These utility locators consist of two main parts, a transmitter and a receiver.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct pre-excavation conference at Project site.

1.04 INFORMATIONAL SUBMITTALS

A. Investigation reports.

1.05 SIM PREREQUISITE QUALIFICATIONS

A. Scanning contractor shall submit certification of experienced-based training that meets or exceeds the guidelines detailed in ASNT document 'Recommended Practice SNT-TC-1A, Personnel Qualification and Certification in Nondestructive Testing Level I '. The ASNT document recommends 8 hours as a minimum for training and a minimum of 60 hours practicing GPR in order to be a certified NDT Level I in Ground Penetrating Radar.

B. Scanning contractor shall submit/reference guideline, ASTM Designation D 6432-99 – Standard Guide for Using the Surface Ground Penetrating Radar Method for Subsurface Investigation.

C. Scanning contractor shall utilize detailed methods, Subsurface Investigation Methodology, SIM requirement for competent field personnel.

D. Pretraining mentorship, 4 weeks of application training from mentor.

E. 80 hours of classroom curriculum, GPR theory, underground utility location training, SIM investigative method training.

F. Post training mentorship 4 week practical application of testing equipment and investigative methods.

G. Field technicians shall maintain minimum OSHA 10 safety training certificate.

H. Scan contractor insurance requirements, commercial liability insurance $1,000,000 limit with $5,000,000 umbrella (includes auto and worker comp), professional liability $2,000,000 limit.

I. GPR equipment provided by scanning contractor:

1. Ground penetrating radar system, to include:

2. Radar Data Acquisition System/Controller with integrated display.

3. Various applicable RADAR antennas, Utility and Concrete.

4. Miscellaneous hardware, cables, hand cart, marking tape and power

supply.

J. Electromagnetic Locating Equipment:

1. Capable of receiving electromagnetic and communication line frequencies passively or induced from potentially imbedded power or communication lines.

1.06 INVESTIGATION SCOPE

A. Scanning contractor will utilize job site information, available as-builts and prints/plans and previously detailed equipment to locate and mark out steel reinforcement, conduits and other anomalies within slab.

B. This mark out may include depth estimates of targets.

C. If the scan area includes a slab on grade and the post scan work requires trenching a lower frequency antenna may be used to locate targets in the backfill material under the slab.

D. Review of equipment capabilities and potential job-site performance impedances.

1.07 SIM PRE-SCAN INVESTIGATION

A. SIM Pre-investigation Steps:

B. Job Hazard Analysis, form review, or equal site safety review documentation. Review and sign site safety plan if applicable.

C. Site walk and project scope meeting, review scan locations. Note: Look for visible clues such as electrical pullboxes, service access ports like manholes, catchbasins and other utility boxes, visible conduits, etc.

D. Site contact interview, review known utilities, discuss possible unknowns, and anticipated critical targets. Review site post scan scope of work. Suggest scan area options.

E. GPR data samples will be required for reporting.

F. Use spray paint to mark utility locations and wooden stakes where possible.

G. Client deliverable requirements, report format/documentation. GPS Mapping of site findings.

1.08 SIM SCANNING PROCEDURES

A. Quality of scan data:

1. It is recommended that the scanning contractor calibrate the GPR system to the conditions at each site. This calibration may be estimated or a test performed to determine the correct dielectric of the soil using hyperbola matching or calibrating to an object at a known depth.

2. Perform several test scans through the scan area to determine the approximate maximum depth penetration and to gauge the probability of success in finding the desired targets.

3. Review the clarity of the scan data. Adjustments in gain, depth range, filters, and other settings may be necessary.

1.09 SIM METHODS FOR COMPLETE INVESTIGATION

A. Follow and document the SIM methods applied.

B. Confirm information collected from As-built site plans, original design plans.

C. Site walk above ground utility indicators.

D. Scan and mark with electromagnetic locator.

E. Trace all known utilities. Typical known utility list includes five primary utilities to any building, water, electric, gas, sanitary sewer, and communication lines. Additionally, all utilities identified on a drawing not on list, any that have been communicated verbally, and any utility for which a feature can be observed.

F. Use EM Locator at visible features valve, manhole, riser, etc.

G. Use direct connection method when possible. (Note: Do not connect directly to any potentially live electrical wires)

H. Use induction clamp if direction connection is not possible

I. Use induction method if induction clamp is not possible

J. After connecting or inducing with the transmitter, use the receiver to complete a full 360° sweep around the connection point.

K. Mark and trace all potential fields that are detected.

L. During this sweep, measure mA levels on the receiver in order to assist in correctly identifying the target line.

M. Identify the target line by tracing it to the connection point and at least to the next feature.

N. After tracing and marking any utility, sweep parallel to the utility on both sides in order to check for laterals/T's.

O. Insert traceable rodder or sonde into known sewer, storm and drain lines.

P. Trace the rodder or sonde using the receiver.

Q. Use EM receiver to attempt to locate any unidentified, known utilities from features using passive modes (Power/Radio).

R. Sweep using passive modes parallel to the utility on both sides in order to check for laterals/T's.

S. Scan with GPR standard utility antenna, typical frequency 400 MHz or 350 Hyper stacking antenna. 6.3.1 Calibrate GPR settings to current site conditions.

1. Use GPR to attempt to locate any unidentified, known utilities.

2. Collect scans with GPR parallel to any marked utility in order to check for laterals/T's.

3. Document any known utilities that could not be located.

4. Perform passive sweeps with electromagnetic locator to locate unknown utilities

5. Sweep all areas in a grid with spacing determined by site conditions.

6. Sweep separately with Power mode and Radio mode (and Cathodic Protection mode when applicable)

7. Collect GPR scans to locate unknown utilities.

8. Collect GPR scans across all previously located utilities to confirm locations and approximate depths.

9. Document findings with photos and additional reporting/mapping if required.

1.10 SIM POST INVESTIGATION HAND OFF

A. If possible, conduct a recap and review of findings with site contact.

B. Explain scan findings—Where did the technologies work well and where results were inconclusive due to interference and or soil conditions.

C. Explain markings and depth estimates.

D. Review original scope to confirm expectations were met/exceeded.

END OF SECTION 02 50 00

SECTION 02 60 00

CONSTRUCTION SURVEYING

PART 1 – GENERAL

1.01 DESCRIPTION

A. The WORK under this Section includes providing all labor, materials, tools and equipment necessary to perform all surveying and staking necessary for the completion of the Project in conformance with the Drawings and Specifications and standard engineering and surveying practices, including all calculations required to accomplish the WORK.

B. The WORK shall include the staking, referencing and all other actions as may be required to preserve and restore land monuments and property corners which are situated within the Project area, and to establish monuments as shown on the Drawings.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.01 CONSTRUCTION

A. All surveying involving property lines or monuments shall be done by, or under the direction of, a Registered Land Surveyor licensed in the State of California.

B. The State will supply information relative to the approximate locations of monuments and corners, but final responsibility for locations, referencing, and restoration shall rest with the CONTRACTOR.

C. In the event the CONTRACTOR does not replace the survey monuments and property corners disturbed by the CONTRACTOR's operations, the State may, after first notifying the CONTRACTOR, replace the monuments in question. The cost of such replacements shall be deducted from payments to the CONTRACTOR.

D. The CONTRACTOR shall provide the State with a copy of all surveyors' notes, if requested by the ENGINEER, prior to each Pay Request payment for which payment for Pay Item No. 2702.1, Construction Surveying, is increased from the previous Pay Request payment.

E. The CONTRACTOR shall provide the State with a copy of all surveyors' notes, prior to the request for final payment, and include the information on the record drawings.

F. The CONTRACTOR shall obtain all information necessary for as-built plan production, from actual measurements and observations made by its own personnel, including Subcontractors, and submit this information to the STATE's Representative.

G. The CONTRACTOR shall use competent, qualified personnel and suitable equipment for the layout work required and shall furnish all stakes, templates, straightedges and other devices necessary for establishing, checking and maintaining the required points, lines and grades.

H. The CONTRACTOR shall perform all staking necessary to delineate clearing and/or grubbing limits; all cross sections necessary for determination of excavation and embankment quantities, including intermediate and/or remeasure cross sections as may be required; all utility staking; all staking of concrete vault and drainage structures, including the necessary checking to establish the proper location and grade to best fit the conditions on site; the setting of such finishing stakes as may be required; the staking of right-of-way; the staking, referencing and other actions as may be required to preserve or restore land monuments and property corners; and all other staking necessary to complete the project.

I. Field notes shall be kept in standard bound notebooks in a clear, orderly and neat manner, consistent with standard engineering and surveying practices. The CONTRACTOR's field books shall be available for inspection by the STATE's Representative at any time.

J. All field survey notes, including those which become source documentations from which quantities for payment are computed, shall be recorded by a notekeeper furnished by the CONTRACTOR. The notekeeper shall be thoroughly familiar with generally accepted standards of good survey notekeeping practice.

K. The STATE's Representative may randomly spot-check the CONTRACTOR's surveys, staking and computations at the STATE's Representative's discretion. After the survey or staking has been completed, the CONTRACTOR shall provide the STATE's Representative with a minimum of 72 hours notice prior to performing any WORK, and shall furnish the appropriate data as required, to allow for such random spot- checking; however, the State assumes no responsibility for the accuracy of the WORK.

L. Within ten days of Notice to Proceed, unless otherwise approved by the STATE's Representative, the CONTRACTOR shall stake the location of the new concrete vault, and/or storm drain service connections. The stake shall be a surveyor lathe marked as to the type of service, and placed at an appropriate offset for the location shown on the Drawings.

END OF SECTION 02 60 00

SECTION 03 20 00

CONCRETE REINFORCING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes steel reinforcement bars.

1.02 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site

1.03 ACTION SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Requirements, for submittal requirements and procedures.

B. Provide Product Data for the following:

1. Each type of steel reinforcement.

2. Bar supports.

3. Mechanical splice couplers.

C. Sustainable Design Submittals.

D. Shop Drawings: Comply with ACI SP-066.

1. Include placing drawings that detail fabrication, bending, and placement.

2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

E. Construction Joint Layout: Indicate proposed construction joints required to build the structure.

1. Location of construction joints is subject to approval of Structural.

1.04 INFORMATION SUBMITTALS

A. Welding Certificates:

1. Reinforcement to Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M.

B. Material Certificates: For each of the following, signed by manufacturers:

1. Epoxy-Coated Reinforcement: CRSI's "Epoxy Coating Plant Certification."

C. Material Test Reports: For the following, from a qualified testing agency:

1. Steel Reinforcement:

a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.

2. Mechanical splice couplers.

D. Field Quality-Control Reports

E. Minutes of Preinstallation Conference.

1.05 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage and to avoid damaging coatings on steel reinforcement.

1. Store reinforcement to avoid contact with earth.

2. Do not allow epoxy-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.

3. Do not allow dual-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.

4. Do not allow stainless steel reinforcement to come into contact with uncoated reinforcement.

PART 2 - PRODUCTS

2.01 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615, Grade 60, deformed.

B. Low-Alloy Steel Reinforcing Bars: ASTM A706, deformed.

C. Headed-Steel Reinforcing Bars: ASTM A970.

D. Galvanized Reinforcing Bars:

1. Steel Bars: ASTM A615, deformed bars.

2. Zinc Coating: ASTM A767, Class I, zinc coated after fabrication and bending.

E. Epoxy-Coated Reinforcing Bars:

1. Steel Bars: ASTM A615, Grade 60, deformed bars.

2. Epoxy Coating: ASTM A775 with less than 2 percent damaged coating in each 12-inch bar length.

2.02 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.

1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

b. For epoxy-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.

c. For dual-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.

d. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

e. For stainless steel reinforcement, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

B. Mechanical Splice Couplers: ACI 318 Type 1or Type 2, same material of reinforcing bar being spliced; tension-compression type or dowel-bar type.

C. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch (1.2908 mm) in diameter.

1. Finish: Galvanized ASTM A884, Class A, Type 1, epoxy coated, with less than 2 percent damaged coating in each 12-inch (305-mm) wire length.

2.03 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 - EXECUTION

3.01 PREPARATION

A. Protection of In-Place Conditions:

1. Do not cut or puncture vapor retarder.

2. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.02 INSTALLATION OF STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.

B. Accurately position, support, and secure reinforcement against displacement.

1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.

2. Do not tack weld crossing reinforcing bars.

C. Preserve clearance between bars of not less than 1 inch (25 mm), not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

D. Provide concrete coverage in accordance with ACI 318.

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Splices: Lap splices as indicated on Drawings.

1. Bars indicated to be continuous, and all vertical bars to be lapped.

2. Stagger splices in accordance with ACI 318.

3. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.

4. Weld reinforcing bars in accordance with AWS D1.4, where indicated on Drawings or in accordance with manufacturer’s instructions.

3.03 JOINTS

A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by the STATE’s Representative.

1. Place joints perpendicular to main reinforcement.

2. Continue reinforcement across construction joints unless otherwise indicated.

3. Do not continue reinforcement through sides of strip placements of floors and slabs.

3.04 INSTALLATION TOLERANCES

A. Comply with ACI 117.

3.05 FIELD QUALITY CONTROL

A. Special Inspections: The STATE will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Steel-reinforcement placement.

2. Steel-reinforcement mechanical splice couplers.

3. Steel-reinforcement welding.

END OF SECTION 03 20 00

SECTION 03 40 00

PRECAST CONCRETE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnishing and installing precast concrete elements as indicated.

B. Precast concrete covers for walkways, covers for communication trenches, and steps: Use lightweight concrete.

C. Precast concrete manholes and other utility structures: Use normal weight concrete.

D. Precast concrete access panels as indicated: Use normal weight concrete.

E. Precast Concrete Laggings: Use normal weight concrete.

1.02 RELATED SECTIONS

A. Section 01 33 00: Submittal Procedures

B. Section 01 41 00: Quality Requirements

C. Section 01 60 00: Product Requirements

D. Section 03 20 00: Concrete Reinforcing

E. Section 07 92 00: Joint Sealants

1.03 REFERENCES

A. American Concrete Institute (ACI):

1. ACI 318: Building Code Requirements for Reinforced Concrete

2. ACI 347: Formwork for Concrete

B. ASTM International (ASTM):

1. ASTM A27: Steel Castings, Carbon, for General Application

2. ASTM A36: Structural Steel

3. ASTM A47: Ferritic Malleable Iron Castings

4. ASTM A123: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

5. ASTM A167: Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

6. ASTM A185: Steel Welded Wire Fabric, Plain, for Concrete Reinforcement

7. ASTM A283: Low and Intermediate Tensile Strength Carbon Steel Plates

8. ASTM A497: Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement

9. ASTM A615: Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

10. ASTM A675: Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties

11. ASTM C31: Making and Curing Concrete Test Specimens in the Field.

12. ASTM C33: Concrete Aggregates

13. ASTM C39: Compressive Strength of Cylindrical Concrete Specimens

14. ASTM C185: Air Content of Hydraulic Cement Mortar

15. ASTM C330: Lightweight Aggregates for Structural Concrete

16. ASTM C509: Elastomeric Cellular Preformed Gasket and Sealing Material

17. ASTM C881: Epoxy-Resin-Base Bonding Systems for Concrete

C. American Welding Society (AWS):

1. AWS D1.1: Structural Welding Code Steel

2. AWS D1.4: Structural Welding Code Reinforcing Steel

D. Federal Specifications (FS):

1. FS QQ-C-40: Caulking: Lead Wool and Lead Pig

E. Prestressed Concrete Institute (PCI):

1. PCI MNL 116: Manual for Quality Control of Plants and Production of Prestressed, Precast Concrete Products

2. PCI MNL 117: Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products

F. Comply with ACI 347 and with South Coast Air Quality Management District (SCAQMD) Volatile Organic Compounds (VOC) regulations.

1.04 QUALITY ASSURANCE

A. Comply with Quality Requirements (see 1.02 above).

B. Fabricator Qualifications:

1. Experienced in casting concrete members, similar to those specified, as a major part of fabricator's Work.

2. Provide experienced personnel, equipped with adequate facilities operating under established quality control procedures, capable of the required rate of delivery.

C. Erector Qualifications: Have a successful proven past record and be regularly engaged in erecting precast concrete panels similar to those specified.

D. Welders and Tackers: Comply with AWS D1.1 and D1.4.

E. Form Design - PCI MNL 117, Division V, Section 2. Face of casting - Not thinner than one inch or 1 1/2 times maximum aggregate size, whichever is larger, except as indicated.

F. Lifting Device Criteria - PCI MNL 117, Division IV, Article 4.2.4.

G. Tolerances, General - Conform to following Articles of PCI MNL 117:

1. Article 2.3.1, Tolerances for Finished Product.

2. Article 6.2.4, Tolerances for Erection.

H. Source Quality Control:

1. Fabricating, testing and identifying procedures: Comply with manufacturing and testing procedures in PCI MNL 117, Division II.

2. Test castings: Cast at least two full-size castings of each type and size indicated.

a. Cast test castings to simulate a production run; incorporate reinforcing and other embedded items.

b. Finished test castings: Inspected by the STATE or its designee to determine casting acceptability.

c. Maintain a complete record of proportions, mixing, consolidating and curing procedures.

d. Retain not less than one test unit, of a lot having a particular finish, at the casting plant until entire lot of castings, having that finish, has been accepted and installed in final position. Accepted finished mock-ups maintained at the casting plant may be considered as accepted production run castings. Identify each test casting installed in accordance with PCI MNL 117, Article 2.2.3, Record Keeping.

3. Inspection: Inspect production runs; ensure castings conform to specified requirements.

4. Test reports: Maintain records, for inspection by the STATE or its designee, in accordance with PCI MNL 117, Articles 2.2.3 and 2.2.4, and Appendix C. Provide copy of test reports to the STATE or its designee.

5. Casting Plant Precautions: Comply with applicable environmental requirements.

6. Verify castings have attained specified 28-day strength.

I. Concrete Testing:

1. Employ independent testing laboratory to test two specimens for each compression test for each concrete mix.

a. Obtain concrete for specimens from actual production batch.

b. Provide six-inch diameter by 12 inch specimens in accordance with ASTM C31.

c. Match finishes on accepted Work mock-up.

1.05 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Requirements, for submittal requirements and procedures.

B. Shop Drawings, installation instructions, product data, and manufacturers' literature: Indicate dimensions, reinforcement, welds, radius of corners, mix design, lifting positions and devices, details of lifting inserts, anchors, connections, connections to structure, accessories, joints, shim arrangement, conduits, pipe sleeves, reglets, recesses, penetrations, openings and similar configurations required for civil, structural, architectural, mechanical, electrical, and other Work.

C. Working Drawings: Erection drawings and procedures. Indicate method and sequence of operations and location of precast Sections in Work with same identification marks used in fabrication. Stamp, sign and seal Working Drawings using civil or structural engineer registered as a Professional Engineer in State of California.

D. Reports: Submit reports of concrete tests.

E. Design calculations for members: For deflection calculations, consider deflections caused by dead load, erection load, wind load, concrete creep, and shrinkage.

F. Design ceiling panels inside stations to withstand a positive and negative wind pressure of 30 psf. Provide steel bracing design for both wind and seismic loads.

G. Provide calculations for seismic loads in accordance with applicable building codes.

H. Prepare, stamp, sign and seal design calculations using registered civil or structural engineer licensed as a Professional Engineer in the State of California.

I. Samples: Three of each finish, 12 inch by 12 inch minimum; adequate in size to show range of color and texture, typical joints, inserts, finished edges and corners.

J. Pounds of selected coarse aggregates for ceiling panels and pilasters.

K. Welder certifications in accordance with AWS D1.1 or AWS D1.4.

1.06 DEFINITIONS (Not Used)

1.07 WORKSITE CONDITIONS

A. Maintain clear, well-drained unloading areas and road access around and in area so precast concrete hauling and erection equipment will be able to operate under their own power.

B. Erect barricades, warning lights and signs to safeguard traffic in immediate area of hoisting and handling operations.

C. Remove mortar, plaster, grout and other construction droppings before they harden.

D. Protect castings from being stained by adjacent construction operations.

E. Protect adjacent surfaces from welding operations.

F. Perform casting placement Work when ambient temperature is warmer than 40 deg F and during dry weather.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 01 60 00 - Product Requirements, for general requirements for product delivery, storage, and handling procedures.

B. Conform to PCI MNL 117, as follows:

C. Handling Equipment: Division III, Article 3.3.6.

D. Storage Area: Division III, Section 4.

E. Handling and Lifting Devices for Reinforcement: Division IV, Article 4.2.4.

F. Transporting, Handling, Loading and Delivery: Division VI, Article 6.2.1 and Article 6.2.2.

1. Lift, support and erect castings to prevent damage and overstressing. Handle castings by means of lifting inserts or straps.

2. Level, align and temporarily brace castings securely in position.

3. After erection, remove lifting inserts to depth of 3/4 inch inward from surface of concrete.

4. Plug resulting hole with stiff mortar; match color and finish of casting.

PART 2 - PRODUCTS

2.01 CONCRETE REINFORCEMENT

A. Billet-steel bars conforming to ASTM A615, Grade 60. Welded steel wire fabric conforming to ASTM A185.

2.02 CONCRETE FORMWORK

A. PCI MNL 117, Division V, Section 2, Article 5.2.1.

2.03 GASKETS

A. Preformed, firm, cellular, neoprene conforming to ASTM C509, sized to be under constant compression in joints, and manufactured in lengths to eliminate or minimize field splices.

2.04 ANCHORS AND INSERTS

A. Completely encased anchors: ASTM A675 Grade 65, hot-dip galvanized in accordance with ASTM A123.

B. Steel clip anchors: ASTM A36, hot-dip galvanized in accordance with ASTM A123.

C. Steel plate: ASTM A283 hot-dip galvanized in accordance with ASTM A123.

D. Cast-steel casting clamps: ASTM A27, Grade 32510 or 35018, hot-dip galvanized in accordance with ASTM A123.

E. Stainless steel joint connections: ASTM A167, Type 316.

F. Malleable iron castings - ASTM A47, Grades 32510 and 35018.

2.05 LIFTING INSERTS

A. As indicated on reviewed and approved Working Drawings.

2.06 FORMING MATERIALS

A. Precast structural units: PCI MNL 117, Division V, Section 2.

B. Lining: PCI MNL 117, Division V. Section 2.

2.07 FORM RELEASE AGENT

A. Synthetic resin or organic compound containing no wax, oil, silicates or varnish, and compatible with specified coatings, sealants, contact surfaces of forming materials, fresh concrete, curing process, and adhesives to be applied to wall panels. Comply with SCAQMD VOC requirements.

2.08 SURFACE SEALERS AND SUBSTRATE CLEANER

A. Covers for communication trenches, concrete manholes, and other utility structures.

B. Substrate Cleaner: Approved by coating/sealer manufacturer and compatible with substrate.

2.09 SHIMS

A. Nylon, lead, PVC, or hard neoprene.

2.10 CAULKING

A. Lead, FS QQ-C-40, Type II, Grade C.

2.11 WELDING MATERIALS

A. AWS D1.1 and AWS D1.4 as applicable.

2.12 AGGREGATES

A. For normal weight concrete:

1. Fine aggregate.

2. Coarse aggregate.

3. Maximum size: Conform to ACI 318, Article 3.3.

B. For lightweight structural concrete:

1. Fine aggregate: ASTM C33.

2. Low density filler: ASTM C330.

3. Nominal density: Not more than 110 pounds per cubic foot at 28 days.

2.13 CONCRETE MIXES

A. Water-cement Ratio by Weight: Not greater than 0.45.

B. Air Entrainment: As required for Workability.

C. Six-Inch by 12-Inch Cylinder 28 day Compressive Strength: Minimum 5000 psi when tested in accordance with ASTM C39.

D. Provide similar water-cement and cement-aggregate ratios of face and back-up mixes.

E. Precast concrete: Class 5000, unless indicated otherwise.

2.14 GROUT

A. For normal and lightweight precast concrete:

1. Cement Grout: Portland cement, sand, and water sufficient for placement and hydration.

2. Nonshrink Grout.

3. Epoxy-resin Grout: Two-component, mineral-filled, epoxy-resin conforming to ASTM C881 of Type, Grade and Class required for specific application.

2.15 SEALANT AND JOINT FILLERS

A. Sealants shall be as specified in Section 07 92 00 - Joint Sealants.

2.16 METAL ANCHORS AND SUPPORTS

A. Embedded Plates and Dowels: Type 316 stainless steel of sizes indicated or, if not indicated, as required for adequate joint strength.

B. Shims: Lead buttons or hard neoprene of required joint thickness and of size required to support precast concrete Work.

2.17 FABRICATION

A. Formwork: Conform to reviewed and accepted Working Drawings.

B. Molds: Conform to reviewed and accepted Working Drawings and PCI MNL 117, Division V, Section 2.

1. Before placing concrete, thoroughly clean molds and coat with form release agent.

2. Fabricate molds so that mold surfaces in contact with fresh concrete are smooth and have no irregularities or discernable joint marks.

C. Concrete Reinforcement: PCI MNL 117, Division V, Section 3.

D. Embedments: PCI MNL 117, Division V, Section 4.

E. Lifting Devices: Conform to reviewed and accepted Working Drawings.

F. Placing and Consolidating Concrete: PCI MNL 117, Division V, Section 5.

G. Finish:

1. Smooth finish: As-cast using flat, smooth, nonporous molds.

2. Broom finish top surfaces of concrete covers for walkways and communication trenches.

H. Curing:

1. Methods other than steam.

2. Steam curing: Conform to PCI MNL 116, Division III, except disregard Section 3.4.3, Live Steam.

a. Keep concrete continuously covered not less than 24 hours after casting.

b. Initial curing: Maintain temperature of concrete at placement temperature, but not warmer than 100 deg F, until concrete has developed final set but not less than two hours after casting has been completed.

c. Final curing: Allow concrete temperature to increase not more than 25 deg F per hour, to not warmer than 150 deg F; maintain temperature until concrete has developed indicated design strength.

d. Cooling: Cool concrete gradually, at rate not more than 20 deg F per hour.

e. Protection: After removing castings from casting bed, or mold, prevent castings from cooling at a rate faster than 20 deg F per hour.

I. Identifying Castings:

1. Mark each casting to correspond to identification mark on Shop Drawings for casting location.

2. Mark each casting with date cast.

PART 3 - EXECUTION

3.01 INSPECTION

A. Perform concrete testing.

B. Verify structure and anchorage inserts have been placed.

C. Verify bearing surfaces for castings are smooth and level.

D. Examine surfaces and parts of structure to receive precast concrete. Correct conditions detrimental to proper and timely completion of Work. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Thoroughly clean bearing surface of castings.

B. Provide concrete foundations with anchor bolts and stainless steel mounting plate to receive light-fixture bollard bars. Coordinate size and location.

3.03 ERECTION

A. Install precast concrete as indicated and as detailed on reviewed and approved Shop Drawings.

B. Set units dry and without mortar. Maintain specified joint width with concealed spacing shims. Place shims in accordance with reviewed and approved Working Drawings.

C. Adjust differences in placement between members to within specified tolerance and allow members to fully deflect under own weight before making final connection.

D. Unless otherwise indicated, fasten panels in place by bolting, welding, or both. Protect panels and adjacent surfaces from damage caused by construction activities.

E. Clean field welds with wire brush and coat materials, other than stainless steel, with same material used for shop coat. If galvanized, use zinc-rich coating.

F. Remove shims and spacers from joints of non-load bearing units after fastening but before applying sealant.

G. Where indicated, grout members in place and seal joints with specified joint filler compound.

3.04 ADJUSTING AND CLEANING

A. Correct castings which do not conform to specified requirements. Replace damaged units with new castings when patching is unacceptable to the STATE or its designee.

1. Prepare surface to be patched with bonding agent.

2. If the STATE or its designee has given written permission to repair damage by patching, repair coatings in accordance with PCI MNL 117, Division II, Section 4, and cured patching will be indistinguishable from surrounding surface.

3. Protect and maintain the precast concrete Work throughout construction period so there will be no indication of wear or damage at time of final acceptance. Normal weathering of exposed precast concrete Work is permitted during construction if other construction activities and conditions do not interfere and result in an unacceptable condition of Work.

B. CLEANING - GENERAL

1. Clean installed castings with detergent, water, fiber brush, and sponge, and rinse thoroughly with clean water.

2. Remove stubborn stains with acid, but only after more conservative methods have been unsuccessful; thoroughly rinse casting with clean water.

END OF SECTION 03 40 00

SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Joint sealants.

2. Closed-cell spray polyurethane foam.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.04 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.

2. Joint-sealant manufacturer and product name.

3. Joint-sealant formulation.

4. Joint-sealant color.

1.05 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency.

B. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:

1. Joint-sealant location and designation.

2. Manufacturer and product name.

3. Type of substrate material.

4. Proposed test.

5. Number of samples required.

C. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.

2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.

D. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

E. Field-Adhesion-Test Reports: For each sealant application tested.

F. Sample Warranties: For special warranties.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.07 PRECONSTRUCTION TESTING

A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Adhesion Testing: Use ASTM C 794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

2. Compatibility Testing: Use ASTM C 1087 to determine sealant compatibility when in contact with glazing and gasket materials.

3. Stain Testing: Use ASTM C 1248 to determine stain potential of sealant when in contact with masonry substrates.

4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.

5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.

6. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.

7. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by the STATE's Representative.

2. Conduct field tests for each kind of sealant and joint substrate.

3. Notify the STATE's Representative seven days in advance of dates and times when test joints will be erected.

4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.

a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.

6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.08 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.

2. When joint substrates are wet.

3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.

4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.09 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following:

1. Architectural sealants shall have a VOC content of 250 g/L or less.

2. Sealants and sealant primers for nonporous substrates shall have a VOC content of 250 g/L or less.

3. Sealants and sealant primers for nonporous substrates shall have a VOC content of 775 g/L or less.

C. Low-Emitting Interior Sealants: Sealants and sealant primers shall comply with the testing and product requirements of the California Department of Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Comply with 2019 California Green Building Standard Code.

2.02 SEALANTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Dow Corning Corporation.

2. Sika Corporation.

3. Tremco.

4. or equal.

B. S-1:

1. ASTM C920, polyurethane or polysulfide.
2. Color: To match adjacent area color.

C. S-3:

1. ASTM C920, polyurethane or polysulfide.
2. Type S.
3. Class 25, joint movement range of plus or minus 50 percent.
4. Grade NS.
5. Shore A hardness of 15-25.
6. Minimum elongation of 700 percent.
7. Color: To match adjacent area color.

D. S-4:

1. ASTM C920 polyurethane or polysulfide.
2. Type S.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 25-40.
6. Color: To match adjacent area color.

E. S-6:

1. ASTM C920, silicone, neutral cure.
2. Type S.
3. Class: Joint movement range of plus 100 percent to minus 50 percent.
4. Grade NS.
5. Shore A hardness of 15-20
6. Minimum elongation of 1200 percent.
7. Color: To match adjacent area color.

F. S-9:

1. ASTM C920 silicone.

2. Type S

3. Class 25.

4. Grade NS.

5. Shore A hardness of 25-30.

6. Non-yellowing, mildew resistant.

7. Color: To match adjacent area color.

G. C-1: ASTM C834, acrylic latex.

1. Color: To match adjacent area color.

H. C-2: One component acoustical caulking, non drying, non hardening, synthetic rubber.

1. Color: To match adjacent area color.

I. C-3: ASTM C570, oil and resin.

1. Color: To match adjacent area color.

2.03 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.04 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

2.05 CLOSED-CELL SPRAY POLYURETHANE FOAM

A. Closed-Cell Spray Polyurethane Foam: ASTM C 1029, Type II, minimum density of 1.5 lb/cu. ft. and minimum aged R-value at 1-inch thickness of 6.2 deg F x h x sq. ft./Btu at 75 deg F.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed Corporation.

b. Fomo Products.

c. Johns Manville; a Berkshire Hathaway company.

d. or equal.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

3. Remove laitance and form-release agents from concrete.

4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.

2. Do not stretch, twist, puncture, or tear sealant backings.

3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.

2. Completely fill recesses in each joint configuration.

3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Installation of Foam Insulation:

1. Spray insulation to envelop entire area to be insulated and fill voids.

2. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.

3. Comply with manufacturer’s written instructions.

3.04 LOCATIONS

A. Exterior Building Joints, Horizontal and Vertical:

1. Metal to Metal: Type S-1, S-2.

2. Metal to Masonry: Type S-1.

3. Masonry to Masonry: Type S-1.

4. Threshold Setting Bed: Type S-1, S-3, S-4.

5. Expansion and Control Joints: Type S-6.

B. Metal Reglets and Flashings:

1. Flashings to Wall: Type S-6.

2. Metal to Metal: Type S-6.

C. Sanitary Joints:

1. Walls to Plumbing Fixtures: Type S-9.

2. Counter Tops to Walls: Type S-9.

3. Pipe Penetrations: Type S-9.

D. Interior Joints:

1. Typical Narrow Joint 1/4 inch or less at Walls and Adjacent Components: Type C-1, C-2, C-3.

2. Perimeter of Doors, Windows, Access Panels which Adjoin Concrete or Masonry Surfaces: Type C-1, C-2, C-3.

3. Joints at Masonry Walls and Columns, Piers, Concrete Walls or Exterior Walls: Type C-1, C-2, C-3.

4. Exposed Isolation Joints at Top of Full Height Walls: Type C-1, C-2, C-3.

5. Exposed Acoustical Joint at Sound Rated Partitions: Type C-2.

6. Concealed Acoustic Sealant: Type S-4, C-1, C-2, and C-3.

E. Conduit Penetrations: Type S-9 and S-6.

3.05 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint

Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

2. Inspect tested joints and report on the following:

a. Whether sealants filled joint cavities and are free of voids.

b. Whether sealant dimensions and configurations comply with specified requirements.

c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.

3. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.

4. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.06 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.07 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 07 92 00

SECTION 23 05 00

MECHANICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This Section supplements all Sections of this Division and applies to all Work specified and indicated on the Contract Drawings. Provide for complete installation of mechanical systems.

1.02 SUBMITTALS

A. Refer to individual mechanical Sections for submittals required.

B. Submit in accordance with Section 01 33 00 - Submittal Procedures

C. If the equipment submitted under Division 23 requires changes in material or labor from that required in the Contract Drawings and Specifications, such changes shall be submitted as shop drawings.

D. Operating and Maintenance Manual.

E. Copy of the Test and Balance Report.

1.03 REFERENCE STANDARDS

A. The following abbreviations apply to all sections of Division 23:

1. AWG: American Wire Gauge.

2. HEPA: High Efficiency Particulate Air.

3. PSI: Pounds per square inch.

4. PSIG: Pounds per square inch gage.

5. PVC: Polyvinyl chloride.

6. WG: Water gage.

1.04 SERVICE MANUALS

A. Upon completion of the installation, and as a condition of its acceptance, prepare and submit an Operating and Maintenance Manual to THE STATE's Representative for approval. Compile the manual from information supplied by equipment manufacturers and from test and balance data furnished. Each manual shall include the following:

1. Copy of all As-Built controls and As-Built wiring diagrams.

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

3. Copy of all guarantees and warranties issued for components of the systems, showing all dates of expiration. Such dates shall not be sooner than the expiration of the completed installation guarantee specified herein.

4. Copy of Valve Chart:

   a. Format: Arrange format of valve charts by area and sequence all valve numbers starting with mechanical equipment rooms.

   b. Information: Furnish the following information typed on valve charts for each valve specified.

      i. Room numbers and name where valve is located, i.e., "ZG Boiler Room".

      ii. Valve number assigned by Contractor and stamped on brass plate, i.e., "147".

      iii. Service medium using designation assigned to Drawings on mechanical symbols, i.e., "heating hot water supply".

      iv. Valve types as specified in Section 23 20 00, VALVES, i.e., "eccentric plug valve" or "gate valve".

      v. Function valve serves, i.e., "strainer shut-off" or "balancing valve".

      vi. Zone identification, i.e., "AHU-2" or "auxiliary heating".

5. A complete index at the front furnishing immediate information as to location in the manual of all data regarding the installation. Numbered tab sheets shall be used.

6. Name, address and telephone number of Contractor and each subcontractor employed for work under this Division.

B. All material shall be neatly typed or shall be printed material. Instructions specified shall be in continuous narrative form not fragmented sections as prepared by individual equipment manufacturers.

C. Submit four (4) copies of manuals in binders along with two (2) digital copies with identification readable from the outside stating "HYDRONIC LOOP REPLACEMENT, Coalinga State Hospital."

1. Submit in separate, multiples of two, 3-ring loose leaf binders, 2-inch size, with chrome-plated piano hinges and black hard-coated covers.

2. Small or large literature not easily inserted in binders shall each be put in heavy manila envelopes.

3. Furnish each binder with plastic enclosed tabs on reinforced paper neatly arranged. Type each of the following on a separate tab:

a. Parts.

b. Guarantees and warranties.

c. Valve chart.

d. Index.

e. List of contractors and subcontractors.

4. File under correct tabs. Clearly identify each piece of literature and envelope with equipment name and numbers.

1.05 MANUFACTURER'S DIRECTIONS

A. In all cases where manufacturers of articles used in this Contract furnish printed directions covering points not shown on Drawings or specified, such printed directions shall be followed.

1.06 DRAWINGS

A. Diagrammatic Drawings: For purposes of clarity and legibility, the Drawings are essentially diagrammatic and, although size and location of equipment is drawn to scale, Contractor shall make use of all data in all of the Contract Documents, and verify this information at Project site.

B. Routing of Piping:

1. Drawings indicate required size and termination of pipes and suggest correct routes of piping to conform to the site and structures, to prevent obstructions and to preserve clearance.

2. It is not the intent to indicate all necessary offsets and it shall be Contractor's responsibility to install piping in such a manner as to conform to site and structures, prevent obstructions, preserve headroom, keep openings and passageways clear, and make all equipment requiring inspection, maintenance and repair, accessible without further instructions or extra cost to THE STATE.

C. Interferences:

1. No interferences shall occur which prevent grade lines from being established for the work.

2. Installed work which interferes with the work specified in other Sections of the Specifications shall be removed and rerouted at the discretion of THE STATE's Representative.

1.07 SPARE PARTS AND SPECIAL TOOLS

A. Spare parts shall be furnished to THE STATE as follows and receipts obtained and included with Service Manuals.

1. One year's supply of all expendable parts.

B. Special Tools: If any part of equipment furnished requires a special tool for assembly, adjustment, setting or maintenance thereof and such tool is not readily available on the commercial tool market, it shall be furnished with equipment as a standard accessory.

1.08 PRELIMINARY OPERATION AND EMERGENCY REPAIRS

A. THE STATE reserves the right to operate portions of the mechanical system on a preliminary basis or make emergency repairs without voiding the guarantee or relieving Contractor of its responsibilities.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Wherever possible, all materials and equipment used in the installation of this Work will be of the same brand of manufacture for each class of material or equipment.

2.02 FIRESTOPPING

A. Manufacturers:

1. 3M

2. Hilti

3. Approved by STATE

B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.

1. Silicone Firestopping Elastomeric Firestopping: {Single} {Multiple} component silicone elastomeric compound and compatible silicone sealant.

2. Foam Firestopping Compounds: {Single} {Multiple} component foam compound.

3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.

4. Fiber Stuffing and Sealant Firestopping: Composite of {mineral} {ceramic} fiber stuffing insulation with silicone elastomer for smoke stopping.

5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.

6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.

7. Firestop Pillows: Formed mineral fiber pillows.

C. Color: As selected from manufacturer's full range of colors.

2.03 SEALANTS

A. Sealant 5: One-part non-sag urethane sealant, complying with ASTM C 920, Type S, Grade NS, Class 25.

Application: Exterior door, entrance & window frames. Exterior & interior vertical joints in concrete & masonry metal in flashing

1. Bostik Construction Products Div., Chem-Calk 900.

2. Mameco International, Inc., Vulkem 116.

3. Tremco, Inc., Dymonic.

4. Sika Corporation, Sikaflex 1-A.

B. Sealant 6: Multi-part pouring urethane sealant, complying with ASTM C 920, Type M, Grade P, Class 25.

Application: Exterior & Interior joints in horizontal surfaces of concrete; between metal & concrete masonry

1. Tremco, Inc., HPL.

2. Mameco International, Inc., Vulkem 255.

3. Sika Corporation, Sikaflex 2C NS/SL.

4. W.R. Meadows, Pourthane.

PART 3 - EXECUTION

3.01 EXCAVATION AND BACKFILL

A. General:

1. Do all excavation and backfill required to install the work of this Division.

2. Perform all excavation and backfill outside of buildings' perimeters.

B. Excavation: For direct-buried piping, bury piping outside the building to a depth of not less than 2'-6" below finish grade unless noted otherwise.

C. Backfilling: Do not backfill until final inspection and approval for the piping installation by THE STATE's Representative. Backfill material shall be as specified under pertinent sections.

3.02 DEMOLITION

A. General:

1. All demolished or removed materials become the property of Contractor and it shall be its responsibility to remove such materials from the Project site.

B. Piping:

1. Piping shall be capped as follows:

a. When part of existing piping is removed.

b. When part of existing piping to be replaced pipe shall be capped temporarily until new piping is connected.

C. Insulation: All damaged insulation on existing or new piping or equipment shall be replaced by Contractor at no additional cost to THE STATE.

3.03 SERVICE CONTINUITY

A. All facility utilities and equipment shut-down shall be coordinated with THE STATE's Representative.

3.04 PROTECTION AND CLEANING

A. Protection: Fully protect all finished parts of the materials and equipment against physical damage from whatever cause during the progress of this work and until completion.

B. During construction, cap all lines and equipment nozzles so as to prevent the entrance of sand and dirt. Protect equipment by covering it with polyethylene sheets.

C. Cleaning: After installation has been completed, clean all systems as follows:

1. Piping and Equipment to be Insulated: Clean exterior thoroughly to remove rust, plaster, cement and dirt before insulation is applied.

3.05 CUTTING AND PATCHING

A. Sleeves and Inserts: Provide all sleeves, inserts, and openings necessary for the installation of the mechanical work.

B. Openings:

1. Special forming, recesses, chases, and curbs, as necessary for the correct reception and installation of the mechanical equipment, as shown on the Drawings, are specified in other Divisions.

2. Examine all Drawings to ascertain that correct provisions have been made for the work. If such provisions are not made in time, Contractor shall bear all extra costs incurred in later cutting and patching to accommodate this work.

3.06 CONCRETE WORK

A. Housekeeping Pads and Isolation Bases:

1. Furnish all required dimensional drawings for bases and pads and location thereof.

2. Furnish all embedded anchor bolts and sleeving and ensure installation of same.

3.07 OPERATIONAL TESTS

A. General:

1. Before acceptance tests are performed, demonstrate to THE STATE's Representative that all systems and components are complete.

2. Systems shall be operable and capable of maintaining continuous uninterrupted operational service during the operating and demonstration periods of operation.

3. All control systems shall be completely operable with calibration and setting correctly set and adjusted.

B. Test and Balance:

1. Pressure tests shall be performed as specified.

2. General:

a. Notify THE STATE's Representative when any test is ready to be performed. THE STATE's Representative is to be present for all tests.

b. Furnish all equipment required for testing including fittings for additional openings and all openings required inside and outside the buildings.

c. After the inspection has been approved, or portions thereof, certify in writing the time, date, name and title of the person approving the test. This shall also include the description and what portion of the system has been approved. The person making the inspection shall sign the certification.

d. A complete record shall be maintained of all testing that has been approved, and shall be made available at the Project site to all authorities concerned.

e. Upon completion of the work, all records and certifications approving testing requirements shall be submitted to THE STATE's Representative.

f. Defective work or material shall be replaced or repaired as necessary at no additional cost to THE STATE and the inspection and test repeated. Repairs shall be made with new materials. No caulking of screwed joints or holes will be acceptable.

g. Isolate all equipment subject to damage from test pressure. Make no test against a service valve or meter.

3. Timing of Tests: Two weeks before expected completion date, put all systems and equipment into operation and continue operation of same during each working day, but

not less than five 8-hour periods, until demonstration of all adjusting, balancing and testing has been approved.

4. Functional Tests: Any installed item not meeting the schedule or specified performance shall be removed and replaced with items whose performance is in accordance with the Drawings and Specifications at no additional cost to THE STATE.

5. After all systems have been completely installed, connections made and tests completed, make arrangements with THE STATE's Representative to operate the systems for a period of ten (10) working days during the hours of a normal working day.

6. Notify THE STATE's Representative in writing when the operational period may start and the time for this period shall be scheduled by mutual agreement.

7. During this operation period, instruct THE STATE's operating personnel in accordance with written instructions of the Service Manual specified.

8. Perform tests as specified and as requested by THE STATE's Representative to prove installation is in accordance with Contract requirements. Perform tests in presence of THE STATE's Representative, and furnish test equipment, facilities, and technical personnel required to perform tests.

3.08 SERVICES

A. General: Perform service on all mechanical Work until acceptance of the Work including oiling and greasing, adjustments, cleaning, packing of seals, and other items as recommended by equipment manufacturer in the maintenance manual hereinbefore specified.

B. Strainers: Remove, clean and reinstall each strainer screen as specified below after systems have been flushed.

1. Clean each strainer screen after all adjustments have been made and system has operated a minimum of 24 hours, but before final test and balancing operation is started.

2. Clean each strainer screen again, after final test and balancing operation and before completion of the Project.

C. Purge all air from water systems after each servicing. Protect all furnishings and finishes during each servicing operation and repair or replace to original condition those damaged as a result of servicing at no additional cost to THE STATE.

D. Replace insulation removed or damaged after each operation. Use insulation as specified in Section 23 07 00, MECHANICAL INSULATION.

E. Put system in full operating condition.

3.09 INSTALLATION – FIRESTOPPING

A. Install material at fire-rated construction perimeters and openings containing penetrating

sleeves, piping, ductwork, conduit and other items, requiring firestopping.

END OF SECTION 23 05 00

SECTION 23 05 16

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work:

1. Construction, installation, materials and equipment described herein are generally common to the various sections of this Division.

2. Refer to individual mechanical section for piping schedule required for each particular piping system.

3. Requirements of this Section are in addition to any similar or more comprehensive requirements in other sections of this Division.

4. Requirements of this Section apply to all sections in this Division, except as may be specifically modified in those sections.

1.02 SUBMITTALS

A. Submit in accordance with Section 01 33 00 - Submittal Procedures

B. Descriptive Data:

1. Flow switches.

2. Pressure switches.

3. Lists of material manufacturers.

4. Flexible couplings.

C. Shop Drawings:

1. Miscellaneous equipment supports.

D. Underground Distribution System: Submit manufacturer's certification showing underground distribution system was installed in the presence of a manufacturer's representative and in accordance with manufacturer's printed requirements.

E. Welding: Submit proposed welding procedures and list of proposed qualified welders. Refer to paragraph 3.03 D below.

PART 2 - PRODUCTS

2.01 CHILLED WATER PIPING

A. Typical Service: Chilled water systems.

B. Pipe: See Section 23 20 13, ABOVE-GROUND PIPING; and Section 23 20 16, UNDERGROUND PIPING.

C. Valves: See Section 23 20 00, VALVES.

D. Strainers:

1. 250 lb. Y-pattern bronze, screwed, with machined gasketed strainer screen retainer cap. NIBCO or approved equal.

2. Strainer screen shall be Monel with 3/64" perforations (225 per sq. inch).

E. Air Vents: See paragraph 2.01 E in Section 23 05 19, PIPING SPECIALTIES.

2.02 HEATING HOT WATER PIPING

A. Typical Service: Heating hot water.

B. Pipe: See Section 23 20 13, ABOVE-GROUND PIPING; and Section 23 20 16, UNDERGROUND PIPING.

C. Valves: See Section 23 20 00, VALVES

D. Strainers:

1. 250 lb. Y-pattern bronze, screwed, with machined gasketed strainer screen retainer cap. NIBCO or approved equal.

2. Strainer screen shall be Monel with 3/64" perforations (225 per sq. inch).

E. Air Vents: See paragraph 2.01 E in Section 23 05 19, PIPING SPECIALTIES.

2.03 EQUIPMENT DRAIN, INDIRECT WASTE, AND CONDENSATE DRAIN PIPING

A. Pipe: Copper Tubing, ASTM B88, Type M, hard drawn. Fittings shall be ANSI/ASME B16.22 solder wrought copper. Joints: ASTM B32, solder, Grade 95TA lead free.

B. Condensate drain from air handling unit shall be insulated.

2.04 DISSIMILAR METAL PIPING JOINTS

A. Use non-conductive fittings whenever ferrous and non-ferrous piping material are joined together.

1. HVAC Systems: Cast iron fitting.

2. Domestic or Industrial Water: Threaded M.P.S. minimum 3-inches long electro-zinc plated steel casing with inert NSF/FDA listed lining. ASTM F-492 rated at 225°F, 300 PSI.

2.05 INSTRUMENTS

A. Thermometers and pressure gages shall be as specified in Section 23 05 19, PIPING SPECIALTIES.

2.06 HANGERS AND SUPPORTS

A. See Section 23 05 29, PIPING HANGERS AND SUPPORTS

2.07 PIPE CLEANING

A. See Section 23 20 13, ABOVE-GROUND PIPING; and Section 23 20 16, UNDERGROUND PIPING.

2.08 WATER TREATMENT

A. See Section 23 25 00, HVAC WATER TREATMENT

2.09 SLEEVES, CORE DRILLING AND ESCUTCHEONS

B. General:

1. Sleeves shall be permanently installed type where waterproofing is required and cast-in-place or drypacked in core drilled hole.

2. Escutcheons shall be prime coated steel type unless otherwise specified.

C. Sleeves:

1. Exterior Walls and Floor Slabs Below Grade: Concrete pipe dry-packed in place with annular space caulked watertight.

2. Roof Slab: Cast iron sleeve with integral flashing clamp. DANCO or approved equal.

D. Escutcheons shall be as follows:

1. 6" and Smaller: Prime coated steel with set screw. DANCO or approved equal.

2. Larger than 6": Prime coated brass with set screw. M.W. SAUSSE or approved equal.

E. Caulking:

1. Watertight: M.W. SAUSSE or approved equal.

2. Fireproofing Sound Attenuating: Caulk with a compressible polyurethane foam strip.

2.10 FLASHING

A. Flashing shall be 4 lb. seamless lead flashing assembly with 10" skirt, steel reinforcing boot and caulk type counterflashing sleeve.

B. Manufacturer: Flashing assembly shall be MAYCO or approved equal.

2.11 ACCESS PANELS

A. Sizes: As required for complete access; minimum size 12".

B. Doors:

1. No. 13 USSG steel door and trim.

2. No. 16 USSG steel frame.

3. Metal wings for keying into construction.

4. Concealed hinges, cylindrical lock keyed to facility security standards.

5. In Plaster Ceilings: ACUDOR or approved equal.

6. In Wallboard: ACUDOR or approved equal.

C. Access Tile Identification: Buttons, tabs and markers to identify location of concealed work. Submit for review.

D. Provide cylindrical lock keyed to security standards.

PART 3 - EXECUTION

3.01 GENERAL

A. Rough-in Work: Proceed as rapidly as the building construction will permit; complete, test and have approval before enclosing.

B. Conceal all piping within finished rooms unless otherwise noted on Drawings.

C. Cleaning: Thoroughly clean piping before installation. Cap all pipe openings to exclude dirt until fixtures are installed and final connections made.

D. Cut pipe accurately to measurements established at the building; work into place without springing or forcing; clear all windows, doors and other openings. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted.

E. Pipe Damage: Show no tool marks or threads on exposed plated, polished or enameled connections from fixtures. Tape finished surfaces to prevent damage during plastering.

F. Make all changes in direction with fittings and changes in main sizes through eccentric reducing fittings. Unless otherwise noted, install water supply and return piping with straight side of eccentric fittings at top of pipe.

G. Pitch pipe lines as required for drainage and elimination of air as follows:

1. Chilled and Heating Hot Water: Upwards in direction of flow.

2. Waste: 1/4" per foot downwards toward mains.

3. Vents: 1/3" per foot upwards away from fixture trap.

H. Provide swing joints, ball joints, expansion loops, and devices necessary for a flexible piping system.

I. Securely bolt in place to building structures all equipment, isolators, hangers, etc.

J. Provide union and shut-off valves located to facilitate maintenance and removal of all equipment or apparatus.

K. Equipment Specified in Other Sections: For rough-ins and final connections to equipment specified in other Sections, ascertain exact sizes, services and locations before starting work. Ensure accuracy of work shown on Drawings before starting work. Furnish correct installation.

L. Dissimilar Metals: Provide cast iron fittings or flanges between all ferrous and non-ferrous materials.

M. All piping connections to equipment shall be made with screwed or flanged unions to permit dismantling. Unions shall also be installed in the piping systems to permit disassembly consistent with good installation practice and as required for removal of connected equipment from place of installation.

N. Sleeves, frames, and wall pipes shall be provided for all pipes and ducts passing through concrete floors and walls. Special sleeves through floors and walls shall be installed in accordance with manufacturer's printed instructions and as detailed.

1. All sleeves and frames through exterior floors and walls above ground and all interior floors and walls shall be black iron pipe unless otherwise noted. Sleeves and frames shall be of a size to accommodate the pipe or duct and insulation. Sleeves and frames shall be grouted in place with installation left smooth and finished to match surrounding surfaces.

2. Pipes penetrating fire-rated walls, partitions, roofs, or floors shall have the opening between the pipe and the building construction material, or between the pipe and the sleeve, sealed with an intumescent fire barrier material produced by PARAGON or approved equal. Thickness of fire barrier shall be appropriate for fire rating of building component.

3. Pipes passing through exterior floors and walls below ground, 2-1/2-inches and smaller, shall utilize black iron pipe sleeves as specified for above-ground in conjunction with a modular mechanical-type seal as hereinafter specified.

a. The modular mechanical-type seal shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall sleeve. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut. Tightening of the bolts shall cause the rubber sealing elements to expand, providing a watertight seal between the pipe and wall sleeve.

b. The required inside diameter of the sleeve and the installation of the seal shall provide a watertight joint. Seals shall be "Link Seal" manufactured by LINK SEAL or approved equal. Provide a seal consisting of a combination of a sleeve and a pressure clamping system manufactured by LINK SEAL or approved equal.

4. Cutting of openings and installation of sleeves and frames through exterior floors and walls above grade, and interior floors and walls shall be done in a neat, workmanlike manner. Openings shall be cut only as large as required for the installation.

5. Escutcheons for exposed pipe through floors and walls where exposed to view shall be provided and shall be chromium plated except where special escutcheons are required under plumbing fixtures. Escutcheons shall be sized to conceal the floor or wall opening and sleeve.

O. Interference: Wherever piping runs above or below ceilings, arrange the run of the piping in such a manner that it does not interfere with grilles, light outlets or light fixtures.

P. Valves: Valves shall be provided on all piping wherever indicated or specified using adapters where required. All removable or replaceable equipment shall be valved. All valves shall have a securely fastened stamped brass metal plate, each bearing a different number identified in the maintenance manual.

Q. Openings in Pipes: All openings in pipes shall be kept closed during the progress of the Work.

R. Lubrication: Furnish all lubrication for the operation of all equipment until completion. Run in all bearings, and after they are run in, drain and flush bearings and refill with a new oil change. Refer to maintenance manual specification for lubrication chart. Bearings that require greasing shall be greased in accordance with the maintenance manual procedure.

3.02 HANGER AND SUPPORTS

A. Refer to Section 23 05 29, PIPING HANGERS AND SUPPORTS.

3.03 PIPE JOINTS

A. Copper Piping:

1. Cut square, remove burrs and clean inside of female fitting to a bright finish with steel wool, wire brush, sandpaper or emery cloth. Apply solder flux with brush to tubing. Remove internal parts of solder-end valves prior to soldering.

2. Provide cast iron fittings at points of connection of all copper tubing and any ferrous end equipment.

3. All soldered or brazed joints shall be made by a brazer currently certified for 2-inch pipe. Certifying individual or agency shall in turn be certified by AWS.

4. All soldered or brazed joints shall be acceptable only if 100% full joint penetration of the soldering or brazing alloy is achieved.

5. All soldered or brazed joints shall comply with Section IX of ASME Boiler and Pressure Vessel Code.

6. Joints for copper tube shall be as follows:

    a. Systems Operating at Below 100ºF: 95-5 tin-antimony solder.

    b. Systems Operating at 100ºF and Above: Sil-Fos brazing.

B. Screwed Piping:

1. Cut with machine cutter, hand pipe cutter or carborundum pipe wheel. Deburr with file or scraper or pipe reamer. Do not ream to exceed I.D. of pipe and thread to ANSI B2.1 requirements.

2. Use teflon tape on male thread prior to joining other services. No more than two full threads shall remain exposed after joinings.

3. Use litharge and glycerin on joint prior to joining for air piping.

C. Brass Screwed Pipe:

1. Cut threads, remove burrs, and apply red lead or approved pipe dope as specified for steel screwed pipe.

2. Make up pipe with surface of chrome plated pipe and fittings.

3. Do not mark surface of chrome plated pipe and fittings.

D. Welding:

1. Before proceeding, submit for approval:

    a. Proposed procedures conforming to.

    b. List of Welders: Qualified per Section IX of ASME, Boiler and Pressure Vessel Code.

2. Field Procedures:

    a. Pipe cleaned free from rust, scale and oxide.

    b. Pipe Beveled Each End: Per approved procedures.

    c. Backing rings: Hot water over 100 psi.

E. Leaky Joints:

1. Remake leaky joints with new material.

2. Remove leaking section and fittings as requested by THE STATE's Representative and replace as approved and at Contractor's expense.

3. Do not use thread cement or caulking to make joint tight.

3.04 ACCESS TO EQUIPMENT

A. General:

1. All piping, equipment and accessories shall be installed to permit access for maintenance.

2. Any relocation of piping, equipment and accessories required to provide maintenance access shall be accomplished by Contractor at no additional cost to THE STATE.

B. Access:

1. Supply access doors where any valves and equipment requiring access for servicing, repairs or maintenance are located in walls, chases, or above ceilings.

2. Arrange for the necessary openings in the building to allow for admittance of all apparatus.

3.05 INSTRUMENTS

A. Installation of Pressure Gages:

1. Pressure gages installed on insulated pipe or equipment shall be installed with extension nipples.

2. Locate gages for ease of reading and removing.

3. Install all gages with shut-off cocks.

4. Install one gage between the suction and discharge lines of pumps with shut-off cock on each side and interconnecting piping made up with flexibility.

3.06 SLEEVES, CORE DRILLING AND ESCUTCHEONS

A. Sleeves:

1. Provide sleeving for all pipes that penetrate walls and floors.

2. Cast Iron Sleeves: Secure waterproofing membrane under flashing clamp. Caulk annular space watertight.

3. Sleeves in floors shall extend 2" above finish floor with annular space caulked watertight.

B. Core Drilling:

1. Core drilled holes shall be sized to allow for dry packing sleeves in place; to allow for insulation to extend through holes; to allow for fireproof caulking or clearance around pipes to prevent direct contact between pipes and structures.

2. Locations of core drilling shall be approved by THE STATE's Representative prior to drilling.

C. Escutcheons: Provide escutcheons on all piping that penetrates floors, walls and ceilings where exposed to view.

3.07 VALVES

A. See Section 23 20 00, VALVES

B. General:

1. All valves shall be first quality of approved equal manufacture, shall allow for necessary clearances, and shall be tight at the specified test pressure.

2. Each valve shall have the maker's name or brand, the figure or list number and the guaranteed working pressure cast on the body and cast or stamped on the bonnet, or shall be provided with other means of easy identification.

3. Valves shall be minimum working pressure and materials as fittings specified for the service except as herein modified.

4. All gate and globe valves shall be repackable under pressure. Regardless of service, valves shall not be designed for less than 125 lbs. per square inch steam working pressure.

C. Arrangement: Valves shall be installed in the systems so located, arranged and operated as to give complete regulation of all apparatus, equipment and fixtures.

D. Installation: Valves shall be installed in the following locations:

1. In all branches and headers of water pipe serving a group of fixtures.

2. On both sides of all apparatus and equipment.

3. For shutoff of risers and branch mains.

4. For flushing and sterilizing the systems.

5. Where shown on the Drawings.

6. Valves shall be installed for accessibility and easy maintenance.

3.08 STRAINERS

A. General:

1. Bronze bodied strainers shall be installed in copper piping systems.

2. Blow-out connection shall be valved with valve sized same as the blow-out connection.

B. Valves: Valves shall be gate or ball type.

3.09 FLASHING

A. Piping: Provide flashing assembly with counter-flashing on each pipe passing through roof.

3.10 EQUIPMENT SUPPORTS

A. General:

1. Provide all necessary steel framing supports for piping and equipment for a complete and correct installation.

B. Approval: Submit drawings of miscellaneous supports for approval.

END OF SECTION 23 05 16

SECTION 23 05 19

PIPING SPECIALTIES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Provide piping specialties as indicated on the Drawings and as specified, complete.

1.02 SUBMITTALS

A. Submit in accordance with Section 01 33 00 - Submittal Procedures

B. Shop Drawings and Product Data:

1. The following list includes the required shop drawings that shall be submitted:

a. Vents

b. Vacuum breakers

c. Pressure gages

d. Thermometers

e. P/T test plugs.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Pressure Gauges:

1. Manufacturers:

a. H.O. Trerice Co.

b. AMETEK, U.S. Gauge Div.

c. Ashcroft by Dresser Industries.

d. Marsh Instrument Co.

e. Weiss Instruments Inc.

f. Or equal.

2. Gauge: ASME B40.1.

a. Liquid filled.

b. Dial Size: 4-1/2-inch diameter.

c. Scale: Both psi and kPa.

d. Bourdon Tube: 316 Stainless Steel.

e. Socket: 316 Stainless Steel.

f. Movement: Stainless Steel.

g. Case: Aluminum, solid front with blow-out back.

h. Ring: Threaded fiberglass reinforced polypropylene.

i. Window: Acrylic.

j. Pointer: Micro adjustable, black finished, front adjustable.

k. Dialface: Aluminum, white background with black graduation and markings.

l. Accuracy: 0.5 percent of scale range, ASME B40.100 Grade 2A.

m. Options Required:

1) Red Set Hand.

2) Maximum Registering Pointer.

3. Snubber Screw. Provide on all gauges on suction and discharge sides of pumps.

4. Select dial range of each gauge for normal operating point at mid-span and full range not to exceed 50% of test pressure.

B. Pressure Gauge Taps

1. Manufacturers:

a. H.O. Trerice Co.

b. Or equal.

2. Needle Valve: ¼ inch NPT for minimum 125 psi.

3. Ball Valve: Brass ¼ inch NPT for 125 psi.

4. Pressure Snubber:

a. Series 872 Brass.

b. ¼ inch NPT connections.

c. Or approved equal.

5. Coil Siphon:

    a. Series 885.

    b. 40 Brass.

    c. ¼ inch NPT.

    d. Or approved equal.

C. Dial Thermometers

1. Manufacturers:

    a. H.O. Trerice Co.

    b. AMETEK, U.S. Gauge Div.

    c. Ashcroft by Dresser Industries.

    d. Marsh Instrument Co.

    e. Weiss Instruments Inc.

    f. Or approved equal.

2. Thermometer: ASTM E1.

    a. Bimetallic type.

    b. Dial Size: 5 inch diameter.

    c. Scale: Dual Scale Fahrenheit and Celsius.

    d. Case: Stainless Steel.

    e. Window: Glass.

    f. Pointer: Black finished.

    g. Dialface: Aluminum, white background with black and blue graduations and markings.

    h. Accuracy: +/- 1% Full Scale.

    i. Options Required:

        1) Maximum Registering Pointer.

        2) Silicone Dampened Movement.

3. Select dial range of each gauge for normal operating point at mid-span and full range not to exceed 50% of maximum design.

4. Connection: ½" brass union with copper bulb for hydronic service. Provide and select bulbs suitable for steam service. Select bulb length to extend into 2/3 of pipe diameter.

5. Provide thermowells for each thermometer. The thermowells shall be selected for each gauge bulb and shall be ½" NPT. Provide brass thermowells.

D. Test Plugs

1. Manufacturer:

a. Peterson Equipment Company Inc, Pete's Plugs, or approved equal.

2. ¼ inch NPT or ½ inch NPT brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with:

a. Neoprene core for temperatures up to 250 degrees F at 125 PSIG.

b. Nordel core for temperatures up to 250 degrees F at 125 PSIG.

E. Air Vents:

1. Air vents shall be installed on all coils, and other points required for efficient operation of system.

a. Automatic Vents shall be:

1) Bell & Gossett: Model # 87.

2) Hoffman: Water Air Vent Valves, Model # 78, # 79.

3) Honeywell: Model # EA79A1004.

4) Or approved equal.

b. Automatic air vents shall be installed on high points in piping and where exposed to view for operating pressures to 200 psig.

c. Manual Vents: For vents on coils, and other mechanical equipment, Mueller Co., BELL & GOSSETT or approved equal.

1) Provide air chambers at all high points in piping with air vent cocks fully accessible. Provide air chambers with diameters same size as pipe and a minimum of 2 inches long except furnish same length as diameter for pipes larger than 2 inches. When air vent cocks on air chambers are not fully accessible, extend cocks with 1/4 inch copper water tube ASTM B 88, Type K.

d. Vacuum Breakers: Vacuum breakers shall be WATTS or equal with bronze

body chrome plated in finished areas.

PART 3 - EXECUTION

3.01 ADJUSTMENT AND CLEANING

A. Valves and Specialties:

1. All valves and specialties shall be adjusted to operate smoothly and without binding or leaking. All vents shall be tested and proven to open freely for the passage of air.

2. Locate strainers as necessary to allow easy cleaning.

3. Provide P/T test plugs at each sensor in the heating hot water and chilled water piping loops for use in performing calibration checks and for troubleshooting.

END OF SECTION 23 05 19

SECTION 23 05 29

PIPING HANGERS AND SUPPORTS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Provide piping supports, hangers, guides, and anchors as indicated on the Drawings and as specified, complete.

1.02 SUBMITTALS

A. Submit in accordance with Section 01 33 00 - Submittal Procedures

B. Shop Drawings and Product Data:

1. The following list includes the required shop drawings and product data that shall be submitted:

a. Manufacturer's technical product data, installation instructions, and dimensioned drawings for each type of pipe and pipe fitting.

b. Piping schedule showing manufacturer, pipe weight, fitting type, and joint type for each piping system.

c. All pipe supports, hangers, guides, and anchors shall be submitted as shop drawings.

C. Pressure Tests:

1. All pressure tests shall be performed with the use of a bristol recording gage, and a record of all tests kept for hand-over to THE STATE.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All hangers, supports, anchors, and guides for pressure piping shall be in accordance with ANSI B-31.

B. Horizontal Piping Hangers:

1. Provide one of the following types of hangers for horizontal piping manufactured by TOLCO or approved equal.

a. All Pipes Except Copper:

1) Except as otherwise specified, provide clevis type, TOLCO or approved equal. Provide clevis hanger for insulated lines up to 12 inches, TOLCO or approved equal to keep the clevis nut outside the insulation.

2) Where the pipe exceeds the maximum loading recommended for clevis type hangers, provide steel pipe clamp, TOLCO or approved equal.

2. Copper Tubing Support:

   a. Hangers in direct contact with pipe. TOLCO or approved equal.

   b. Hangers on Outside of Insulation. TOLCO or approved equal.

3. Provide trapeze hangers where several pipes can be installed parallel and at the same level, and fabricate from structural steel shapes.

4. Floor Supports: Provide one of the following means of supporting horizontal piping from floor.

   a. Where bottom of piping is less than 1 foot-6 inches above finish floor for 0 to 8 inches diameter, provide cast-iron pipe rests, TOLCO or approved equal, with pipe nipples to suit. Fasten to floor.

   b. Where bottom of pipe is higher than 1 foot-6 inches above finish floor and where provision for expansion is required provide pipe-roll stands, TOLCO or approved equal, without vertical adjustment, or TOLCO or approved equal, with vertical adjustment as required. Provide concrete piers and fasten stands to piers.

5. Wall Supports: Provide the following means of supporting horizontal piping from wall.

   a. Provide steel J-hook for pipe located close to wall, up to 3-inch pipe, TOLCO or approved equal.

   b. For hanger suspension with 750-pound maximum loading, provide light welded-steel bracket with hole for one rod, 3/4-inch diameter, TOLCO or approved equal.

   c. For pipe-roll stand support, provide welded-steel bracket, light for 700-pound maximum loading, TOLCO or approved equal, medium for 1500-pound maximum loading TOLCO or approved equal, heavy for 3000-pound maximum loading, TOLCO or approved equal.

C. Vertical Piping Supports:

1. All Pipes except Copper: Vertical pipe supports shall be steel extension pipe-clamps, TOLCO or approved equal. Maximum loading for each size pipe: 3/4"-2"/255 lbs.; 2-1/2"/390 lbs.; 3"/530 lbs.; 4"/810 lbs.; 6"/1570 lbs.; 8"/2500. Bolt clamp securely to pipe, reset clamp-end extension on building structure.

2. Copper Tubing Support: For uninsulated vertical lines, provide plastic coated riser clamp, TOLCO or approved equal, with isolation fitting.

D. Beam clamps shall be malleable iron, TOLCO or equal, for 3/8-inch hanger rods. Forged-steel beam clamp, TOLCO or approved equal, for hanger rod up to 1-1/2 inches.

E. Inserts:

1. Furnish and set inserts in concrete forms. Provide reinforcing rods for pipe sizes over 3 inches.

2. Concrete inserts shall be black malleable iron universal type for threaded connections with lateral adjustment, TOLCO or approved equal, for pipe sizes up to 8 inches.

3. For pipes 8 inches and over or equivalent group of pipes on trapeze, use two or more inserts to prevent exceeding maximum loading in accordance with manufacturer's printed instructions.

F. Anchors and Guides: Provide anchors and guides where indicated on the Drawings. Guides shall be TOLCO or approved equal.

PART 3 - EXECUTION

3.01 PREPARATION

A. Piping and Fittings. Ream all pipe to full inside diameter after cutting and clean before erection.

3.02 INSTALLATION

A. General.

1. Run all piping as direct as possible and conceal piping in finished rooms unless shown or specified otherwise. Arrange pipe lines to give ample room for the pipe insulation specified in Section 23 07 00, MECHANICAL INSULATION.

2. Make tee connections with standard tee fittings for full size branches. For reduction branches, when branch line is a minimum of 2 pipe sizes smaller than main line, use reducing tees or weldolets and threadolets for steel pipe and brazolets for copper pipe.

3. Screwed joints shall be made with teflon tape or a pipe joint compound recommended by the pipe manufacturer, applied to the male threads only. Welded joints shall be welded as set forth in the standard manual of Pipe Welding of the Heating, Piping, and Air Conditioning Contractors Association.

4. Joints in copper pipework shall be made with silver solder for systems operating at 100ºF or above, and with 95-5 tin-antimony solder for systems operating at below 100ºF.

B. Installation.

1. Condensate Drainage System Pipe Joints.

a. Joints in copper drainage tube shall be soldered using ASTM B 32, Grade 50A solder and fittings recommended by the tube manufacturer. Surfaces to be soldered shall be cleaned bright. The joints shall be fluxed and made with solder.

2. Hangers.

a. Provide hangers to support the required loads. Supports shall permit movement

due to expansion and contraction. Where Drawings indicate details of supports and anchors, conform to details shown. Where details are not shown, conform to requirements of this Section.

b. Support piping with hangers in direct contact with the pipe for insulated piping not requiring a vapor barrier except on pipes where pipe saddles are specified. Size hangers to fit on the outside of insulation requiring a vapor barrier and on pipes having pipe saddles. Refer to Section 23 07 00, MECHANICAL INSULATION.

c. Hang pipe from primary building structure. Piping shall not be hung from other piping. All rigid hangers shall provide a means of vertical adjustment after erection. Do not suspend pipe from metal roof deck.

d. Where non-insulated pipes, in which vibration may occur, pass through walls, floors, or partitions, encase pipe in acoustical wall sleeves.

3. Hydronic Piping.

   a. Water Piping:

4. Piping shall be run as indicated on the Drawings.

5. Allowance for expansion shall be made in the installation of all piping so that the usual variation in temperature will not cause undue stress at any point. Pipes shall be securely anchored where necessary to correctly distribute expansion stresses.

6. Eccentric fittings shall be used for all changes in pipe sizes of supply and return lines arranged to prevent trappage of air, except where reducing tees are used.

7. Flanged elbows shall be installed for water connections to equipment with heat exchangers to allow easy removal of tube bundles. No obstruction shall be placed in space required for tube removal.

8. Concealed high points shall have air chambers with 1/4-inch copper tube vent line and stop cock carried to accessible point.

   a. Valves and Strainers:

9. General: Provide valves at each piece of equipment to provide isolation of the equipment from its connected system. Locate strainers and valves as necessary to provide easy isolation and cleaning of strainers.

10. Unless shown otherwise, provide a check valve, a balancing valve and gate valve, in the discharge line and a strainer and gate valve in the suction line of each circulating pump.

11. Equipment with automatic control valves shall have gate valves installed either ahead or behind the control valve, to permit removal of the control valve from the line without draining the system.

12. Provide "eccentric plug valves" for balancing valves.

13. Provide gate valve or butterfly valves for isolation.

3.03 HORIZONTAL PIPING SUPPORT

A. Support horizontal piping on threaded hot rolled steel rod. Threaded rod shall not be reduced to sizes smaller than provided for in support thread sizes.

B. Maximum spacing between single supports for steel pipe and copper tubing shall be in accordance with SMACNA.

C. The spacing specified is included to limit deflection in the pipe to an acceptable minimum. Shorten intervals as necessary so the support manufacturer's maximum recommended safe load values in accordance with ANSI B 31.1 are not exceeded.

D. Trapeze Hanger. Spacing shall not be farther than the closest interval for any size pipe supported thereby, or as necessary to prevent damage or failure to the structure. Provide additional framing as required to transfer loads to structure.

E. Supporting rods shall be attached to concrete by inserts placed before concrete is poured.

F. Supporting rods over 18 inches long shall be braced at every fourth hanger with diagonal bracing attached to the structure by inserts placed before concrete is poured.

3.04 VERTICAL PIPING SUPPORT

A. Support vertical piping with wrought steel riser clamps.

B. Support steel pipe at every floor to relieve joint stresses.

C. Where pipe sleeves extend above floor, place pipe clamps at ceiling below, support clamp-end extension from inserts.

3.05 FIELD QUALITY CONTROL (HYDRONIC PIPING)

A. Piping System Leak Tests:

1. Make pressure tests in the presence of THE STATE's Representative.

2. Piping: Pressure test at 125 psig (860 kPa) or 150% of the operating pressure, whichever is greater. If found that any portion of the system does not function correctly, Contractor shall make corrections as approved at no additional cost to THE STATE.

END OF SECTION 23 05 29

SECTION 23 05 48

VIBRATION AND SEISMIC CONTROL

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Provide all vibration isolators for mechanical equipment to prevent the transmission of vibration and mechanically transmitted sound to the building structure as indicated on the Drawings and as specified, complete. Include adjustments of each mounting system, and the measurement of isolator system performance. Specific mounting arrangements for each item of mechanical equipment shall be as described herein, and as indicated by schedules and details on the Drawings.

B. Provide seismic restraints on piping and equipment as required by 2022 California Building Code (CBC), Part 2, Title 24 C.C.R.

1.02 SUBMITTALS

A. Submit in accordance with Section 01 33 00 - Submittal Procedures

B. Shop Drawings, Product Data and Calculations:

1. The following list includes the required shop drawings that shall be submitted:

a. Manufacturer's model number for each isolator, the machine or pipeline to which it is to be applied, and the number of isolators to be furnished for each machine or pipeline.

b. For steel spring mounts or hangers - free height, deflected height, solid height, isolator loading, and diameter of spring coil.

c. For neoprene isolators - free height, deflected height, and isolator loading.

d. Dimensional and weight data for concrete inertia bases, steel and rail bases, and details of isolator attachment.

e. For seismic slack cables - indicated method to achieve vertical restraint.

f. Furnish seismic calculations and drawings per CBC 2022 for all mechanical equipment, isolated or non-isolated, piping and ductwork. Calculations shall be certified by a registered engineer with experience in the design of restraints for flexibly mounted equipment. Seismic restraint design and anchorage design are part of this certification requirement.

C. Submit written certification from isolation manufacturer that isolation is installed correctly.

1.03 JOB CONDITIONS

A. Existing Conditions: Notify the STATE's Representative of any Project conditions which adversely affect vibration isolation system installation or performance. Do not proceed until approval is received.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General:

1. Vibration isolators shall be provided in accordance with the weight distribution to produce uniform deflection. Furnish deflections indicated.

2. Where indicated, scheduled, or specified, provide specific vibration isolation equipment manufactured by M.W. SAUSSE or approved equal. Where specific type of vibration isolation equipment is not shown or specified, provide isolators recommended by the isolation manufacturer compatible with equipment arrangements shown. A single manufacturer for all vibration isolation equipment is required, unless specifically approved in writing by the STATE's Representative.

B. Bases:

1. Base Type A. Provide steel base where shown on the Drawings. Bases shall be one of the following types:

a. Integral Structural Steel Base. Base shall be rectangular in shape for all equipment other than centrifugal refrigeration machines and pump bases which may be tee shaped. Pump bases for split case pumps shall include supports for suction and discharge base ells. All perimeter members shall be beams with a minimum depth equal to 1/10 of the longest dimension of the base. Beam depth shall not exceed 14 inches provided that the deflection and misalignment is kept within the limits as recommended by the manufacturer. Height saving brackets shall be employed in all mounting locations to provide a base clearance of 1 inch. Bases shall be M.W. SAUSSE or approved equal.

b. Steel Rail Base. Base shall be for equipment having legs or bases that do not require a complete supplementary base. Members shall be rigid to prevent stress in the equipment, and shall be cross braced to prevent twisting under seismic loads.

1) Bases with Spring Isolators. Base shall be constructed of steel wide flange members welded to height saving brackets. Base shall be M.W. SAUSSE or approved equal with cross braces.

2) Bases with Neoprene Isolators. Base shall be constructed of steel channel rails. Bases shall be M.W. SAUSSE or approved equal with cross bracing.

2. Base Type B. Provide floating concrete base where shown on the Drawings. Provide rectangular structural channel concrete forms for floating foundations. Bases for split case pumps shall be large enough to provide support for suction and discharge base ells. Channel depth shall be a minimum of 1/12 of the longest

dimension of the base, but not less than 6 inches. The base depth shall not exceed 12 inches unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include 1/2 inch diameter reinforcing bars welded in place on 6 inch centers running both ways in a layer 1-1/2 inches above the bottom and drilled steel members with sleeves welded below the holes to receive the equipment anchor bolts. Height saving brackets shall be employed in all mounting locations to maintain a 1 inch clearance below the base. Bases shall be M.W. SAUSSE or approved equal.

C. Isolators:

1. General. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid, equal to 50% of the rated deflection.

2. Isolator Type 1, Neoprene Mounting. Double deflection neoprene mounting shall have a minimum static deflection of 0.35 inch. All metal surfaces shall be neoprene covered to prevent corrosion and have friction pads both top and bottom so they need not be bolted to the floor. Bolt holes shall be furnished for those areas where bolting is required. Isolators shall be M.W. SAUSSE or approved equal.

3. Isolator Type 2, Free Standing Springs. Spring isolators shall be free standing and laterally stable without any housing and complete with 1/4 inch neoprene acoustical friction pads between the baseplate and the support. All mountings shall have leveling bolts, rigidly bolted to the equipment. Isolators shall be M.W. SAUSSE or approved equal.

4. Isolator Type 3, Housed Spring Mounting with Limit Stop. Springs in housings shall be as specified for Isolator Type 2. Housing shall include vertical resilient limit stops to prevent spring extension when weight is removed, as when equipment is drained. The housing shall serve as blocking during erection and the installed and operating heights shall be the same. A minimum clearance of 1/2 inch shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Mountings used outside shall be hot dipped galvanized. Isolators shall be M.W. SAUSSE or approved equal.

5. Isolator Type 4, Vibration Hanger. Vibration hanger shall contain a steel spring and 0.3 inch deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bushing that passes through the hanger box. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30 degree arc before contacting the hole and short circuiting the spring. Isolators shall be M.W. SAUSSE or approved equal.

6. Isolator Type 5, Vibration Hanger. Vibration hanger shall be as specified for Type 4, but shall be pre-compressed to the rated deflection so as to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a measuring device. Isolators shall be M.W. SAUSSE or approved equal.

7. Isolator Type 6, Vibration Hanger. Vibration hanger shall contain a steel spring located in a neoprene cup manufactured with a grommet to prevent short circuiting of the hanger rod. The cup shall contain a steel washer designed to distribute the load on the neoprene and prevent its extrusion. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30 degree arc before contacting the hole and short circuiting the spring. Hangers shall be provided with an eye bolt on the spring end and provision to attach the housing to the flat iron duct straps. Hangers shall be M.W. SAUSSE or approved equal.

8. Isolator Type 7, Vibration Hanger. Hanger shall be a double deflection neoprene-in-shear, Type 2, having a maximum static deflection of 0.35 inch. Isolators shall be M.W. SAUSSE or approved equal.

D. Isolation of Piping Systems.

1. All metal piping which connects to resiliently mounted equipment shall be suspended with resilient hangers or supported by floor mounted isolators. The first three supports from the connected machine shall have the same static deflection as indicated for the machine. The next two supports shall have static deflection at least equal to one-half of the static deflection indicated for the machine mounting, and the remaining pipe supports shall provide static deflection of 0.35 inches minimum.

2. Where static deflection in excess of 0.35 inches is required, floor isolators shall be Type 3 and isolation hangers shall be Type 5. Where deflection of less than 0.35 inches is required, floor isolators shall be Type 1 and isolation hangers shall be Type 7.

3. Flexible Connections:

a. Flexible neoprene connectors shall be used to connect all piping to all isolated equipment, except equipment for which flexible connectors are not permitted by codes. For this application provide swing connections, changing direction a minimum of 3 times before joining isolated equipment. Swing connections shall be made within 6 feet of the isolated equipment.

b. Connectors shall be manufactured of multiple plies of nylon tire cord fabric and neoprene, both molded and cured in hydraulic presses. No steel wire or rings shall be used as pressure reinforcement. Connectors up to, and including 2 inch diameter may have threaded ends. Connectors 2-1/2 inches and larger shall be manufactured with floating steel flanges. All connections shall be rated a minimum of 150 psi at 220ºF. All flanged equipment shall be directly connected to neoprene elbows in the size range 2-1/2 through 6 inches or any larger available size if the piping makes a 90 degree turn at the equipment. All straight through connections shall be made with either flanged or screwed connectors pre-extended as recommended by the manufacturer to prevent additional elongation under pressure. Sizes 12 inches and larger operating at pressures above 100 psi shall employ control cables with end fittings isolated from the anchoring plates by means of 1/2-inch-thick bridge bearing, neoprene washer busings designed for a maximum of 1000 psi.

4. Drain connections from isolated equipment to floor drains shall have at least 1 inch air gap above from drain.

5. Acoustical Sleeves. Where piping passes through equipment walls, floors or ceilings, provide a split seal consisting of two bolted pipe halves with 3/4 inch or thicker neoprene sponge bonded to the inner faces. The seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping. Concrete shall be packed around the seal to make it integral with the floor, wall or ceiling if the seal is not already in place around the pipe prior to the construction of the building member. Seals shall project a minimum of 1 inch past either face of the wall. Where temperatures exceed 240ºF, 10 lb. density fiberglass shall be used in lieu of the sponge.

E. Isolation of Fractional Horsepower Equipment: All fractional horsepower fans, pumps, and equipment which are mounted on or suspended from floors that are not on-grade shall be isolated with neoprene-in-shear isolators as specified except where such isolators are furnished as an integral part of the machine.

F. Electrical Connections to Resiliently Mounted Equipment: Electrical connections to equipment which is supported or suspended by vibration isolators shall be made with long lengths of flexible steel conduit or flexible armored cable. These flexible connections shall be located so as to prevent rigid connections between the resiliently mounted equipment and the building structure.

G. Seismic Restraints.

1. Floor mounted equipment and piping.

a. Type S. Similar to Type 3 as specified in Paragraph 2.1 C, Isolators, designed for earthquake loads. Restraints shall be TOLCO or approved equal.

b. Type SL. All directional seismic restraints shall consist of interlocking steel members restrained by a one-piece molded bushing or bridge-bearing neoprene. Bushing shall be replaceable and shall have a minimum thickness of 1/4-inch. A minimum air gap of 1/8-inch shall be incorporated in the snubber design in all directions before contact is made between the rigid and resilient surfaces. Snubber ends shall be removable to allow inspection of internal clearances. Neoprene bushing shall be rotated to ensure no short circuits exist. Restraints shall be TOLCO or approved equal seismic snubbers.

2. Suspended Equipment and Piping: Type SC, Seismic Slack Cables. Cables shall be arranged to achieve the specified all-directional restraints, and sized to resist seismic loads. Cables shall be installed with sufficient slack to prevent short circuiting the vibration isolators. Restraints shall be TOLCO or approved equal type seismic slack cables.

H. Flexible Pipe Connectors at Building Seismic Joints.

1. For HHWS and HHWR pipes at expansion loops, at the outside of the buildings, and where crossing building seismic joints, provide flexible pipe connectors by Mason Industries/Mercer Rubber (MR) model VFL Stainless Steel Flanged Vee.

2. For CHWS CHWR pipes at expansion loops, at the outside of the buildings, and where crossing building seismic joints, provide flexible pipe connectors by Mason Industries/Mercer Rubber (MR) model VFL Stainless Steel Flanged Vee.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Vibration Isolation Hangers.

1. Resilient hangers shall be installed as near as possible to the supporting overhead structure. The machine suspension points shall be located in a rigid and heavy portion of the building structure. Suspension of machines from lightweight floor slabs is not allowed.

2. Suspension rods shall be attached to rigid members of the machine structure. When such attachment points do not exist, a heavy steel framework shall be provided to support the machine with suspension rods attached to this framework.

3.02 FIELD QUALITY CONTROL

A. General:

1. Install all vibration isolators in accordance with manufacturer's printed recommendations.

2. Replace isolators which do not produce the required deflection, are incorrectly loaded above or below their correct operating height, or which do not produce the required isolation as approved and at no extra cost to the STATE.

END OF SECTION 23 05 48

SECTION 23 05 53

PIPING & EQUIPMENT IDENTIFICATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Provide pipe, valves, and equipment identification labels as specified herein complete.

B. Provide other pipe tracing identification as herein specified.

1.02 RELATED REQUIREMENTS

A. Division 01: General Requirements.

B. Section 23 05 00: Mechanical General Provisions.

C. Section 23 05 16: Basic Mechanical Materials and Methods.

D. Section 23 07 00: Mechanical Insulation.

E. Section 23 20 13: Above-Ground Piping.

F. Section 23 20 16: Underground Piping.

G. Section 23 20 00: Valves.

1.03 REFERENCES

A. ANSI A13.1-1981, Scheme for the Identification of Piping Systems.

1.04 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTAL PROCEDURES, and Section 23 05 00, MECHANICAL GENERAL PROVISIONS.

B. Submit product data and installation instructions for each item specified.

C. Submit full size nameplates and tags samples, representing different sizes and colors. Samples will be returned to Contractor after approval.

1.05 QUALITY ASSURANCE

A. Comply with provisions of:

1. Section 23 05 00, MECHANICAL GENERAL PROVISIONS.

2. ANSI/ASME A13.1: Scheme for the Identification of Piping Systems.

3. APWA: Uniform Color Code.

OR

4. IAPMO: Uniform Plumbing Code (UPC).

PART 2 - PRODUCTS

2.01 GENERAL

A. Use ANSI 13.1-1981 for specified standard identification for background color, letter color, length of color and letter height of marker required to identify piping systems. Marker shall include flow direction arrows.

B. Piping systems, controls, valves, apparatus, etc., except those that are installed in inaccessible locations in partitions, walls, and floors, shall be permanently identified.

2.02 VALVES IDENTIFICATION

A. Furnish prepared chart or diagram for each piping system, indicating by identifying letter or model number of each valve in the system, its location, and function.

B. Install charts in aluminum frame with clear glass front and secure on wall where designated by the Project Inspector.

C. Bind copies of each chart in operating instructions manual.

D. Provide each valve with a brass, aluminum, or plastic disc, not less than 1-1/4 inches diameter bearing engraved numbers corresponding to those indicated on chart. Fasten discs to valve with No. 14 brass wire.

E. Provide an additional tag for safety valves and other valves that could be hazardous to safety and health of occupants. Distinguish these tags from regular valve tags by color (such as yellow with black letters, and marked "Danger"); submit Sample tag to the Owner’s Representative for review.

2.03 INSTRUMENTS AND CONTROLS IDENTIFICATION

A. Identify panel-mounted instruments and controls with engraved bakelite nameplates permanently affixed to panel boards.

B. Identify alarm indicating devices and alarm reset devices by nameplates.

C. Identify damper motors and automatic valves, flow switches, pressure switches, etc., with embossed aluminum or plastic tape affixed to controller, indicating service and setting.

2.04 EQUIPMENT IDENTIFICATION

A. Identify each major piece of equipment with engraved bakelite nameplates permanently affixed to the equipment, indicating the room numbers it services. Equipment identification designation shall be the same to its designation indicated on the “As-Built Drawings”. Room numbers in the nameplates shall correspond to the final room numbers.

2.05 ABOVE-GRADE PIPE IDENTIFICATION

A. Identify pipes by means of colored labels with directional flow arrows and identification of the pipe content, in conformance to ANSI/ASME A13.1 or the UPC.

B. Materials: Precoiled acrylic plastic with clear polyester coating, all-temperature, self-adhering.

C. Size:

Outside Diameter of Pipe or Insulation	**Length of Color Field**	**Size of Letter**
¾ to 1 ¼-inch	8-inch	½-inch
1 ½ to 2-inch	8-inch	¾-inch
2 ½ to 6-inch	12-inch	1 ¼-inch”
8 to 10-inch	24-inch	2 ½-inch”
over 10-inch	32-inch	3 ½-inch

D. Colors: As indicated in Schedule

E. Locations:

1. On accessible piping, whether insulated or not (including inside utilidors or coffin vaults, mechanical rooms, attic, and ceiling spaces); except that labels shall be omitted from piping where contained material is obvious due to its connection to fixtures (such as faucets, water closets, etc.).

2. Near each valve and branch connection in such accessible piping.

3. At each pipe passage through wall or floor.

4. At not more than 20 feet spacing on straight pipe run between bands required in 2 and 3 above.

5. At each change in direction.

F. Application: Install on clean surfaces free of dust, grease, oil, or any material that will prevent proper adhesion. Replace non-adhering or curling labels with new labels, as required by the Project Inspector.

G. Schedule:

Content of Pipe	Legend	Background Color	Lettering Color
Chilled water supply	Chilled Water Supply	Green	White
Chilled water return	Chilled Water Return	Green	White
Heating hot water supply	Heating Hot Water Supply	Yellow	Black
Heating hot water return	Heating Hot Water Return	Yellow	Black

2.06 UNDEGROUND PIPE IDENTIFICATION

A. Detectable Marking Tape:

1. Provide and install detectable marking tape along buried piping. Tape shall be specifically manufactured for marking and locating underground utilities with electronic equipment. Tape shall be acid and alkali resistant, and manufactured with integral wires or foil backing, encased with protective cladding. Tape shall be a minimum of two inches in width.

2. Manufacturer: Reef Industries, Inc., Advantage Brands, Inc., Northtown Company, Mutual Industries, Inc., or approved equal.

3. Detectable marking tape shall be color-coded blue per APWA Color Code.

B. Tracer Wire:

1. Solid copper wire type THWN, 12 AWG gage, with heat and moisture resistant insulation.

2.07 APPARATUS IDENTIFICATION

A. Apparatus nameplates shall be black Lamacoid plates with white lettering engraved through the black layer.

B. Equipment identification shall be embossed aluminum or engraved plastic plate securely attached to equipment.

2.08 MANUFACTURERS

A. Seton Name Plate Co., Telephone No. - (800) 243-6624.

B. D & G Sign and Label, Telephone No. - (800) 356-9269.

C. Brady.

D. Brimar Industries.

E. Stranco, Inc.

F. Or approved equal.

PART 3 - EXECUTION

3.01 PIPE IDENTIFICATION APPLICATION/INSTALLATION

A. Correct detrimental conditions prior to commencing the Work of this Section.

B. Install pipe identification markers and identification tags as specified with materials and installation procedures recommended by manufacturer and in accordance with manufacturer's instructions.

3.02 VALVES IDENTIFICATION APPLICATION/INSTALLATION

A. All valves shall have a 1-1/2" diameter brass identification tag identifying valve number and service.

B. Secure tags to valves using metal seals with copper wire.

C. Valves that are equipped with chain operators shall have an additional tag secured to the hook or clip that supports the swagged chain.

3.03 EQUIPMENT IDENTIFICATION APPLICATION/IDENTIFICATION

A. Identification shall be provided for the following types of equipment:

1. Automatic valves.

2. Flow switches.

3. Pressure switches.

4. Valves.

5. Flow measuring and flow control devices.

B. Equipment out of view behind access doors in unfinished rooms shall also be identified on the face of the access door.

3.04 LOCATION

A. On exposed piping, markers shall be located, installed and easily observable in locations adjacent to valves or flanges and adjacent to changes in direction, branches and where pipe pass through walls and floors. On straight runs pipes shall be identified every 20 feet.

B. On concealed pipe lines which are accessible by access doors, ceiling removal etc., markers shall be located at each point of entry, junction and exit to the concealed space

and spaced every 20 feet on straight runs, except in vertical shafts where it should be identified at every floor near the ceiling.

3.05 UNDERGROUND PIPING IDENTIFICATION

A. Place tracer wire on top of non-metal utility lines allowing some slack. Do not wrap tracer wire around pipe. Fasten tracer wire in place at approximately 10 feet on centers with non-metal ties.

B. Install underground detectable pipe marking tape continuously buried 8 to 10 inches above the buried utility pipe. Wrap tape on pipe risers up to a height of 12 inches above grade.

END OF SECTION 23 05 53

SECTION 23 07 00

MECHANICAL INSULATION

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Section includes insulation for above-ground chilled water and heating hot water piping. See Section 23 20 13, ABOVE-GROUND PIPING.

B. Provide all mechanical insulation as indicated on the Drawings and as specified, complete.

C. See Section 23 20 16, UNDERGROUND PIPING for insulation on underground piping.

1.02 QUALITY ASSURANCE

A. All insulation shall have composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to the insulation) fire and smoke hazard ratings as tested by procedure ASTM E 84, NFPA 255, and UL 723 not exceeding:

1. Flamespread, 25

2. Smoke Developed, 50

3. Accessories such as adhesives, mastics, cements, tapes and fiberglass cloth for fittings shall have the same component rating as listed above.

4. Insulation shall comply with FS HH-I-552, HH-I-562, ASTM C 547-67 and MIL-I-22344B.

1.03 PRODUCT DELIVERY

A. Delivery of Materials: Material shall be furnished to the Project site bearing the manufacturer's label.

1.04 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTAL PROCEDURES, and Section 23 05 00, MECHANICAL GENERAL PROVISIONS.

B. Shop Drawings and Product Data:

1. Complete material list of items to be furnished and installed under this Section.

2. Manufacturer's specifications and other data required demonstrating compliance with the specified requirements.

3. Shop Drawings, catalog cuts and manufacturer's data indicating insulation, jacketing, adhesives, and coating. Insulating materials shall be certified by manufacturer to comply with the California quality standards for insulating materials.

4. Display sample cutaway sections.

5. Manufacturer's recommended method of installation procedures, which will become part of this Section.

1.05 QUALITY ASSURANCE

A. Qualifications of Manufacturer and Installer, Materials, Fabrication, Execution, and Standard of Quality: Comply with provisions stated under Section 23 05 00, MECHANICAL GENERAL PROVISIONS; and Section 23 05 16, BASIC MECHANICAL MATERIALS AND METHODS.

B. Test Ratings:

1. Comply with provisions stated under Section 23 05 00, MECHANICAL GENERAL PROVISIONS; and Section 23 05 16, BASIC MECHANICAL MATERIALS AND METHODS, with emphasis on ASTM E84, NFPA 255, or UL 723. ASTM C167, ASTM C302, UL label or listing of satisfactory test results from the National Institute of Standards and Technology, or a satisfactory certified test report from an acceptable testing laboratory. Approval by the State Fire Marshal is required.

2. Furnish labels, legibly printed with the name of the manufacturer or listings indicate that fire hazard ratings do not exceed those specified for materials proposed for installation. Flame spread index of not more than 25 and smoke developed rating not exceeding 50.

3. Tests shall be performed on each item individually when insulation, vapor barrier covering, wrapping materials, or adhesives are installed separately at the Project site.

4. Test insulation, vapor barrier covering, wrapping materials and adhesives as an assembly when they are factory composite systems.

C. Regulatory Requirements: Insulation furnished and installed under this Section shall conform to the requirements of the California Building Code Parts 4, Mechanical Code, Part 5, Plumbing Code and Part 6, Energy Code.

D. All chemically based products such as sealers, primers, fillers, adhesives, etc. shall meet the California air quality regulations.

1.06 PRODUCT HANDLING

A. Protection, Replacement, Delivery and Storage: Comply with provisions stated under Section 23 05 00, MECHANICAL GENERAL PROVISIONS; and Section 23 05 16, BASIC MECHANICAL MATERIALS AND METHODS.

PART 2 - PRODUCTS

2.01 MATERIALS - GENERAL

A. Piping insulating material shall be fire resistant, non-corrosive, shall not break, settle, sag, pack or disintegrate under vibration, nor absorb more than 1 percent moisture by weight.

B. Piping insulating material shall be furnished with thickness indicated in Table 1, unless otherwise noted on the Drawings, and shall furnish thermal resistance in the range of R-4.0 to 4.6 in accordance with inch at 75 degrees F. For any other value of R, insulation thickness shall be calculated accordingly and submitted for review.

C. Pipe Insulation: Pipe insulation shall be multiservice-type suitable for all lines operating from -20°F to 500ºF. Insulation shall be one-piece consisting of glass fibers bonded with phenolic resin and molded into a hollow cylinder covered with a factory applied vapor barrier jacket. Thermal conductivity (Btu/hr square foot degrees F./IN) shall not exceed:

1. At 75ºF mean temperature 0.22

2. At 100ºF mean temperature 0.23

3. At 200ºF mean temperature 0.25

D. Asbestos in any quantity in insulating material is not permitted.

E. Provide insulation materials, adhesives, coatings, sealants, fitting covers, and other accessories with a fire hazard rating not to exceed 25 for flame spread, 25 for fuel contributed and 50 for smoke developed, except for materials listed as follows:

1. Nylon anchors for installing insulation to ducts or equipment.

2. Treated wood blocks.

F. Flame-proofing treatments subject to moisture damage are not permitted.

G. Tape: Wherever tape is used for sealing purposes, it shall be of type and applied as recommended by the non-conductive covering manufacturer. Where recommendation is lacking, the tape used shall be sealed with MANVILLE LINACOUSTIC or approved equal.

H. Insulating Cement: Insulating cement shall be all-purpose cement. Where insulating cement is applied to pipe fittings in concealed locations, it shall be "one-coat" cement.

TABLE 1 - MINIMUM PIPING INSULATION THICKNESS

Insulation Thickness Required (in inches)

Piping System Type	**Temperature Range (degrees F)**	**1" and less**	**1.25" to 2"**	**2.5" to 4"**	**5" to 6"**	**8" and larger**
Heating Hot Water	Up to 180	1.5	1.5	2.0	2.0	2.0
Chilled Water	40-60	1.0	1.25	1.5	1.5	1.5

Condensate Drain	½-inch minimum insulation thickness	0.5	0.5	0.5	0.5	0.5

I. Lagging Adhesives: Shall be nonflammable and fire-resistant and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Insulation finished with canvas shall be provided with laps adhered in accordance with manufacturer's recommendations. A finish coat of same material shall be applied to entire outer surface of lagging cloth at coverage specified by manufacturer.

J. Canvas Jackets: Furnish 6 ounce in accordance with square foot minimum, 48 by 48 thread count canvas jacketing.

K. Insulation Jackets:

1. Exterior insulation exposed to weather, including pipe insulation in utilidors and coffin vaults, shall be weatherproofed with Childers aluminum jacketing as basis of design, or Pabco, RPR, or approved equal. Jacketing shall be manufactured from 1100, 3105 or 5010 aluminum alloy with 3/16-inch corrugations. Smooth or embossed jackets may be permitted in special situations to match an existing installation. Jacketing shall be furnished with an integrally bonded moisture barrier over entire surface in contact with insulation. A minimum thickness of 0.016 aluminum jacketing is to be provided on ducts and piping. A minimum thickness of 0.020 shall be provided on tanks, equipment, and heat exchangers.

2. Insulated elbows, of 90 degrees and 45 degrees, with a nominal iron pipe size of ½ inch to 8 inches shall be provided with Childers aluminum Ell-Jacs insulation covers as basis of design, or Pabco, RPR, or approved equal, manufactured from 1100 aluminum alloy of 0.024-inch thickness. Insulated elbows with a nominal pipe size of 10 inches to 18 inches shall be provided with Childers 4-piece aluminum Ell-Jacs as basis of design, or Pabco, RPR, or approved equal.

3. Tees, Flanges, and Valve Insulation in Conjunction with Aluminum Jacketing: Furnish Childers Aluminum Special Fabrications Insulation Covers as manufactured by Childers Products Company, Pabco, RPR, or approved equal.

L. Adhesives: Adhesives shall be water based, UL Classified, meet the requirements of NFPA 90A and NFPA 90B, have been tested according to relevant ASTM requirements, and be acceptable to the State Fire Marshal. Name, type and method of installation shall be submitted for review.

M. Valve and Fitting Cover: When installed in conjunction with PVC jacketing, furnish Zeston 25/50 rated polyvinyl chloride fitting covers as manufactured by Johns Manville, Knauf Insulation, Speedline, or approved equal.

2.02 HEATING HOT WATER PIPING INSULATION

A. General: Insulate heating hot water supply and return, including valves, strainers and fittings with insulation thickness as indicated in Table 1.

B. Materials:

1. Classes of Insulation:

a. Class A: Calcium silicate molded pipe insulation, suitable for service temperature up to 1200 degrees F, ASTM C533; Johns Manville Thermo-12 Gold, or approved equal. Fittings: diatomaceous silica thermal insulating cement.

b. Class B: Glass fiber molded pipe insulation suitable for service temperatures up to 850 degrees F. Pipe insulation shall be one piece, preformed, and provide a minimum R factor of 4.0 at 75 degrees F mean temperature. Insulation shall be faced with all-purpose, fire-retardant, vapor barrier jacket. Pipe insulation shall be Johns Manville Micro-Lok, Knauf Redi-Klad 1000, Owens Corning FIBERGLAS Pipe Insulation SSL II-ASJ, or approved equal.

c. Class C: Flexible open-cell melamine (foam insulation) suitable for service temperature -150 degrees F to 400 degrees F. Thermal conductivity at 75 degrees F, K = 0.26. Pipe insulation, one-piece pre-formed, laminated to heavy non-reinforced PVC jacket, with locking track, factory installed to jacket, to snap insulation and jacket onto pipe. Similar to TechLite 079 Series as manufactured by Accessible Products Co., or approved equal. Installation shall comply with manufacturers recommendations.

d. Class D: Mineral fiber pipe insulation suitable for service temperatures up to 1,200 degrees F. Pipe insulation shall be one-piece, preformed up to 3 inches thickness, and provide a minimum R factor of 4.0 at 75 degrees F mean temperature. Insulation shall be faced with all-purpose, fire-retardant, vapor barrier jacket. Pipe insulation shall be 8 pounds in accordance with cubic foot density by Roxul Techton 1200, Fibrex COREPLUS 1200, Industrial Insulation Group, LLC (IIG) MinWool-1200, or approved equal.

2. Locations and Class of Insulation Required:

TABLE 2 – LOCATIONS AND CLASS OF INSULATION REQUIRED

SERVICE AND LOCATION	**CLASS OF INSULATION**
Heating hot water pipes in boiler and mechanical equipment rooms	A, B, C, or D
Heating hot water pipes in all other locations, including in utilidors and coffin vaults, except direct buried	A, B, C, or D

3. Fittings on indoor piping shall be covered with flush, hand-wrapped, Class A, B, C, or D insulation, to match the adjoining pipe insulation and covered with polyvinyl chloride fitting covers: Zeston 2000 25/50 by Johns Manville, Knauf Insulation Proto PVC Fitting Cover, Speedline Polyco Smoke Safe, or approved equal.

4. Adhesive: Fibrous Adhesive to bond calcium silicate to itself and non-porous surfaces.

2.03 CHILLED WATER PIPING INSULATION

A. General: Insulate chilled water supply and return piping and condensate drains.

B. Materials:

1. Classes of Insulation:

a. Class A: Expanded polystyrene pipe insulation, self-extinguishing type, either molded or extruded; Dow Chemical Co. STYROFOAM, ITW Insulation Systems XPS PIB, Foam-Control EPS, or approved equal.

b. Class B: Glass fiber molded pipe insulation ASTM C547. Pipe insulation shall be one piece, preformed, and provide a minimum R factor of 4 at 75 degrees F mean temperature. Insulation shall be faced with all-purpose, fire-retardant, vapor barrier jacket. Pipe insulation shall be Johns Manville Micro-Lok, CertainTeed Snap-On, Owens Corning FIBERGLAS SSL II-ASJ, or approved equal.

c. Class C: Expanded (foamed) urethane (polyurethane) or polyisocyanurate pipe insulation of self-extinguishing type molded or fabricated, Dyplast Products, LLC ISO-C1/2.0, ITW Trymer, Specialty Products & Insulation Co. Polyisocyanurate Pipe Insulation, Armacell Armalok, or approved equal.

d. Class D: Foamed plastic pipe insulation, self-extinguishing type, ASTM C534 Type 1 - tubular. Pipe insulation shall be one-piece preformed, flexible tubing type and provide a maximum K factor of 0.28 at 75 degrees F mean temperature. Pipe insulation shall be Armacell Armaflex, Aeroflex Aerocel, Rubatex INSUL-TUBE 180, or approved equal.

2. Locations and Class of Insulation Required: For thickness required, refer to Table 1 of this Section.

TABLE 3 – SERVICE, LOCATION AND CLASS OF INSULATION REQUIRED

SERVICE AND LOCATION	**CLASS OF INSULATION**
Condensate drains in all locations	D
Chilled water pipes in all other locations, including in utilidors and coffin vaults, except direct buried	A, B, C

3. Adhesives:

a. Polystyrene adhesives: Synthetic rubber and resin adhesives specifically designed to adhere extruded and expanded rigid polystyrene and urethane insulation to themselves and to other porous and non-porous substrates.

b. Vapor barrier laps and penetrations: Furnish protective coating and lagging adhesive on butt joints of foil-faced vapor barriers, and where pins and staples puncture facings.

2.04 LOW TEMPERATURE EQUIPMENT INSULATION

A. General:

1. Insulate air eliminators and similar equipment operating at reduced surface temperatures.

2. Do not insulate chilled water expansion tanks, and chemical feeders.

B. Materials:

1. Expanded polystyrene, 2 inches thick, self-extinguishing type, Dow Chemical Co.'s STYROFOAM, Owens Corning FOAMULAR, Foam-Control EPS, or equal, or 1-1/2 inches thick expanded urethane (polyurethane) or polyisocyanurate, self-extinguishing type, Dyplast Products, LLC ISO-C1/2.0, ITW Trymer, Specialty Products & Insulation Co. Polyisocyanurate Pipe Insulation, or approved equal.

2. Canvas Jackets: 6 ounce in accordance with square foot minimum.

3. Vapor Barrier Laps and Penetrations: Furnish protective coating and lagging adhesive on butt joints of foil-faced vapor barriers and where pins and staples puncture facings.

PART 3 - EXECUTION

3.01 INSTALLATION/APPLICATION

A. The insulation and materials shall be applied only by mechanics skilled at such Work. The appearance of the finished Work shall be of equal importance with its mechanical correctness and efficiency. Insulation for heating surfaces and piping shall not be applied until such times as those surfaces have been heated to dry out the insulation. Insulation shall not be applied until the system is tested as required.

B. Installation:

1. Wherever vapor barriers are specified, all portions of the covering at joints and fittings shall be vapor sealed.

2. Insulation shall be continuous through all walls, floors, and ceilings unless otherwise specified, or shown.

3. Insulate unions, flanges, and valve bodies but not operating handwheels or levers.

4. Insulation in crawl spaces having dirt floors shall have a vapor barrier jacket.

5. Application of all materials shall be in accordance with the manufacturer's printed instructions.

6. The insulation shall be handled in a manner that will not adversely affect its structural or insulating properties.

7. Support shall be provided for the insulation on vertical lines to prevent the insulation from slipping downward.

8. Do not place insulation over vent and drain inlets and outlets.

9. Self-sealing laps shall have an additional field applied coat of adhesive applied to the opposite mating surface. Both hot and cold pipe self-sealing jacket laps on longitudinal and butt joints shall be stapled at 6 inches maximum spacing for both exposed and concealed. On cold pipe insulation, the staples and the longitudinal and butt edges shall be sealed with mastic as indicated in the jacket manufacturer's printed recommendations.

10. Where pipe hanger rods penetrate vapor barrier, vapor barrier shall be carried up and sealed around rod for a distance of 12 inches away from the outside of the pipe insulation.

11. Fittings and Valves:

    a. Hot Pipelines (above 60ºF.):

12. Flanges, couplings, valves, anchors, and fittings shall be insulated with factory premolded, prefabricated or field fabricated sections of insulation of the same material and thickness as the adjoining pipe insulation.

13. When segments of insulation are used, elbows shall be provided with not less than three segments. When nesting size sections of insulation are used, all voids shall be filled with insulating cement or mineral fiber. Sections of insulation shall be secured in place with wire or by joining the sections with adhesive. Adhesive shall be applied over the insulation in two coats with glass cloth or tape embedded between coats. Cloth or tape shall overlap itself 1 inch (25 mm) and adjoining insulation jacket 2 inches. In lieu of above finish, factory-premolded one-piece PVC fitting covers shall be used. If used, PVC fitting covers shall be secured by stapling, tack fastening, banding, or taping. When PVC fitting covers are used, factory pre-cut blanket inserts furnished by the fitting cover manufacturer may be used. Inserts shall be installed in accordance with the fitting manufacturer's printed recommendations. Insulated flanges, couplings, valves, anchors, and fittings shall be covered with preformed or field-fabricated sections of aluminum jacket secured with bands in lieu of finishes specified above.

14. When pipe insulation with factory-applied aluminum jacket is provided, flanges, valves and fittings may be insulated with factory- or field-fabricated sections of the same material and thickness as adjoining pipe insulation and jacket. Sections shall

be secured with bands. Unless otherwise shown, unions shall not be insulated and pipe insulation and jacket shall terminate neatly at the ends of unions.

15. All termination points shall be finished with a brush coat of adhesive.

    a. Cold Pipelines (-30°F to 60ºF.):

16. Flanges, couplings, unions, valves, anchors and fittings unless otherwise shown shall be insulated with factory premolded, prefabricated or field fabricated sections of insulation of the same material and thickness as the adjoining pipe insulation. Insulation on valve packages in room-fan-coil units may be omitted where the units are furnished with auxiliary drain or drip pans.

17. Anchors, when secured directly to the pipe shall be insulated for the necessary distance to prevent condensation, but not less than 6 inches from the surface of the pipe insulation. Insulation and vapor barrier shall be extended to cover glands and stem completely. When segments of insulation are used, elbows shall be provided with not less than three segments.

18. When nesting size sections of insulation are used, all voids shall be filled with insulating cement or mineral fiber.

19. Sections of insulation shall be secured in place with wire or by joining the sections with adhesive.

    a. Vapor barrier coating shall be applied over the insulation in two coats with glass tape or cloth embedded between coats. Cloth or tape shall overlap itself 1 inch and adjoining insulation jacket 2 inches. The coating shall be applied to a total dry film thickness of not less than 1/16 inch. In lieu of the above vapor barrier coating, factory-remolded one-piece PVC fitting covers may be used. If used, PVC fitting covers shall be secured by stapling, tack fastening, banding, or taping with vapor barrier tape. Staples or tacks and fitting cover edges shall be sealed with vapor barrier coating, in accordance with the fitting cover manufacturer's printed recommendations. When PVC fitting covers are used, factory pre-cut blanket inserts furnished by the fitting cover manufacturer may be used. Insert shall be installed in accordance with the fitting cover manufacturer's printed recommendations. When required by the Drawings, insulated flanges, couplings, unions, valves, anchors, and fittings shall be covered with preformed or field-fabricated sections of aluminum jacket applied over the vapor barrier and secured bands.

    b. Where unions are shown to be not insulated, the pipe insulation and jacket shall terminate neatly at the ends of the unions. Ends of pipe insulation shall be seated to the pipe with a brush coat of vapor barrier coating at termination points, valves, flanges, and fittings.

3.02 INSTALLATION

A. Except as specified herein, install material in accordance with recommendations of manufacturer. Do not install insulation materials until tests specified in other sections are

completed. Remove foreign material such as rust, scale, or dirt. Surfaces shall be clean and dry. Maintain insulation clean and dry at all times.

B. On cold surfaces where a vapor barrier must be provided and maintained, insulation shall be installed with a continuous, unbroken moisture and vapor seal. Hangers, supports, anchors, or other projections that are fastened to cold surfaces shall be insulated and vapor sealed to prevent condensation.

C. Surface finishes shall be extended in such a manner as to protect raw edges, ends, and surfaces of insulation.

D. Pipe insulation shall be continuous through walls, ceiling or floor openings, or sleeves; except where fire-stop or fire-safing materials are required.

E. Metal shields shall be installed between hangers or supports and the piping insulation. Rigid insulation inserts shall be installed between the pipe and the insulation shields. Inserts shall be of equal thickness to adjacent insulation and shall be vapor sealed accordingly.

F. Insulation shall not be installed in the following locations unless otherwise noted:

1. On unions, flanged connections or valve handles.

2. Over edges of any manhole, clean-out hole, clean-out plug, access door or opening to a fire damper, so as to restrict opening or identification of access.

3. Over any label or stamp indicating make, approval, rating, inspection, or similar data, unless provision is made for identification and access to label or stamp.

3.03 INSTALLATION OF HEATING HOT WATER PIPING INSULATION

A. General: Heating hot water supply and return piping, after having been tested, shall be cleaned and insulated.

B. Application: Insulate heating hot water supply and return piping in accordance with manufacturer's instructions and as specified herein.

1. Install insulation on valve bodies up to valve bonnet. Fill void in saddles, in accordance with Section 23 05 16: BASIC MECHANICAL MATERIALS AND METHODS, with insulation and seal joints.

2. Install insulating material to fittings, valves, and strainers and smooth to thickness of adjacent covering. Leave strainer clean-out plugs accessible. Covers fabricated from polyvinyl chloride shall be furnished.

C. Insulation Jackets in Exposed Indoor Locations:

1. Cover completed insulation with canvas jacket tightly pasted to covering with lagging adhesive. Lap jacket seams 1-1/2 inches minimum. Finish entire jacket with coating of undiluted adhesive.

2. Equivalent factory applied pre-sized, glass fiber reinforced, or glass fiber jackets may be furnished. Seal jacket seams with adhesive in accordance with manufacturer's instructions.

3. Johns Manville Zeston 2000, Knauf Insulation Proto PVC Fitting Cover, Speedline Polyco Smoke Safe, or equal, fitting covers may be furnished, with molded or segmented insulation equal to specified insulation applied to fittings. Secure covers in accordance with manufacturer's instructions.

4. In addition to above requirements, cover exposed insulated piping within a distance of 8 feet above floors with 26 gage galvanized steel jacket, except in mechanical equipment rooms.

D. Concealed Indoor Locations: Cover insulation over fittings, valves, and strainers with canvas. Provide pipe insulation with factory or field applied standard jacket of 4 ounce minimum canvas, fiberglass cloth, or glass fiber reinforced jacket. Seal jacket laps with adhesive in accordance with manufacturer's instructions.

E. Exposed Outdoors, Including in Utilidors and Coffin Vaults: In addition to canvas or fiberglass cloth cover, pipe insulation exposed to weather shall be provided with an additional 0.016 inches thick aluminum jacket with 2 inches lap connected with one-inch hem overlap joint located on side of pipe and turned down to shed water. Jacket shall be strapped 12 inches on center with 1/2 inches wide, stainless steel strapping and wing seals. Aluminum jacket shall be mitered to fit fittings.

3.04 INSTALLATION OF CHILLED WATER PIPING INSULATION

A. General: Chilled water supply and return piping, and condensate drain lines, after having been tested, shall be cleaned and insulated.

B. Application: Insulation on chilled water lines and condensate lines shall be jacketed with fire-resistant vapor barrier of laminated aluminum foil consisting of 2 plies with glass-yarn reinforcing. Jacket joints shall be lapped and sealed with an approved adhesive. Insulation shall be secured with aluminum bands not less than 0.005-inch thick by 3/4 inches wide, spaced not over 12 inches on centers, or as recommended by manufacturer.

1. Longitudinal Seams: Butt hinged sections of covering tightly together and seal down jacket flap with adhesive, or with factory-applied, self-sealing lap with pressure-sensitive sealer protected with release paper.

2. End Joints: Wrap joint with a 3-inch wide (minimum) self-sealing tape.

3. Fittings and Valves: Fittings and valves shall be covered with same material of same thickness as pipe insulation, sealed with an approved, vapor-sealing tape or compound and covered with Johns Manville Zeston polyvinyl-chloride cover, Knauf Insulation Proto PVC Fitting Cover, Speedline Polyco Smoke Safe, or approved equal.

4. Pipe hangers shall be insulated or attached to pipe by an insulating insert, butted between adjoining insulation sections.

C. Additional Jackets:

1. Exposed Indoor Insulation: Cover with 26 gage galvanized sheet metal jacket to 8 feet above floors, except in mechanical equipment rooms.

2. Exposed Outdoor Insulation, Including in Utilidors and Coffin Vaults: In addition to canvas or fiberglass cloth cover, provide 0.016-inch thick aluminum jacket with one-inch wide aluminum bands and seals. Install appropriate jackets on valves and fittings.

3.05 INSTALLATION OF LOW-TEMPERATURE EQUIPMENT INSULATION

A. General: Provide removable sections of insulation over parts of equipment requiring insulation.

B. Coat joints of polyurethane insulation with neoprene-based contact adhesive. Adhesives furnished shall be approved by insulation manufacturer. Fill and seal external voids and seams with non-shrinking sealant.

C. Canvas Jacket: Cover completed insulation with canvas jacket tightly pasted to covering with lagging adhesive. Lap jacket seams a minimum of 1 ½ inches. Finish entire surface of canvas jacket with one brush coat of diluted lagging adhesive, Childers CP-50A, Foster 30-36, Mon-Eco Industries (MEI) Eco-Lag Adhesive, or equal, and heavy final coat of undiluted adhesive.

3.06 CLEANUP

A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.07 PROTECTION

A. Protect the Work of this Section until Substantial Completion.

END OF SECTION 23 07 00

SECTION 23 08 00

MECHANICAL SYSTEMS COMMISSIONING

PART 1 – GENERAL

1.01 DESCRIPTION

A. The purpose of this section is to specify the Contractor's responsibilities and participation in the commissioning process relative to Division 23.

B. Commissioning testing shall be performed by the Owner's Commissioning Authority (CxA) with assistance from the Contractor and appropriate subcontractors. Commissioning is primarily the responsibility of the STATE's CxA, with start-up, testing and support for commissioning the responsibility of the Contractor. The commissioning process does not relieve the Contractor from participation in the process or diminish the role and obligations to complete all portions of work in a satisfactory and fully operational manner.

C. Work of Division 23 includes:

1. Testing and start-up of the chilled water and heating hot water hydronic distribution systems.

2. Furnish qualified personnel to assist with commissioning/functional tests to verify system performance.

3. Completion and endorsement of Pre-functional Test Forms provided by the CxA to assure that Division 23 systems are fully operational and ready for functional testing.

4. Furnish equipment, materials and labor necessary to correct deficiencies found during the commissioning process which fulfill contract and warranty requirements.

5. Furnish operation and maintenance information and as-built drawings to the CxA for review, verification and organization, prior to distribution.

6. Furnish assistance to the CxA to develop, edit and document system operation descriptions.

7. Furnish training for the systems specified in this Division with coordination of the STATE's Representative by the CxA.

D. Various sections in Division 23 outline the specific commissioning responsibilities of applicable subcontractors and Contractor to coordinate and manage the commissioning responsibilities of those subcontractors. Reference to work performed by subcontractor shall not relieve Contractor from sole responsibility for all work of the project.

1.02 RELATED WORK

A. All installation, testing and start-up procedures and documentation requirements specified within Division 23.

B. Commissioning Functional Test Procedures that required participation of the Division 23 subcontractors.

C. Cooperate with the CxA in the following manner:

1. All testing and start-up procedures and documentation requirements specified within Division 1 and Division 23 and related portions of this project.

2. Allow sufficient time before final completion dates so mechanical systems start-up, test and balance, and commissioning can be accomplished.

3. Provide labor and material to make corrections when required without undue delay.

4. Put all hydronic systems and equipment into full operation and continue the operation of the same during each working day of the testing, balancing, and commissioning.

5. Provide pressure/temperature taps where directed or necessary for taking measurements to test and balance hydronic systems.

PART 2 - PRODUCTS

2.01 TEST EQUIPMENT

A. Standard test equipment for commissioning will be provided by the Contractor.

B. Contractor shall provide standard and specialized test equipment as necessary to test and start up the hydronic systems.

C. Proprietary test equipment required by the manufacturer, whether specified or not, shall be provided by the manufacturer of the equipment through the installing subcontractor. Have manufacturer provide the test equipment, demonstrate its use and assist the CxA in the commissioning process.

D. The Contractor shall provide all equipment, software and all test programming support as necessary to start up, calibrate, debug and verify proper function of the control/facility management system. This equipment and software shall be provided for use by both the test and balance subcontractor and the CxA.

PART 3 - EXECUTION

3.01 WORK PRIOR TO COMMISSIONING

A. Complete all phases of work so the systems can be energized, started, tested and otherwise commissioned. Division 23 has primary start-up responsibilities with obligations to compete systems, including all sub-systems, so they are functional. This includes the complete installation of all equipment materials, raceways, wire, terminations, controls, etc., per the Contract Documents and related directives, clarifications, change orders, etc.

B. A Commissioning Plan will be developed by the CxA. Upon request of the CxA, the Contractor shall furnish assistance and consultation. The Commissioning Plan will be developed prior to completion of the installation. The Contractor is obligated to assist the CxA in preparing the Commissioning Plan by furnishing all necessary information pertaining to the actual equipment and installation. If Contractor-initiated system changes have been made that alter the commissioning process, the CxA will notify the STATE's Representative and the Contractor may be obligated to compensate the CxA to test the revised product or confirm the suitability/unsuitability of the substitution or revision.

C. Specific pre-commissioning responsibilities of Division 23 are as follows:

1. Normal start-up services required bringing each system into a fully operational state. This includes motor rotational check cleaning, lug tightening, control sequences of operation, etc. The CxA will not begin the commissioning process until each system is complete, including normal contractor start-up and debugging.

2. The Contractor shall complete the Pre-functional Test Forms on the systems to be commissioned to verify that all aspects of the work are complete in compliance with the plans and Specifications. Contractor start-up forms may be substituted for the Pre-functional Test Forms with prior approval by the CxA.

3. Factory start-up services will be provided for key equipment and systems specified in Division 23. Factory start-up activities shall be documented and submitted. The Contractor shall coordinate this work with the manufacturer and the CxA.

4. Notify the STATE's Representative and CxA when systems are ready for functional testing.

D. Commissioning is intended to begin upon completion of a system. Commissioning may proceed prior to the completion of systems and/or sub-systems, if expediting this work is in the best interests of THE STATE. Commissioning activities and schedule will be coordinated with the Contractor. Start of commissioning before system completion will not relieve the Contractor from completing those systems as per the schedule.

3.02 PARTICIPATION IN COMMISSIONING

A. Commissioning testing shall be performed by the CxA with assistance from the responsible Contractor and subcontractors. Provide skilled technicians to start up and debug all systems within this division of work. These same technicians shall be made available to assist the CxA in completing the commissioning program as it relates to each system and their technical specialty. Work schedules, time required for testing, etc., will be requested by the CxA and coordinated by the Contractor. Contractor will ensure the qualified technician(s) are available and present during the agreed-upon schedules and of sufficient duration to complete the necessary tests, adjustments and/or problem resolutions.

B. System problems and discrepancies may require additional technician time, CxA time, redesign and/or reconstruction of systems and system components. The additional technician time shall be made available for the subsequent commissioning periods until the required system performance is obtained.

C. The CxA reserves the right to judge the appropriateness and qualifications of the technicians relative to each item of equipment, system and/or sub-system. Qualifications of technicians include expert knowledge relative to the specific equipment involved, adequate documentation and tools to service/commission the equipment and an attitude/willingness to work with the CxA to get the job done. A liaison or intermediary between the CxA and qualified factory representatives does not constitute the availability of a qualified technician for purpose of this work.

D. Furnish a draft report with final test measurements to the CxA and shall provide qualified technicians and instruments needed for balancing to demonstrate a sample of up to 100% of measurements until specified results are achieved.

3.03 WORK TO RESOLVE DEFICIENCIES

A. In some systems, maladjustments, misapplied equipment, and/or deficient performance under varying loads will result in a system that does not meet the original design intent. Correction of work will be completed as approved by the STATE's Representative, with input from the Contractor, equipment supplier and CxA. Whereas all members will have input and the opportunity to discuss, debate and work out problems, the A/E will have final jurisdiction on the necessary work to be done to achieve performance.

B. Corrective work shall be completed in a timely fashion to permit the timely completion of the commissioning process. Experimentation to render system performance will be permitted. If the CxA deems the experimentation work to be ineffective or untimely as it relates to the commissioning process, the CxA will notify the STATE's Representative indicating the nature of the problem, expected steps to be taken and the deadline for completion of activities. If the deadline(s) pass without resolution of the problem, the STATE reserves the right to obtain supplementary services and/or equipment to resolve the problem. Costs incurred to solve the problems in an expeditious manner will be the Installing subcontractor's responsibility except where they are a result of design issues.

3.04 ADDITIONAL COMMISSIONING

A. Additional commissioning activities may be required after system adjustments, replacements, etc., are completed. The Contractor, suppliers and CxA shall include a reasonable reserve to complete this work as part of their standard contractual obligations.

B. The cost of compensation of the CxA for repeat testing or troubleshooting due to systems that do not meet specified performance shall be borne by the Contractor.

3.06 SYSTEMS TO BE COMMISSIONED

A. Systems to be commissioned include:

1. Site hydronic chilled water piping distribution system.

2. Site hydronic heating hot water piping distribution system.

3.07 TRAINING

A. The Contractor shall be required to participate in the training of the STATE's engineering and maintenance staff for each system and the related components. Training may be conducted in a classroom setting, with system and component documentation, and suitable classroom training aids, or in the field with the specific equipment. The type of training will be per the STATE's option.

B. The Contractor shall be responsible for the generic training as well as instructing the STATE's staff on the system peculiarities specific to this project.

3.08 SYSTEMS DOCUMENTATION

A. In addition to the requirements of Division 1, update Contract Documents to incorporate field changes and revisions to system designs to account for actual constructed configurations. All drawings shall be red-lined on two (2) sets. Division 23 as-built drawings shall include updated architectural floor plans and the individual electrical systems in relation to actual building layout.

B. Maintain as-built red-lines on the job site as required in Division 1. Given the size and complexity of this project, red-lining of the drawings at completion of construction based on memory of key personnel is not satisfactory. Continuous and regular red-lining and/or posting of drawings is considered essential and mandatory.

C. In addition to the stated requirements for operation and maintenance data, submit one (1) copy of equipment technical literature, operation and maintenance literature and shop drawings to the CxA as soon as they are available. This requirement is for review of these documents prior to distribution of multiple copies for the STATE's final use.

END OF SECTION 23 08 00

SECTION 23 20 00

VALVES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Provide all valves as indicated on the Drawings and as specified, complete.

1.02 SUBMITTALS

A. Shop Drawings and Product Data:

1. Submit in accordance with Section 01 33 00 - Submittal Procedures.

2. The following list includes the required shop drawings and samples that shall be submitted:

a. All valves.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General. Unless otherwise indicated, all valves of all types installed in connection with mechanical piping shall comply with the following:

1. Furnish one make throughout the Project manufactured by NIBCO or approved equal, unless otherwise indicated.

2. Pack all stems in conformance to ANSI B16.34.

3. All valves 2 inches and smaller shall be threaded and have bronze bodies.

4. All valves 2-1/2 inches and larger shall be iron body bronze mounted (IBBM) type and shall be flanged.

5. Wheel handles shall be non-heating style cast from malleable iron ASTM A197.

6. All valves 4 inches and larger mounted in excess of 7 feet above the floor in mechanical rooms shall be equipped with chain operators and guides. Extend chains to within 6 feet-6 inches of floor.

7. Mark each valve at the factory with the following minimum information, engraved, stamped, or cast on each valve or metal tag permanently attached to the valve.

a. Manufacturer's name.

b. Catalog or figure number.

c. Size and pressure class.

d. Arrows to indicate direction of flow on check, globe, angle, non-return, and eccentric plug valves.

e. UL approved valves shall bear the UL label.

8. Each valve shall be the same size as the pipe in which it is installed.

B. Gate Valves.

1. General. Provide wedge disc pattern with non-rising stem, repackable under full operating pressure when wide open.

2. 125 psig Gate Valves.

a. General. Provide valves designed for 125 psig steam and 200 psig non-shock water, oil, and gas working pressures.

b. Size, 2 inches and smaller (screwed).

1) Materials. Provide bodies, bonnets, and discs made from bronze conforming to ASTM B62. Stems shall be copper silicon alloy.

2) Manufacturer. Provide NIBCO or approved equal.

c. Size, 2-1/2 inches and larger (flanged).

1) General. Provide bolted bonnets, renewable ring seats, and matching machined guides in body and disc to accurately position disc in the seat.

2) Materials. Provide body and bonnet made from cast iron conforming to ASTM A126, Class B. Disc and seat rings shall be made from bronze conforming to ASTM B62. Stem shall be copper silicon alloy.

3) Manufacturers. Provide NIBCO or approved equal.

C. Ball Valves.

1. Bronze or stainless steel body.

2. Threaded ends.

3. Full port.

4. Stainless steel ball.

D. Globe and Angle Valves.

1. General. Stems shall be repackable under full operating pressure when wide open.

2. Size, 2 inches and smaller.

a. General. Provide valves designed for 300 psig steam and 400 psig non-shock water, oil, and gas working pressures. Valves shall permit seat, disc, and union bonnet replacement without removing valves from piping.

b. Materials. Provide bodies and bonnets, made from bronze conforming to ASTM B61. Stems shall be a copper silicon alloy. Provide discs and seats made from industry standard, type 500 Grinnell, hardened stainless steel.

c. Manufacturers.

1) Globe Pattern. NIBCO or approved equal.

2) Angle Pattern. NIBCO or approved equal.

3. Size, 2-1/2 inches and larger.

a. General. Provide valves designed for 125 psig steam and 200 psig water, oil, and gas working pressures. Valves shall have bolted bonnets, outside screw and yoke, and bottom guided stems. Seats shall be replaceable without removing valves from the line.

b. Materials. Provide body and bonnet made from cast iron conforming to ASTM A126, Class B. Disc and seat shall be made from bronze conforming to ASTM B62. Stem shall be copper silicon alloy.

c. Manufacturers.

1) Globe Valves. NIBCO or approved equal.

2) Angle Valves. NIBCO or approved equal.

E. Check Valves.

1. Size, 2 inches and smaller.

a. General. Provide swing check valves designed for 200 psig steam and 400 psig non-shock water, oil, and gas working pressures. Regrinding valve seats shall not require removal of valve from line. Provide screwed caps, renewable side plugs, hinges, and bronze discs. Valves shall operate equally well in the vertical or horizontal position.

b. Materials. Body shall be made from bronze conforming to ASTM B61. Cap, disc, and hinge shall be made from bronze conforming to ASTM B61 or B62.

c. Manufacturer. NIBCO or approved equal.

2. Size, 2-1/2 inches and larger.

a. General. Provide swing check valves in steam lines and silent check valves in water piping.

b. Water Check Valves.

1) General. Silent type, spring loaded check valves for either vertical or horizontal installation. Valves shall be designed for 175 psig non-shock water working pressure at 250ºF.; spring shall be designed to close valve before reverse flow can occur.

2) Materials. Cast iron body conforming to ASTM A126 Class B, bronze disc and trim or double plates conforming to ASTM B148 or ASTM B62, 316 stainless steel pin and spring, and ANSI B2.1 type seal, for installation between 125 lb. flanges.

3) Manufacturer. NIBCO or approved equal.

F. Eccentric Plug Valves (Balancing Valve).

1. General. Valves shall be non-lubricated eccentric plug style designed for minimum pressure loss in the wide open position. All valves shall be equipped with adjustable opening stops for balancing. Resilient plug facing shall be capable of continuous bubble tight service in water at 250ºF.

a. Provide valves, sizes 5 inches and smaller designed for 150 psig and valves 6 inches and larger for 125 psig, non-shock water working pressures at 250ºF.

b. Valves shall have permanently lubricated corrosion resistant bushings in top and bottom bearings.

c. Bodies shall be tapped with a pipe connection on downstream side of seat for pressure gage connection. Equip valves 4 inches and larger with gear actuators. All gearing shall be enclosed, manufactured for running in oil, and the actuator shall be submersible with seals provided on all shafts to prevent entry of water into the actuator. All shaft bearings shall be furnished with permanently lubricated bronze bearing bushings. Actuator shall clearly indicate valve position and an adjustable stop shall be provided to set closing torque. Valve packing and adjustment shall be accessible without disassembly of the actuator.

2. Manufacturer: NIBCO or approved equal

G. UL Approved Valves.

1. General. Valves shall be designed for a minimum of 175 psig non-shock cold water working pressure, UL approved.

2. Gate Valves.

a. General. Provide OS and Y pattern, guided wedge disc, with stem repackable under full operating pressure.

b. Size, 2 inches and smaller.

1) Materials. Provide bodies, bonnets and discs made from bronze conforming to ASTM B61 or B62, with bronze alloy stems.

2) Manufacturers. NIBCO or approved equal.

c. Size, 2-1/2 inches and larger.

1) Materials. Provide body and bonnet made from cast iron conforming to ASTM A126, Class B. Renewable seat rings and disc shall be made of bronze conforming to ASTM B61 or B62. Stem shall be bronze alloy.

2) Manufacturers. NIBCO or approved equal.

H. Butterfly Valves.

1. General. Provide valves designed for 175 psig 2 through 12 inches, 150 psig 14-20 inches and 250ºF water service.

2. Manufacturer. BRAY Series 30/31 or equal, butterfly valves, as follows:

a. Valves shall be lug type drilled and tapped for dead end service.

b. Valves shall be bi-directional for drop tight shut-off at full rated pressure with flow in either direction. Valves shall be hydrostatically tested at the factory simulating dead end service at 100 psi.

c. Materials of construction shall be:

1) Body: Cast or Ductile Iron.

2) Disc: Stainless Steel.

3) Stem: 300 series stainless steel if exposed to flowing media, 400 series stainless or alloy steel phosphate coated, if not exposed to flowing media.

4) Seat: Ethylene Propylene Diene Monomer.

d. Operator shall be a 10-position lever lock for sizes 2-6 inches with a totally enclosed weatherproof acme screw gear actuator for 8 inches and larger infinite adjustment; memory stop options shall be provided where called for.

e. Disc shall be stainless steel.

2.02 VALVES BY SERVICE

A. Valves for Chilled Water.

1. Ball Valves, 2-inch and Smaller: Shall be 600 psi CWP, have cast brass bodies, replaceable reinforced Teflon seats, conventional port, blowout proof stems, chrome plated brass ball, and threaded or solder ends with extended solder cups.

Threaded	Solder
Stockham T-285-FB-R-70 (full port)	Stockham S-285-FB-R-70 (full port)
Crane 9301	Crane 9302
Worcester 44-11-RT-SE	Worcester 44-11-RT-TE
Jamesbury 351T	---
Apollo 70-100	Apollo 70-200

Approved Equal

2. Gate Valves, 2-inch and Smaller:

   Class 125, body and bonnet ASTM B62. Cast bronze composition. Threaded or soldered ends. Solid disc, copper-silicon alloy stem, brass packing gland. Threaded ends: Stockham B-100 (RS) or B103 (NRS), Crane 428 or 438, Hammond IB640 (RS) or IB645 (NRS), or equal. Soldered ends: Stockham B104 (NRS) or B108 (RS), Milwaukee 115 (NRS) or 149 (RS), NIBCO S-113 (NRS) or S-111 (RS), or approved equal.

3. Gate Valves, 2 ½-inch and Larger:

   Class 125 iron body, bronze mounted, ASTM A126, class B cast iron, flanged ends with Teflon impregnated packing and 2-piece packing glass.

	OSY RS	NRS
Stockham	G-623	G-612
Crane	465 1/2	461
Powell	1793	1787
Hammond	IR1140	IR 1138

   Approved Equal

4. Butterfly Valves: 150 psi tight shut-off, ASTM A126.

   a. Body: Lug type, ASTM A126 iron.

   b. Disc:

      1) For motorized valves: 304 Stainless Steel.

      2) For manual valves: Cadmium-plated ductile, iron for chilled water (bronze, or aluminum bronze for condenser water).

   c. Stem:

1) For motorized valves: 416 Stainless Steel.

2) For manual valves: Solid one-piece, 304 or 316 or 410 stainless steel.

d. Seat and O-rings: EPDM O-ring.

e. Upper and lower stem bearings: Bronze or reinforced Teflon.

f. Operators:

1) Valves 6-inch and smaller: Bray Series 21 as basis of design or Center Line, Stockham, Crane, Belimo, Nibco or approved equal, with lever handle, or Electric Actuator and disc position indicator.

2) Valves 8-inch and larger: Bray Series 21 as basis of design or Center Line, Stockham, Crane, Belimo, Nibco or approved equal, manual gear operator and disc position indicator, or Electric Actuator.

g. Manufacturers: Bray, Milwaukee, Center Line, Stockham, Crane, DeZURIK, Belimo, Nibco or approved equal.

5. Check Valves, 2-inch and Smaller:

Shall be of class 125, threaded or solder ends, body and caps shall be of ASTM B62 cast bronze composition, swing type disc.

Threaded	Solder
Stockham B-319Y	Stockham B-309Y
Hammond IB 904	Hammond IB 912
Crane 37	Crane 1707S
Powell 578	Powell 1825

Approved Equal

a. Class 150 valves meeting above Specifications may be furnished where pressure requires: Stockham B-321, NIBCO T-433-B, Milwaukee 515, or approved equal, threaded.

6. Check Valves, 2 ½-inch and Larger:

Shall be iron body, bronze mounted with body and cap conforming to ASTM A126, class B, cast iron, flanged ends, swing type disc.

Hammond	IR1124
Stockham	G-931
Crane	373

Powell 559

Approved Equal

7. Alternative Check Valves, 2 ½-inch and Larger:

   Shall be class 125/250, iron body, bronze mounted, wafer check valves, with ends designed for flanged type connection, aluminum bronze disc, EPDM seats, 316 stainless steel torsion spring, and hinge pin.

   Stockham WG-961

   Center Line Series 800

   Duo-Chek K12 HAP

   Marlin M125 HZDSF

   Approved Equal

8. Non-Slam Check Valves (Pump Discharge):

   Semi-steel body, bronze trim, top and bottom center guide, stainless steel spring and 125 pound flanged ends.Miller Manufacturing No. 162 or equivalent by Williams-Hager, Val-Matic Valve & Manufacturing Corp., or approved equal.

9. Air Vents: Spirotherm model Spirovent as basis of design or Amtrol, Watts, Dole, Bell and Gossett, or equal, manual type, of size for proper venting. Install at high points of systems.

10. Air Valves: Manufactured by Mueller Co.

    A. Air Valve Meter Pit Model: 330AR1884-BLN

B. Valves for Heating Hot Water.

1. Gate Valves, 2-inch and Smaller: Shall be of class 150 with body and union bonnet of ASTM B62 cast bronze composition, threaded or solder ends, solid disc, copper-silicon stem, brass packing gland, Teflon-impregnated packing, and malleable handwheel.

Threaded	Solder
Stockham B-120 (RS)	
Hammond IB629	Hammond IB648
Crane 431UB	
Powell 2714	

   Approved Equal

2. Ball Valves, 2-inch and Smaller: Shall be 600 psi CWP, have cast brass bodies, replaceable reinforced Teflon seats, conventional port, blowout proof stems, chrome plated brass ball, and threaded or solder ends with extended solder cups.

Threaded	Solder
Stockham T-285-FB-R-70 (full port)	Stockham S-285-FB-R-70 (full port)
Crane 9301	Crane 9302
Worcester 44-11-RT-SE	Worcester 44-11-RT-TE
Jamesbury 351T	---
Apollo 70-100	Apollo 70-200

Approved Equal

3. Gate Valves, 2 ½-inch and Larger: Shall be class 125 iron body, bronze mounted, with body and bonnet conforming to ASTM A126, class B, cast iron, flanged ends, with Teflon-impregnated packing and two-piece packing gland assembly.

	OS & Y	NRS
Stockham	G-623	G-612
Hammond	IR1140	IR1138
Crane	465 1/2	461
Powell	1793	1787

Approved Equal

4. Check Valves, 2-inch and Smaller: Shall be class 150 with body and cap of ASTM B62 bronze composition and threaded ends. Class 150 valves shall have lift-type non-metallic disc and union caps, and are to be furnished in lines with globe valves.

   a. For backflow prevention in lines with gate valves, Y-pattern valves with swing-type disc may be furnished.

      Stockham B-322B

      Crane 27TF

      Approved Equal

   b. For Class 150 service, threaded ends:

      Stockham B-321

      NIBCO T-433-B

Crane 137

Approved Equal

c. For Class 200 Service, threaded ends:

Hammond IB944

Stockham B-345

Crane 36

Powell 560

Approved Equal

5. Check Valves, 2 ½-inch and Larger: Shall be iron body, bronze mounted, with body and cap conforming to ASTM A126, class B, cast iron, flanged ends, and swing-type disc.

Crane 373

Hammond IR1124

Powell 559

Stockham G-931

Approved Equal

a. Alternative for above listed check valves shall be Class 125/250 iron body, bronze mounted, wafer check valve, with ends designed for flanged type connection, aluminum bronze disc, EPDM seats, 316 stainless steel torsion spring, and hinge pin.

Center Line Series 800

Hammond IR9253

Marlin M125 HZDSF

Duo-Chek G12 HAP

Stockham WG-961

Approved Equal

C. Electric Motor Operated Valves: Belimo, Bray or approved equal.

D. Valves, General:

B. Flange gaskets: Mineral fiber, 1/16 inch thick, equivalent to Garlock Style 9800, Durlon 8300, or approved equal.

C. Handles or hand wheels on valves shall be removable and, unless specified to be of loose key type, shall be securely fastened to their stems. Valve handwheels, except those on radiator valves, shall be of steel, brass, or cast iron.

D. Boiler shut-off valves and valves on steam mains installed more than 6 feet above floor, shall be furnished with chain wheels and chains to within 6 feet of floor. Chains shall be free hanging and in a position to permit operation of valve from floor. When pulleys or extensions are required to locate these chains in such a position, furnish, and install said pulleys or extensions as required to provide a satisfactory operating installation. Extensions over one foot long shall be furnished with a supported outboard bearing.

E. Furnish and install chains or wire rope with required accessories to open safety valves from boiler room floor.

F. Flow Control Valves: Refer to Section 23 05 16, BASIC MECHANICAL MATERIALS AND METHODS.

2.03 VALVE VAULT

A. Installed isolation valves will be housed in pre-cast concrete vault with variable depth per plan. Manufacturer shall be Old Castle Model: 506 LA Vault-Vault.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install all valves in accordance with manufacturer's printed instructions and as indicated on Drawings.

3.02 ADJUSTMENT AND CLEANING

A. Valves and stops shall be adjusted, packed, and repacked as may be required to eliminate leaks and to meet flow requirements of ASME B31.

END OF SECTION 23 20 00

SECTION 23 20 13

ABOVE-GROUND PIPING

PART 1 – GENERAL

1.01 SUMMARY

A. Above-ground piping is defined by any piping that is not direct-buried.

B. Section Includes: Above ground piping systems for heating, ventilating, and air conditioning systems. Systems include but are not limited to the following:

1. Heating Hot Water System, plastic pipe and fittings.
2. Chilled Water System, plastic pipe and fittings.
3. Expansion Loops.
4. Transition fittings.
5. Loose-fill insulation.
6. Cellular foam glass insulation.
7. Pre-insulated piping.
8. Data logging

C. Related Requirements:

1. Division 01: General Requirements.
2. Section 23 05 00: Mechanical General Provisions.
3. Section 23 05 16: Basic Mechanical Materials and Methods.
4. Section 23 05 53: Piping & Equipment Identification.
5. Section 23 07 00: Mechanical Insulation.
6. Section 23 08 00: Mechanical Systems Commissioning.
7. Section 23 20 00: Valves.
8. Section 23 20 16: Underground Piping.
9. Section 23 25 00: HVAC Water Treatment
10. Section 31 50 00: Excavation Support and Protection

1.02 REFERENCES

A. ASTM F 2389-07 - Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems.

B. CSA B137.11 - Polypropylene (PP-R) Pipe and Fittings for Pressure Applications.

C. NSF/ANSI 14 – Plastic Piping System Components and Related Materials.

D. ASTM F1668 - Standard Guide for Construction Procedures for Buried Plastic Pipe

E. ASTM D2657 - Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings

F. DIN-DVS 2207-11 2017 – Welding thermoplastic materials – Heated element welding of pipes, piping parts and panels made of polypropylene.

1.03 DEFINITIONS

A. Definitions shall be in accordance with local mechanical codes and ASTM F 2389.

1.04 SUBMITTALS

A. Provide submittals in accordance with Section 01 33 00, SUBMITTAL PROCEDURES, Sections 23 05 00, MECHANICAL GENERAL PROVISIONS, and 23 05 16, BASIC MECHANICAL MATERIALS AND METHODS.

B. Provide Manufacturer's Product Data submittals for the following, demonstrating conformance to specified standards and specification requirements:

1. Cellular glass insulation

2. Loose-fill insulation

3. Hydronic piping

4. Pre-insulated, pre-fabricated piping

5. Other products listed in Part 2 of this Section

C. Provide a thermal expansion/contraction analysis, with calculations, of the piping system. Provide Shop Drawings, signed and sealed by a professional engineer, showing pipe sizes, locations, and elevations. Show pipe with details showing clearances between piping, and show insulation thickness. Show dimensioned piping layout and details of expansion loops, elbows, anchor points, building entry points and other pertinent information required to verify layout, intent and type of materials are in accordance with this Section. Prefabricated pipe units shall be dimensioned and numbered to fit actual Work with field verified conditions prior to start of factory fabrication.

D. The Contractor shall indicate location of all installed fittings, in addition to the as-built drawing content required in accordance with Section 01 77 00.

E. Delegated Design Submittals

1. Provide the thermal expansion/contraction analysis, with calculations, of the piping system. Provide design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.

2. Show locations of pipe anchors and alignment guides and expansion joints and loops.

3. Show locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.

4. Show locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

F. Informational Submittals

1. Provide Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

a. Suspended ceiling components.

b. Other building services

c. Structural members

G. Qualification Data for Installers

1. Certify that each installer has been trained by the manufacturer's representative for fusion piping installation.

H. Field Quality-Control Reports

I. Preconstruction Test Reports

1. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

J. Warranty Information

1. Submit documentation of 10-year warranty with coverage for parts, materials, labor, property damage, and personal injury.

1.05 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing hydronic piping systems with the following working-pressure ratings:

1. Heating Hot Water Piping: 100 psig at 200 degrees F.

2. Chilled Water Piping: 100 psig at 200 degrees F.

1.06 QUALITY ASSURANCE

A. Comply with applicable codes and referenced standards: ASTM, ASME/ANSI, CPC (California Plumbing Code), CMC (California Mechanical Code).

B. Qualifications of Manufacturer: Products used in the Work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production.

C. Material shall be certified by NSF International as complying with NSF 14, and ASTM F 2389 or CSA B137.11.

D. Material shall comply with manufacturer's specifications.

E. Special Engineered products shall be certified by NSF International as complying with NSF 14.

F. Piping Installers: Installers of pre-insulated, pre-fabricated piping shall be certified by manufacturer of pipes and fittings as having been trained and qualified to join polypropylene piping using fusion welding of the same type as specified in Drawings (socket, butt, electrofusion, fusion outlet).

1.07 DELIVERY, STORAGE AND HANDLING

A. Comply with the requirements of Section 23 05 16, BASIC MECHANICAL MATERIALS AND METHODS.

B. Inspect the pipe upon receipt to ensure that it has not been damaged during shipping.

C. Damaged pipe shall be cataloged and returned for replacement following distributor's procedures for returns.

D. Protect piping, valves, fittings, etc. before installation in accordance with manufacturer's written instructions.

E. Always store the pipe on a flat surface. When storing the pipe on racks or supports on the ground always have at least four supports, evenly spaced, under a 19-ft length. Place plywood on top of the supports to prevent warping.

F. Piping shall be shipped from the factory with capped ends and stored on supports off the ground with ends covered at all times to prevent nesting of insects, birds, and other animals. Any pipe found to be without end-caps or not raised off of the ground shall be cleaned by the Contractor prior to installation.

G. Protect piping from accumulation of dirt and debris in and around piping/components.

H. If the pipe is removed from its bag, or the bag has been damaged, do not store the pipe unprotected from UV rays (sunlight) for longer than six months. Pipe that is exposed to direct sunlight for longer than six months will not be covered under the warranty.

I. Never place the forks of a forklift into the ends of the pipe. The interior of the pipe may be damaged and can cause it to crack. Handlers may use a padded rug ram inside the pipe or use a crane or lift to handle larger pipe.

J. In cold weather, take extra care when handling the pipe. Cold temperatures reduce the pipe's flexibility, making it more susceptible to impact damage.

1.08 COORDINATION

A. Coordinate related and adjacent activities in accordance with DIVISION 01.

1.09 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: The STATE will engage a qualified testing agency to perform preconstruction testing on water quality.

1.10 WARRANTY

A. Manufacturer shall warrant pipe and fittings for 10 years to be free of defects in materials or manufacturing.

B. Warranty shall cover labor and material costs of repairing and/or replacing defective materials and repairing any incidental damage caused by failure of the piping system due to defects in materials or manufacturing.

C. Warranty shall be in effect only upon submission by the contractor to the manufacturer valid pressure/leak test documentation indicating that the system was tested and passed the manufacturer's pressure/leak test.

D. The Contractor shall remedy defects due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of three years from Substantial Completion.

E. All Prefab work performed by the manufacturer for the contractor shall be covered by the manufacturer's 10-year warranty including welded joints and fittings.

F. Installers shall be trained and certified to install the pipe according to the manufacturer's guidelines.

G. Manufacturer's representative shall provide training.

PART 2 – PRODUCTS

2.01 PIPE AND PIPING PRODUCTS

A. Pipe shall be Polypropylene (PP-R), (PP-RCT) ASTM F 2389, pipe and socket fusion, fusion outlet fittings, or butt fusion only for NPS 2-1/2 and larger. Pipe shall be manufactured from a PP-RP (RCT) resin (Fusiolen) meeting the short-term properties and long-term strength requirements of ASTM F 2389 or CSA B137.11. The pipe shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All pipe shall be made in an extrusion process. Hydronic heating hot water piping shall contain a fiber

layer (faser) to restrict thermal expansion. All pipe shall comply with the rated pressure requirements of ASTM F 2389 or CSA B137.11. All pipe shall be certified by NSF International as complying with NSF 14, and ASTM F 2389 or CSA B137.11.

B. HHW pipe shall be Aquatherm® Blue Pipe® SDR 9 MF® or approved equal. CHW pipe shall be Aquatherm® Blue Pipe® SDR 11 MF® or approved equal.

C. Operating Conditions: Maximum temperature 200 deg F. Maximum Pressure 100 psig.

D. Chilled Water and Heating Hot Water, 1-1/2-inch and Larger Pipe and Fittings: Aboveground chilled water and heating hot water supply and return piping shall be pre-insulated, prefabricated-pipe type, composed of integral sealed units of HDPE outer jacket, polyurethane foam insulation as manufactured by: Aquatherm or equal. HHW pipe shall be Aquatherm® Blue Pipe® SDR 9 MF® or approved equal. CHW pipe shall be Aquatherm® Blue Pipe® SDR 11 MF® or approved equal.

2.02 FITTINGS

A. Fittings shall be manufactured from a PP-R resin (Fusiolen) meeting the short-term properties and long-term strength requirements of ASTM F 2389. The fittings shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All fittings shall be certified by NSF International as complying with NSF 14, and ASTM F 2389 or CSA B137.11.

B. Fittings shall be Aquatherm® Blue Pipe® MF®, to match pipe, or approved equal.

C. Polypropylene Fittings: socket fusion, butt fusion, electrofusion, or fusion outlet fittings shall be used for fusion weld joints between pipe and fittings.

D. Mechanical fittings and transition fittings shall be used where transitions are made to other piping materials or to valves and appurtenances. Plastic-to-Metal Transition Fittings shall be the following:

1. PP-R one-piece fitting with threaded stainless steel, brass, or copper insert and one PP-R fusion weld joint end.

E. Polypropylene pipe shall not be threaded. Threaded brass or stainless steel transition fittings per ASTM F 2389 shall be used where a threaded connection is required.

F. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.03 EXPANSION ELBOWS AND LOOPS

A. Prefabricated elbows, expansion loops and tees, guides, and anchors shall be furnished where expansion compensation is required. Pre-insulated fittings that must provide compensation for pipe expansion or contraction shall be installed in a suitably sized jacket and insulated with flexible polyurethane foam insulation. Straight units adjoining expansion fittings shall also be insulated with flexible polyurethane foam insulation to compensate for lateral pipe movement.

B. Thrust Blocks: Suitably sized concrete thrust blocks shall be installed where required.

C. Anchors: Prefabricated plate anchors shall be furnished where required and shall consist of a steel plate welded to carrier pipe and sealed to outer jacket.

2.04 POLYPROPYLENE VALVES

A. Polypropylene Valves shall be provided and shall be manufactured in accordance with the manufacturer's specifications and shall comply with the performance requirements of ASTM F 2389 or CSA B137.11. The valves shall contain no rework or recycled thermoplastic materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. Provide valve stem extension and valve vaults.

B. Polypropylene Valves shall be Aquatherm® or approved equal.

2.05 SMOKE AND FIRE RATINGS

A. Where indicated on the drawings that a Plenum-rated Piping System is needed, the pipe shall be wrapped and/or insulated with standard fiberglass or mineral wool pipe insulation, field installed, with bare fittings no closer than every 6 ft. of pipe. The pipe wrap or insulation as a system shall meet the requirements of CAN/ULC-S102.2-03 or ASTM E84. The system shall have a Flame Spread Classification of less than 25 and Smoke Development rating of less than 50.

2.06 UV PROTECTION

A. Where indicated on the drawings that the pipe will be exposed to direct UV light for more than 30 days, it shall be provided with a Factory applied, UV-resistant coating or alternative UV protection.

B. Note that molded fittings ½" to 4" do not need to have UV protection. Larger molded fittings (6"-10") and segmented fittings will need to be protected from UV.

2.07 THERMAL INSULATION AND JACKETING

A. Aboveground piping shall be pre-insulated, pre-fabricated pipe. Insulation materials furnished and installed hereunder should meet the minimum thickness requirements of American Society of Heating, Refrigeration, and Air Conditioning Engineers ASHRAE 90.1 (current edition), "Energy Efficient Design of New Buildings." However, if other factors such as condensation control or personnel protection are to be considered, the selection of the thickness of insulation should satisfy the controlling factor.

B. Granular Loose Fill Insulation

1. Granular, Loose-Fill Insulation: Inorganic, nontoxic, nonflammable, sodium potassium aluminum silicate with calcium carbonate filler. Include chemical treatment that renders insulation hydrophobic.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Gilsulate International, Inc.

b. or approved equal

3. Thermal Conductivity (k-Value): 0.60 at 175 deg F (0.087 at 79 deg C) and 0.65 at 300 deg F (0.094 at 149 deg C).

4. Application Temperature Range: 35 to 800 deg F (2 to 426 deg C).

5. Dry Density: 40 to 42 lb./cu. ft. (640 to 672 kg/cu. m).

6. Strength: 12,000 lb./sq. ft. (58,600 kg/sq. m).

C. Powder, Loose-Fill Insulation

1. Inert, nontoxic, nonflammable, calcium carbonate particles. Include chemical treatment that renders insulation hydrophobic.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. DriTherm International Inc.

b. or approved equal

3. Thermal Conductivity (k-Value): ASTM C 177, 0.58 at 100 deg F (0.084 at 37 deg C) and 0.68 at 300 deg F (0.098 at 149 deg C).

4. Application Temperature Range: Minus 273 to plus 480 deg F (Minus 169 to plus 250 deg C).

5. Dry Density: Approximately 60 lb/cu. ft. (960 kg/cu. m).

6. Strength: 12,000 lb/sq. ft. (58,600 kg/sq. m).

D. Cellular Glass Thermal Insulation

1. Cellular glass insulation, inert, non-toxic, impermeable, inorganic, noncombustible, cellular glass insulation. ASTM C 522-00.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Pittsburgh Corning

b. or approved equal

3. Thermal Conductivity (k-Value): ASTM C 177, 0.29 at 75 deg F (0.033 at 0 deg C).

4. Application Temperature Range: Minus 273 to plus 900 deg F (Minus 169 to plus 482 deg C).

5. Dry Density: Approximately 7.5 lb/cu. ft. (120 kg/cu. m).

6. Compressive Strength: 90 psi. (6.3 kg/sq. cm^2).

E. Spray-on Pipe Insulation

1. Insulation shall be polyurethane foam or polyisocyanurate foam spray applied to the surface of the pipe with a minimum thickness of one inch. Insulation shall be rigid when dried, 90-95% closed cell polyurethane or polyisocyanurate with a 2.0 to 3.0 pounds per cubic foot density and coefficient of thermal conductivity (K- Factor) of 0.16 and shall conform to ASTM C-591.

F. Pre-Insulated Pipe

1. Aboveground piping shall be pre-insulated, pre-fabricated pipe. It shall be a complete system of factory pre-insulated polypropylene piping for the specified service.

2. Carrier pipe shall be polypropylene PP-R or PP-RP(RCT) by Aquatherm or approved equal, conforming to ASTM F-2389, as previously specified herein.

3. Insulation shall be polyurethane foam either spray applied or injected with one shot into the annular space between carrier pipe and jacket with a minimum thickness of one inch. Insulation shall be rigid, 90-95% closed cell polyurethane with a 2.0 to 3.0 pounds per cubic foot density and coefficient of thermal conductivity (K- Factor) of 0.16 and shall conform to ASTM C-591.

4. Jacketing material shall be extruded, black, high-density polyethylene (HDPE), having a minimum wall thickness of 100 mils for jacket sizes less than or approved equal to 12”, and 125 mils for jacket sizes larger than 12” to 24”.

5. Pre-insulated fittings (tees and elbows) shall meet the same requirements as noted herein for pre-insulated pipe. Fittings shall have stubs of an extra 36” of pipe on each inlet and outlet for future ease of insertion into the piping system. Pre-insulator shall provide on-site insulation kit to connect to the pre-insulated system to make a continuous insulation system.

6. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Aquatherm Pipe

b. Thermacor Process, L.P.

c. Perma-Pipe, Inc.

d. or approved equal

PART 3 – EXECUTION

3.01 PIPING APPLICATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Installers shall be trained and certified to install the pipe according to the manufacturer's guidelines. Contact the local manufacturer representative for training.

C. Install listed pipe materials and joining methods below in the following applications:

1. Aboveground: Polypropylene (PP-R) or PP-RP (RCT) piping in SDR 9, based on the required minimum pressure rating and use temperature, in accordance with manufacturer's instructions and ASTM F2389.

D. Installation shall be accomplished with the proper tools for installing manufacturer's piping following manufacturer's instructions.

E. Install hydronic piping level and plumb.

F. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

3.02 FUSION WELDING OF JOINTS

A. Install fittings and joints using socket-fusion, electrofusion, or butt-fusion as applicable for the fitting or joint type. All fusion-weld joints shall be made in accordance with the pipe and fitting manufacturer's specifications and product standards.

B. Fusion-weld tooling, welding machines, and electrofusion devices shall be as specified by the pipe and fittings manufacturer.

C. Prior to joining, the pipe and fittings shall be prepared in accordance with ASTM F 2389 and the manufacturer's specifications.

D. Joint preparation, setting and alignment, fusion process, cooling times and working pressure shall be in accordance with the pipe and fitting manufacturer's specifications.

E. Ream ends of pipes and tubes and remove burrs.

F. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

G. Fusion Joints: Use fusion joints for all pipe connections and pipe/pipe appurtenances connections. Fusion join polypropylene pipe in accordance with ASTM D2657, ASTM F 2389, and the manufacturer's instructions.

H. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

J. Insulation joints made for pre-insulated pipe shall be done in accordance with the insulation manufacturer's instructions.

K. Data Loggers shall be used to log each joint made. Data logger shall record at least the date, time of day and person making each joint. Data logger shall also record the required pressure/leak test for manufacturer's warranty.

3.03 PIPING INSTALLATIONS

A. Refer to Section 23 05 16, BASIC MECHANICAL MATERIALS AND METHODS.

B. Refer to Paragraph 2.04 above for Polypropylene Valves. Also, refer to Section 23 05 23, GENERAL-DUTY VALVES FOR HVAC PIPING.

C. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

D. Installers shall be trained and certified to install the pipe per the manufacturer's guidelines.

E. Install piping at uniform grade of 0.2 percent. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points and elsewhere as required for system drainage. Install manual air vents at high points.

F. In conduits, install drain valves at low points and manual air vents at high points.

G. Install components with pressure rating equal to or greater than system operating pressure.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. See Division 23 specifications Sections for sleeves and mechanical sleeve seals through exterior building walls.

K. Fire stopping shall be provided to both be compatible with the manufacturer's piping and meet the requirements of ASTM E 814 or ULC S115, "Fire Tests of Through-Penetration Firestops". Pipe insulations or fire resistive coating shall be removed where the pipe passes through a fire stop and, if required by the firestop manufacturer, for 3 inches beyond the firestop outside of the fire barrier.

L. When installed in systems with pumps in excess of 3.0 HP, piping shall be protected from excessive heat generated by operating the pump at shut-off conditions. Where the possibility exists that the pump will operate with no flow, the protection method shall be a temperature relief valve or comparable level of protection, set to a maximum temperature of 185°F.

M. If heat tracing or freeze protection is specified for the piping, it should be installed on the pipe interior or exterior. It must be suitable for use with plastic piping and be self-regulating to ensure that the surface temperature of the pipe and fittings will not exceed 70°C (158°F).

N. Heating hot water and chilled water piping shall be installed in a manner so that air will be eliminated from lines or equipment during operation. Pitch pipelines as specified in Section 23 05 16, BASIC MECHANICAL MATERIALS AND METHODS.

O. An air vent shall be installed at each high point of chilled water and heating hot water circulating lines. Refer to air vents as specified under Section 23 05 19, PIPING SPECIALTIES.

P. Air vent valves shall be installed with drains to nearest floor sink or to the outside. Acceptable manufacturers: Bell and Gossett, Hoffman, or approved equal.

Q. Inspections and Tests:

1. Welding Inspection: In accordance with Section 23 05 16, BASIC MECHANICAL MATERIALS AND METHODS.

2. Pressure Testing: In accordance with Section 23 05 16, BASIC MECHANICAL MATERIALS AND METHODS, and the following:

a. Test at 200 psi. Maintain test pressure for at least 4 hours, observed by the Project Inspector, to prove tightness without leaks.

b. Comply with requirements in Paragraph 3.06 below.

3. Field Joint Inspection:

a. Verify installation of insulation at all field joints. Installation of field applied insulation and jackets shall be observed by the Project Inspector.

4. Prepare test and inspection reports. Deliver to the STATE's Representative and the Manufacturer to obtain product warranty.

3.04 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices in Section 23 05 48, VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT.

1. Comply with requirements for pipe hanger, support products, and installation in Section 23 05 29, HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT.

a. Vertical Piping: MSS Type 8 or 42, clamps.

b. Individual, Straight, Horizontal Piping Runs:

i. Adjustable, steel clevis hangers.

ii. Clamps on strut trapeze.

iii. Clamps on strut attached to structure.

iv. Clamps attached directly to the structure.

c. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and 10-foot intervals or at each floor whichever is less.

C. Install hangers and supports at intervals specified in the applicable Plumbing Code and/or as recommended by pipe manufacturer.

D. Hangers and supports shall also be provided within 1-foot of every change of direction and within 1-foot of any pipe fittings and valves.

E. For heating hot water piping, provide clamps and supports that are felt or rubber/vinyl coated or lined.

F. Use care when installing riser clamps to not over tighten the clamps to cause indentation of the pipe. Riser clamps shall be isolated from the building structure by placing felt or rubber pads between the clamp, the pipe and the structure.

G. All piping support materials shall be new and manufactured for the specific purpose of supporting systems, equipment, pipes and accessories. No improvised pipe support solutions shall be allowed.

3.05 EXPANSION AND CONTRACTION

A. Provide expansion and contraction controls, guides and anchors to take into account the expansion and contraction of the pipe. Provide expansion loops or offsets as required and as indicated in the thermal expansion/contraction analysis, with calculations, of the piping system.

1. Install anchors as required and where indicated in the manufacturer's thermal expansion/contraction analysis, with calculations, of the piping system.

2. Install expansion loop or offset between each anchor point. Expansion device shall be able to absorb all the stresses between the two anchor points.

3. Vertical risers of piping shall be anchored at each floor.

4. Provide anchor point at branch take-off in vertical riser of piping.

3.06 PRESSURE/LEAK TESTING

A. While still accessible, all piping shall be pressure/leak tested to the manufacturer's standards.

B. Tests shall be carried out using water, compressed air or a mixture of the two. The test pressure shall be as indicated in the pressure leak testing procedures required by the manufacturer.

C. In the event that water is not available for testing it shall be permissible to use compressed air as a testing medium. Contact the engineering department of the manufacturer for guidance. Follow all precautionary procedures recommended by the piping manufacturer.

D. Any leaks detected shall be repaired at the Contractor's expense by removing the leaking part and replacing with new parts welded per the pipe manufacturer's guidelines.

3.07 INSPECTING AND CLEANING

A. The pipes shall be flushed with cold water after finishing the installation. Flush the system until the water runs clear of debris and dirt.

B. Inspect and test piping systems following procedures of authorities having jurisdiction and as specified by the piping system manufacturer.

C. Clean and disinfect water distribution piping following procedures of the manufacturer and/or the authority having jurisdiction.

D. Each system shall be cleaned by passing cleaning fluids through pipework. Equipment that has been previously cleaned shall be isolated from the system and not be subjected to cleaning fluids.

E. Systems shall be completely flushed after cleaning. Furnish a separate pump for cleaning. Do not use pumps that are furnished as a part of this Contract.

F. Perform cleaning and boil-out after completion of piping and pressure testing and before the system is put into operation. All piping system cleaning and water treatment shall be coordinated with and witnessed by the STATE's Representative. It is imperative that before any system is filled with water, the STATE's Representative verify that cleaning has been properly completed and proper chemical treatment is in place and maintained. Operating staff should be requested to monitor chemical treatment after the system is filled until the project is completed and turned over to them. The Inspector shall witness the cleaning procedure.

G. Do not circulate cleaning solution through cooling coils and heating coils. Provide temporary bypasses.

H. The entire cleaning procedure shall be performed by a contractor furnished independent chemical cleaning company approved by the STATE's Representative.

I. Flush out entire system for a period of not less than 4 hours to clear it of all loose material. Provide necessary cross-connections to loop system and circulate water for 24 hours. During this period, install 80-mesh screen in strainers and periodically clean. Drain entire

system. Refill system. Meter water when refilling to determine amount of chemical required in next procedure. Add trisodium phosphate (TSP) to provide a uniform residual concentration of 10 ppm. Circulate water for 48 hours. During circulation, periodically clean screens as required. Flush system for approximately 4 hours or until all traces of chemicals are removed. Remove 80-mesh screens.

J. For space heating hot water system, provide injection fitting and required connection piping to a 55-gallon chemical drum. Drum shall have provision for wall straps to safely secure to the wall. Chemical pump, controls and interval timer shall be provided. Coordinate with electrical to provide required power for the pump. Coordinate with the plumbing engineer to provide sink and emergency shower/eyewash in mechanical room where water treatment will be performed. Run ¼" copper tubing from the water piping system to the sink with appropriate labels and service valves for collecting samples.

K. Provide water treatment and a 30-day advance notice to the STATE's Representative prior to treatment. The piping system must be complete, pressure tested and cleaned. If water treatment has to be redone due to contractor's incomplete work, extra services will be at contractor's expense.

3.08 DEMONSTRATION AND TRAINING

A. The Contractor shall provide a minimum of four (4) hours of demonstration and training to the Owner's operations personnel covering the following items:

1. Field joint preparation and installation.

2. Installation of field applied insulation.

3. Installation and repair of HDPE & PVC jackets.

4. Testing of installed field joints to ensure water-tight installation.

3.09 CLEANUP

A. Remove rubbish, debris and waste materials and legally dispose of off Project site.

3.10 PROTECTION

A. Protect the Work of this Section until Substantial Completion.

END OF SECTION 23 20 13

SECTION 23 20 16

UNDERGROUND PIPING

PART 1 – GENERAL

1.01 SUMMARY

A. Underground piping is defined as direct-buried piping.

B. Section Includes: Underground piping systems for heating, ventilating and air conditioning systems. Systems include, but are not limited to, the following:

1. Heating Hot Water Piping System, plastic pipe and fittings.
2. Chilled Water Piping System, plastic pipe and fittings.
3. Expansion Loops.
4. Transition fittings.
5. Loose-fill insulation.
6. Cellular foam glass insulation.
7. Pre-insulated piping.
8. Data logging

C. Related Requirements:

1. Division 01: General Requirements.
2. Section 23 05 00: Mechanical General Provisions.
3. Section 23 05 16: Basic Mechanical Materials and Methods.
4. Section 23 05 53: Piping & Equipment Identification.
5. Section 23 07 00: Mechanical Insulation.
6. Section 23 08 00: Mechanical Systems Commissioning.
7. Section 23 20 00: Valves.
8. Section 23 20 13: Above-Ground Piping.
9. Section 23 25 00: HVAC Water Treatment
10. Section 31 50 00: Excavation Support and Protection

1.02 REFERENCES

A. ASTM F 2389-07 - Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems.

B. CSA B137.11 - Polypropylene (PP-R) Pipe and Fittings for Pressure Applications.

C. NSF/ANSI 14 – Plastic Piping System Components and Related Materials.

D. ASTM F1668 - Standard Guide for Construction Procedures for Buried Plastic Pipe

E. ASTM D2657 - Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings

F. DIN-DVS 2207-11 2017 – Welding thermoplastic materials – Heated element welding of pipes, piping parts and panels made of polypropylene.

1.03 DEFINITIONS

A. Definitions shall be in accordance with local mechanical codes and ASTM F 2389.

1.04 SUBMITTALS

A. Provide submittals in accordance with Section 01 33 00, SUBMITTAL PROCEDURES, Sections 23 05 00, MECHANICAL GENERAL PROVISIONS; and 23 05 16, BASIC MECHANICAL MATERIALS AND METHODS.

B. Provide Manufacturer's Product Data submittals for the following, demonstrating conformance to specified standards and specification requirements:

1. Cellular glass insulation

2. Loose-fill insulation

3. Hydronic piping

4. Pre-insulated, pre-fabricated piping

5. Other products listed in Part 2 of this Section

C. Provide a thermal expansion/contraction analysis, with calculations, of the piping system. Provide Shop Drawings, signed and sealed by a professional engineer, showing pipe sizes, locations, and elevations. Show piping in trench, conduit, and cased pipe with details showing clearances between piping, and show insulation thickness. Show dimensioned piping layout and details of expansion loops, elbows, anchor points, building or manhole entry points and other pertinent information required to verify layout, intent and type of materials are in accordance with this Section. Prefabricated pipe units shall be dimensioned and numbered to fit actual Work with field verified conditions prior to start of factory fabrication.

D. The Contractor shall indicate location and depth of all installed fittings, in addition to the as-built drawing content required in accordance with Section 01 77 00.

E. Delegated Design Submittals

1. Provide the thermal expansion/contraction analysis, with calculations, of the piping system. Provide Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.

2. Locations of pipe anchors and alignment guides and expansion joints and loops.

3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.

4. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

F. Informational Submittals

1. Provide Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

   a. Suspended ceiling components.

   b. Other building services

   c. Structural members

2. Provide Profile Drawings if profiles are not shown on the Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1-inch equals 50 feet (1:500) and at vertical scale of not less than 1-inch equals 5 feet (1:50). Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing hydronic piping.

G. Qualification Data for Installers

1. Certify that each installer has been trained by the manufacturer's representative for fusion piping installation.

H. Field Quality-Control Reports

I. Preconstruction Test Reports

1. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

J. Warranty Information

1. Submit documentation of 10-year warranty with coverage for parts, materials, labor, property damage, and personal injury.

1.05 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing hydronic piping systems with the following working-pressure ratings:

1. Heating Hot Water Piping: 100 psig at 200 degrees F.

2. Chilled Water Piping: 100 psig at 200 degrees F.

1.06 QUALITY ASSURANCE

A. Refer to Sections 23 05 00, MECHANICAL GENERAL PROVISIONS; and 23 05 16, BASIC MECHANICAL MATERIALS AND METHODS.

B. Pipe manufacturer representative shall be present to inspect delivered pipe and fittings, shall ensure that piping and associated jacketing is not damaged and shall verify that pipe and fittings are properly stored. The pipe manufacturer's representative shall provide a letter to THE STATE's Representative identifying any noted deficiencies. The Contractor shall repair and/or replace damaged materials.

C. Preparation and installation of field joints shall be observed and approved by the pre-insulated pipe manufacturer's authorized representative and the Project Inspector.

D. Material shall be certified by NSF International as complying with NSF 14, and ASTM F 2389 or CSA B137.11.

E. Material shall comply with manufacturer's specifications.

F. Special Engineered products shall be certified by NSF International as complying with NSF 14.

G. Piping Installers: Installers of pre-insulated, pre-fabricated piping shall be certified by manufacturer of pipes and fittings as having been trained and qualified to join polypropylene piping using fusion welding of the same type as specified in Drawings (socket, butt, electrofusion, fusion outlet).

1.07 DELIVERY, STORAGE, AND HANDLING

A. Comply with the requirements of Section 23 05 16, BASIC MECHANICAL MATERIALS AND METHODS.

B. Inspect the pipe upon receipt to ensure that it has not been damaged during shipping.

C. Damaged pipe shall be cataloged and returned for replacement following distributor's procedures for returns.

D. Protect piping, valves, fittings, etc. before installation in accordance with manufacturer's written instructions.

E. Always store the pipe on a flat surface. When storing the pipe on racks or supports on the ground always have at least four supports, evenly spaced, under a 19-ft length. Place plywood on top of the supports to prevent warping.

F. Piping shall be shipped from the factory with capped ends and stored on supports off the ground with ends covered at all times to prevent nesting of insects, birds, and other animals. Any pipe found to be without end-caps or not raised off of the ground shall be cleaned by the Contractor prior to installation.

G. Protect piping from accumulation of dirt and debris in and around piping/components.

H. If the pipe is removed from its bag, or the bag has been damaged, do not store the pipe unprotected from UV rays (sunlight) for longer than six months. Pipe that is exposed to direct sunlight for longer than six months will not be covered under the warranty.

I. Never place the forks of a forklift into the ends of the pipe. The interior of the pipe may be damaged and can cause it to crack. Handlers may use a padded rug ram inside the pipe or use a crane or lift to handle larger pipe.

J. In cold weather, take extra care when handling the pipe. Cold temperatures reduce the pipe's flexibility, making it more susceptible to impact damage.

1.08 COORDINATION

A. Coordinate installation and related procedures with provisions of Section 23 05 00, MECHANICAL GENERAL PROVISIONS.

1.09 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on water quality.

1.10 WARRANTY

A. Manufacturer shall warrant pipe and fittings for 10 years to be free of defects in materials or manufacturing.

B. Warranty shall cover labor and material costs of repairing and/or replacing defective materials and repairing any incidental damage caused by failure of the piping system due to defects in materials or manufacturing.

C. Warranty shall be in effect only upon submission by the contractor to the manufacturer valid pressure/leak test documentation indicating that the system was tested and passed the manufacturer's pressure/leak test.

D. The Contractor shall remedy defects due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of three years from Substantial Completion.

E. All Prefab work performed by the manufacturer for the contractor shall be covered by the manufacturer's 10-year warranty including welded joints and fittings.

F. Installers shall be trained and certified to install the pipe according to the manufacturer's guidelines.

G. Manufacturer’s representative shall provide training.

PART 2 – PRODUCTS

2.01 PIPE AND PIPING PRODUCTS

A. Pipe shall be Polypropylene (PP-R), (PP-RCT) ASTM F 2389, pipe and socket fusion, fusion outlet fittings, or butt fusion only for NPS 2-1/2 and larger. Pipe shall be manufactured from a PP-RP (RCT) resin (Fusiolen) meeting the short-term properties and long-term strength requirements of ASTM F 2389 or CSA B137.11. The pipe shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All pipe shall be made in an extrusion process. Hydronic heating hot water piping shall contain a fiber layer (faser) to restrict thermal expansion. All pipe shall comply with the rated pressure requirements of ASTM F 2389 or CSA B137.11. All pipe shall be certified by NSF International as complying with NSF 14, and ASTM F 2389 or CSA B137.11.

B. HHW pipe shall be Aquatherm® Blue Pipe® SDR 9 MF® or approved equal. CHW pipe shall be Aquatherm® Blue Pipe® SDR 11 MF® or approved equal.

C. Operating Conditions: Maximum temperature 200 deg F. Maximum Pressure 100 psig.

D. Heating Hot Water and Chilled Water, 2-inch and Larger Pipe and Fittings: Underground chilled water and heating hot water supply and return piping shall be pre-insulated, prefabricated-pipe type, composed of integral sealed units of HDPE outer jacket, polyurethane foam insulation as manufactured by: Aquatherm or approved equal. HHW pipe shall be Aquatherm® Blue Pipe® SDR 9 MF® or approved equal. CHW pipe shall be Aquatherm® Blue Pipe® SDR 11 MF® or approved equal.

2.02 FITTINGS

A. Fittings shall be manufactured from a PP-R resin (Fusiolen) meeting the short-term properties and long-term strength requirements of ASTM F 2389. The fittings shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All fittings shall be certified by NSF International as complying with NSF 14, and ASTM F 2389 or CSA B137.11.

B. Fittings shall be Aquatherm® Blue Pipe® MF®, to match pipe, or approved equal.

C. Polypropylene Fittings: socket fusion, butt fusion, electrofusion, or fusion outlet fittings shall be used for fusion weld joints between pipe and fittings.

D. Mechanical fittings and transition fittings shall be used where transitions are made to other piping materials or to valves and appurtenances. Plastic-to-Metal Transition Fittings shall be the following:

1. PP-R one-piece fitting with threaded stainless steel, brass, or copper insert and one PP-R fusion weld joint end.

E. Polypropylene pipe shall not be threaded. Threaded brass or stainless steel transition fittings per ASTM F 2389 shall be used where a threaded connection is required.

F. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.03 EXPANSION ELBOWS AND LOOPS

A. Prefabricated elbows, expansion loops and tees, guides, and anchors shall be furnished where expansion compensation is required. Pre-insulated fittings that must provide compensation for pipe expansion or contraction shall be installed in a suitably sized jacket and insulated with flexible polyurethane foam insulation. Straight units adjoining expansion fittings shall also be insulated with flexible polyurethane foam insulation to compensate for lateral pipe movement.

B. Thrust Blocks: Suitably sized concrete thrust blocks shall be installed where required.

C. Anchors: Prefabricated plate anchors shall be furnished where required and shall consist of a steel plate welded to carrier pipe and sealed to outer jacket.

2.04 POLYPROPYLENE VALVES

A. Polypropylene Valves shall be provided and shall be manufactured in accordance with the manufacturer's specifications and shall comply with the performance requirements of ASTM F 2389 or CSA B137.11. The valves shall contain no rework or recycled thermoplastic materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. Provide valve stem extension and valve vaults.

B. Polypropylene Valves shall be Aquatherm® or approved equal.

2.05 SMOKE AND FIRE RATINGS

A. Where indicated on the drawings that a Plenum-rated Piping System is needed, the pipe shall be wrapped and/or insulated with standard fiberglass or mineral wool pipe insulation, field installed, with bare fittings no closer than every 6 ft. of pipe. The pipe wrap or insulation as a system shall meet the requirements of CAN/ULC-S102.2-03 or ASTM E84. The system shall have a Flame Spread Classification of less than 25 and Smoke Development rating of less than 50.

2.06 UV PROTECTION

A. Where indicated on the drawings that the pipe will be exposed to direct UV light for more than 30 days, it shall be provided with a Factory applied, UV-resistant coating or alternative UV protection.

B. Note that molded fittings ½" to 4" do not need to have UV protection. Larger molded fittings (6"-10") and segmented fittings will need to be protected from UV.

2.07 THERMAL INSULATION AND JACKETING

A. Underground piping shall be pre-insulated, pre-fabricated pipe. Insulation materials furnished and installed hereunder should meet the minimum thickness requirements of American Society of Heating, Refrigeration, and Air Conditioning Engineers ASHRAE 90.1 (current edition), "Energy Efficient Design of New Buildings." However, if other factors such as condensation control or personnel protection are to be considered, the selection of the thickness of insulation should satisfy the controlling factor.

B. Granular Loose Fill Insulation

1. Granular, Loose-Fill Insulation: Inorganic, nontoxic, nonflammable, sodium potassium aluminum silicate with calcium carbonate filler. Include chemical treatment that renders insulation hydrophobic.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Gilsulate International, Inc.

b. or approved equal

3. Thermal Conductivity (k-Value): 0.60 at 175 deg F (0.087 at 79 deg C) and 0.65 at 300 deg F (0.094 at 149 deg C).

4. Application Temperature Range: 35 to 800 deg F (2 to 426 deg C).

5. Dry Density: 40 to 42 lb./cu. ft. (640 to 672 kg/cu. m).

6. Strength: 12,000 lb./sq. ft. (58,600 kg/sq. m).

C. Powder, Loose-Fill Insulation

1. Inert, nontoxic, nonflammable, calcium carbonate particles. Include chemical treatment that renders insulation hydrophobic.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. DriTherm International Inc.

b. or approved equal

3. Thermal Conductivity (k-Value): ASTM C 177, 0.58 at 100 deg F (0.084 at 37 deg C) and 0.68 at 300 deg F (0.098 at 149 deg C).

4. Application Temperature Range: Minus 273 to plus 480 deg F (Minus 169 to plus 250 deg C).

5. Dry Density: Approximately 60 lb/cu. ft. (960 kg/cu. m).

6. Strength: 12,000 lb/sq. ft. (58,600 kg/sq. m).

D. Cellular Glass Thermal Insulation

1. Cellular glass insulation, inert, non-toxic, impermeable, inorganic, noncombustible, cellular glass insulation. ASTM C 522-00.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Pittsburgh Corning

   b. or approved equal

3. Thermal Conductivity (k-Value): ASTM C 177, 0.29 at 75 deg F (0.033 at 0 deg C).

4. Application Temperature Range: Minus 273 to plus 900 deg F (Minus 169 to plus 482 deg C).

5. Dry Density: Approximately 7.5 lb/cu. ft. (120 kg/cu. m).

6. Compressive Strength: 90 psi. (6.3 kg/sq. cm^2).

E. Spray-on Pipe Insulation

1. Insulation shall be polyurethane foam or polyisocyanurate foam spray applied to the surface of the pipe with a minimum thickness of one inch. Insulation shall be rigid when dried, 90-95% closed cell polyurethane or polyisocyanurate with a 2.0 to 3.0 pounds per cubic foot density and coefficient of thermal conductivity (K- Factor) of 0.16 and shall conform to ASTM C-591.

F. Pre-Insulated Pipe

1. Underground piping shall be pre-insulated, pre-fabricated pipe. It shall be a complete system of factory pre-insulated polypropylene piping for the specified service.

2. Carrier pipe shall be polypropylene PP-R or PP-RP(RCT) by Aquatherm or approved equal, conforming to ASTM F-2389, as previously specified herein.

3. Insulation shall be polyurethane foam either spray applied or injected with one shot into the annular space between carrier pipe and jacket with a minimum thickness of one inch. Insulation shall be rigid, 90-95% closed cell polyurethane with a 2.0 to 3.0 pounds per cubic foot density and coefficient of thermal conductivity (K- Factor) of 0.16 and shall conform to ASTM C-591.

4. Jacketing material shall be extruded, black, high-density polyethylene (HDPE), having a minimum wall thickness of 100 mils for jacket sizes less than or equal to 12”, and 125 mils for jacket sizes larger than 12” to 24”.

5. Pre-insulated fittings (tees and elbows) shall meet the same requirements as noted herein for pre-insulated pipe. Fittings shall have stubs of an extra 36” of pipe on each inlet and outlet for future ease of insertion into the piping system. Pre-insulator shall provide on-site insulation kit to connect to the pre-insulated system to make a continuous insulation system.

6. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Aquatherm Pipe

    b. Thermacor Process, L.P.

    c. Perma-Pipe, Inc.

    d. or approved equal

PART 3 – EXECUTION

3.01 PIPING APPLICATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Installers shall be trained and certified to install the pipe according to the manufacturer's guidelines. Contact the local manufacturer representative for training.

C. Install listed pipe materials and joining methods below in the following applications:

    1. Underground Piping: Polypropylene (PP-R) or PP-RP (RCT) piping in SDR 9, per manufacturer's instructions and ASTM D2774.

D. Installation shall be accomplished with the proper tools for installing manufacturer's piping following manufacturer's instructions.

E. Install hydronic piping level and plumb.

F. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

3.02 EARTHWORK

A. See Section 31 20 00 "Earth Moving" for excavating, trenching, and backfilling.

B. The pipe embedment materials shall be stable, sufficiently granular to be readily worked under the sides of the pipe to provide satisfactory haunching, and readily compactable to achieve soil densities specified by contract documents. These qualities are available in the following materials:

    1. Gravels and sands classified as Soil Types GW, GP, SW, and SP, or by a dual soil classification beginning with one of these symbols, in accordance with Test Method ASTM D 2487.

2. Sands and gravels classified as Soil Types GM, GC, SM, and SC in accordance with Test Method ASTM D 2487.

C. Initial backfill materials shall be placed in compacted layers or as specified in contract documents and local codes.

D. All native and other materials in the pipe embedment zone shall be free from refuse, organic material, cobbles, boulders, large rocks or stones, or frozen soils.

E. The particle size of material in contact with the pipe shall not exceed the following:

1. 1⁄2 in. for pipe to 4 in.

2. 3⁄4 in. for pipes 6 to 8 in.

3. 1 in. for pipes 10 to 16 in.

4. 1-1⁄2 in. for larger pipes.

5. Each soil layer shall be sufficiently compacted to uniformly develop lateral passive soil forces during the backfill operation.

F. The final backfill shall be placed and spread in approximately uniform layers in such a manner as to fill the trench completely so that there will be no unfilled spaces under or about rocks or lumps of earth in the backfill. Large rocks, stones, frozen clods, and other debris greater than 3 in. (76 mm) in diameter shall be removed. Hand mechanical compaction is the preferred method of compaction to a minimum of 12” of cover. When further compaction is required, rolling equipment or heavy tampers shall only be used to consolidate the final backfill, provided the pipe is covered by at least 18-in. of backfill. Initial backfill materials shall be placed in compacted layers of 6-in. A minimum of 12 to 18-in. of cover is required where light traffic is expected. A minimum cover of 24 in. shall be provided for locations with heavy traffic.

G. Trenches under pavements, sidewalks, or roads shall be backfilled and compacted to the required density specified by contract documents or by the appropriate government jurisdiction.

3.03 FUSION WELDING OF JOINTS

A. Install fittings and joints using socket-fusion, electrofusion, or butt-fusion as applicable for the fitting or joint type. All fusion-weld joints shall be made in accordance with the pipe and fitting manufacturer’s specifications and product standards.

B. Fusion-weld tooling, welding machines, and electrofusion devices shall be as specified by the pipe and fittings manufacturer.

C. Prior to joining, the pipe and fittings shall be prepared in accordance with ASTM F 2389 and the manufacturer’s specifications.

D. Joint preparation, setting and alignment, fusion process, cooling times and working pressure shall be in accordance with the pipe and fitting manufacturer’s specifications.

E. Ream ends of pipes and tubes and remove burrs.

F. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

G. Fusion Joints: Use fusion joints for all pipe connections and pipe/pipe appurtenances connections. Fusion join polypropylene pipe in accordance with ASTM D2657, ASTM F 2389, and the manufacturer's instructions.

H. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

J. Insulation joints made for pre-insulated pipe shall be done in accordance with the insulation manufacturer's instructions.

K. Data Loggers shall be used to log each joint made. Data logger shall record at least the date, time of day and person making each joint. Data logger shall also record the required pressure/leak test for manufacturer's warranty.

3.04 PIPING INSTALLATIONS

A. Refer to Section 23 05 16, BASIC MECHANICAL MATERIALS AND METHODS.

B. Refer to Paragraph 2.04 above for Polypropylene Valves. Also, refer to Section 23 05 23, GENERAL-DUTY VALVES FOR HVAC PIPING.

C. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

D. Installers shall be trained and certified to install the pipe per the manufacturer's guidelines.

E. Remove standing water in the bottom of trench.

F. Do not backfill piping trench until field quality-control testing has been completed and results approved.

G. Install piping at uniform grade of 0.2 percent. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points and elsewhere as required for system drainage. Install manual air vents at high points.

H. In conduits, install drain valves at low points and manual air vents at high points.

I. Install components with pressure rating equal to or greater than system operating pressure.

J. Install piping free of sags and bends.

K. Install fittings for changes in direction and branch connections.

L. See Division 23 specifications Sections for sleeves and mechanical sleeve seals through exterior building walls.

M. Fire stopping shall be provided to both be compatible with the manufacturer's piping and meet the requirements of ASTM E 814 or ULC S115, "Fire Tests of Through-Penetration Firestops". Pipe insulations or fire resistive coating shall be removed where the pipe passes through a fire stop and, if required by the firestop manufacturer, for 3 inches beyond the firestop outside of the fire barrier.

N. When installed in systems with pumps in excess of 3.0 HP, piping shall be protected from excessive heat generated by operating the pump at shut-off conditions. Where the possibility exists that the pump will operate with no flow, the protection method shall be a temperature relief valve or comparable level of protection, set to a maximum temperature of 185°F.

O. If heat tracing or freeze protection is specified for the piping, it should be installed on the pipe interior or exterior. It must be suitable for use with plastic piping and be self-regulating to ensure that the surface temperature of the pipe and fittings will not exceed 70°C (158°F).

P. Heating hot water and chilled water piping shall be installed in a manner so that air will be eliminated from lines or equipment during operation. Pitch pipelines as specified in Section 23 05 16, BASIC MECHANICAL MATERIALS AND METHODS.

Q. An air vent shall be installed at each high point of chilled water and heating hot water circulating lines. Refer to air vents as specified under Section 23 05 19, PIPING SPECIALTIES.

R. Air vent valves shall be installed with drains to nearest floor sink or to the outside. Acceptable manufacturers: Mueller Co., Spirotherm, Bell and Gossett, Wessels, or approved equal.

S. Inspections and Tests:

1. Welding Inspection: In accordance with Section 23 05 16, BASIC MECHANICAL MATERIALS AND METHODS.

2. Pressure Testing: In accordance with Section 23 05 16, BASIC MECHANICAL MATERIALS AND METHODS, and the following:

    a. Test at 200 psi. Maintain test pressure for at least 4 hours, observed by the Project Inspector, to prove tightness without leaks.

    b. Comply with requirements in Paragraph 3.10 below.

3. Field Joint Inspection:

    a. Verify installation of insulation at all field joints. Installation of field applied insulation and jackets shall be observed by the Project Inspector.

4. Video Recording of Underground Installation:

    a. Prior to backfill, the Contractor shall video record the entire extent of the underground piping installation. The video recording shall also note depths, and locations of fittings.

    b. The video recording shall be developed on a 12 cm, DVD disk, or Flash Drive. Provide three copies of the recording to the Project Inspector for approval by the Owner's Representative, prior to backfill.

    c. Provide one copy of the recording within the underground piping "as-built" drawing submittal package.

5. Prepare test and inspection reports. Deliver to the STATE's Representative and the Manufacturer to obtain product warranty.

T. Backfill: For excavation, fill, import and export of materials refer to Section 31 23 23, EXCAVATION AND FILL FOR UTILITIES.

1. Immediately after piping is installed in trench, a partial backfill shall be provided in middle of each unit leaving joints exposed for inspection before hydrostatic tests. After all thrust blocks are installed, a hydrostatic test shall be performed.

2. After hydrostatic testing, final backfill of selected earth shall be hand-packed and hand-tamped to 12-inch minimum over top of jacket. Remainder of backfill shall be free of large boulders, rocks over 6-inch in diameter, frozen earth, or foreign matter. Do not furnish wheeled or tracked vehicles for tamping of backfill.

U. Detectable Warning Tape: Provide and install detectable marking tape along buried piping per Section 23 05 53, PIPING & EQUIPMENT IDENTIFICATION. Install continuous metallic/plastic underground warning tapes during back filling of trenches for underground hydronic piping. Locate tapes 6 to 8 inches (150 to 200 mm) below finished grade, directly over piping. Alternatively, install 8 to 10 gauge copper wire at 6" to 8" directly over the pipeline. Provide warning tapes above the wire at 6" to 8" below the finished grade.

3.05 DIRECTIONAL BORING

A. Where required directional boring (horizontal directional drilling, HDD), also commonly referred to as guided horizontal boring, may be utilized for the installation of the underground hydronic system, the following requirements apply:

1. The work shall include all services, equipment, materials, and labor to complete the proper installation, testing, and restoration of underground utilities and environmental protection and restoration.

2. The PP-R or PP-RP(RCT) pipe may be pulled in the directional boring application. Follow the recommendations provided by the manufacturer for maximum pull forces found in the manufacturer's Design Guide. Do not apply more than the maximum safe pipe pull pressure at any time.

3. The pulling head shall be capable of matching the metric pipe. Pull heads may be constructed by the manufacturer or purchased from third party vendors such as Poly-Cam.

4. Following successful pulling of the pipe, the pipe shall be pressure/leak tested per the requirements in this section.

5. Flush the pipe thoroughly and disinfect if required per the requirements of this section.

3.06 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices in Section 23 05 48, VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT.

1. Comply with requirements for pipe hanger, support products, and installation in Section 23 05 29, HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT.

a. Vertical Piping: MSS Type 8 or 42, clamps.

b. Individual, Straight, Horizontal Piping Runs:

i. Adjustable, steel clevis hangers.

ii. Clamps on strut trapeze.

iii. Clamps on strut attached to structure.

iv. Clamps attached directly to the structure.

c. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and 10-foot intervals or at each floor whichever is less.

C. Install hangers and supports at intervals specified in the applicable Plumbing Code and/or as recommended by pipe manufacturer.

D. Hangers and supports shall also be provided within 1-foot of every change of direction and within 1-foot of any pipe fittings and valves.

E. For heating hot water piping, provide clamps and supports that are felt or rubber/vinyl coated or lined.

F. Use care when installing riser clamps to not over tighten the clamps to cause indentation of the pipe. Riser clamps shall be isolated from the building structure by placing felt or rubber pads between the clamp, the pipe and the structure.

G. All piping support materials shall be new and manufactured for the specific purpose of supporting systems, equipment, pipes and accessories. No improvised pipe support solutions shall be allowed.

3.07 EXPANSION AND CONTRACTION

A. Provide expansion and contraction controls, guides and anchors to take into account the expansion and contraction of the pipe. Provide expansion loops or offsets as required and as indicated in the thermal expansion/contraction analysis, with calculations, of the piping system.

1. Install anchors as required and where indicated in the manufacturer's thermal expansion/contraction analysis, with calculations, of the piping system.

2. Install expansion loop or offset between each anchor point. Expansion device shall be able to absorb all the stresses between the two anchor points.

3. Vertical risers of piping shall be anchored at each floor.

4. Provide anchor point at branch take-off in vertical riser of piping.

3.08 LOOSE-FILL INSULATION INSTALLATION (NOT TO BE USED WHERE PRE-INSULATED, PRE-FABRICATED PIPE IS FURNISHED AND INSTALLED)

A. Do not disturb the bottom of trench; otherwise, compact and stabilize it to ensure proper support.

B. Remove standing water in the bottom of trench.

C. Bed the pipe on a minimum 6-inch (150-mm) layer of granular fill material with a minimum 6-inch (150-mm) clearance between the pipes.

D. Form insulation trench by excavation or by installing drywall side forms to establish required height and width of the insulation.

E. Support piping with proper pitch, separation, and clearance to backfill or side forms using temporary supporting devices that can be removed after back filling with insulation.

F. Place insulation and backfill after field quality-control testing has been completed and results approved.

G. Pour loose-fill insulation to required dimension agitating insulation to eliminate voids around piping.

H. Remove temporary hangers and supports.

I. Cover loose-fill insulation with polyethylene sheet a minimum of 4 mils (0.10 mm) thick, and empty loose-fill insulation bags on top.

J. Manually backfill 6 inches (150 mm) of clean backfill. If mechanical compaction is required, manually backfill to 12 inches (300 mm) before using mechanical-compaction equipment.

3.09 CELLULAR GLASS THERMAL INSULATION INSTALLATION (NOT TO BE USED WHERE PRE-INSULATED, PRE-FABRICATED PIPE IS FURNISHED AND INSTALLED)

A. Do not disturb the bottom of trench; otherwise, compact and stabilize it to ensure proper support.

B. Remove standing water in the bottom of trench.

C. Bed the pipe on a minimum 6-inch (150-mm) layer of granular fill material (sand) with a minimum 6-inch (150-mm) clearance between the pipes.

D. Insulation and jacketing shall be applied to the piping in 10’ segments (maximum)

E. After completion, the segments shall be rotated 180 degrees and the bottom of the jacketing and butt strips shall be inspected. Any defects or damage shall be replaced with new insulation.

F. Jacketing and insulations joints shall be staggered.

G. In larger diameter piping, shorter segments can be insulated and jacketed if more practical.

H. Where conditions permit, insulation and jacketing may be applied outside of the trench to sections of piping. Pipe lengths shall be insulated in segments. Length of insulation segment shall not exceed 10' (3 m).

I. Backfill per manufacturer’s instructions.

3.10 PRESSURE/LEAK TESTING

A. While still accessible, all piping shall be pressure/leak tested to the manufacturer’s standards.

B. Tests shall be carried out using water, compressed air or a mixture of the two. The test pressure shall be as indicated in the pressure leak testing procedures required by the manufacturer.

C. In the event that water is not available for testing it shall be permissible to use compressed air as a testing medium. Contact the engineering department of the manufacturer for guidance. Follow all precautionary procedures recommended by the piping manufacturer.

D. Any leaks detected shall be repaired at the contractor's expense by removing the leaking part and replacing with new parts welded per the pipe manufacturer's guidelines.

3.11 INSPECTING AND CLEANING

A. The pipes shall be flushed with cold water after finishing the installation. Flush the system until the water runs clear of debris and dirt.

B. Inspect and test piping systems following procedures of authorities having jurisdiction and as specified by the piping system manufacturer.

C. Clean and disinfect water distribution piping following procedures of the manufacturer and/or the authority having jurisdiction.

D. Each system shall be cleaned by passing cleaning fluids through pipework. Equipment that has been previously cleaned shall be isolated from the system and not be subjected to cleaning fluids.

E. Systems shall be completely flushed after cleaning. Furnish a separate pump for cleaning. Do not use pumps that are furnished as a part of this Contract.

F. Perform cleaning and boil-out after completion of piping and pressure testing and before the system is put into operation. All piping system cleaning and water treatment shall be coordinated with and witnessed by the STATE's Representative. It is imperative that before any system is filled with water, the STATE's Representative verify that cleaning has been properly completed and proper chemical treatment is in place and maintained. Operating staff should be requested to monitor chemical treatment after the system is filled until the project is completed and turned over to them. The Inspector shall witness the cleaning procedure.

G. Do not circulate cleaning solution through cooling coils and heating coils. Provide temporary bypasses.

H. The entire cleaning procedure shall be performed by a contractor furnished independent chemical cleaning company approved by the STATE's Representative.

I. Flush out entire system for a period of not less than 4 hours to clear it of all loose material. Provide necessary cross-connections to loop system and circulate water for 24 hours. During this period, install 80-mesh screen in strainers and periodically clean. Drain entire system. Refill system. Meter water when refilling to determine amount of chemical required in next procedure. Add trisodium phosphate (TSP) to provide a uniform residual concentration of 10 ppm. Circulate water for 48 hours. During circulation, periodically clean screens as required. Flush system for approximately 4 hours or until all traces of chemicals are removed. Remove 80-mesh screens.

J. For space heating hot water system, provide injection fitting and required connection piping to a 55-gallon chemical drum. Drum shall have provision for wall straps to safely secure to the wall. Chemical pump, controls and interval timer shall be provided. Coordinate with electrical to provide required power for the pump. Coordinate with the plumbing engineer to provide sink and emergency shower/eyewash in mechanical room where water treatment will be performed. Run ¼" copper tubing from the water piping system to the sink with appropriate labels and service valves for collecting samples.

K. Provide water treatment and a 30-day advance notice to the STATE's Representative prior to treatment. The piping system must be complete, pressure tested and cleaned. If water treatment has to be redone due to contractor's incomplete work, extra services will be at contractor's expense.

3.12 DEMONSTRATION AND TRAINING

A. The Contractor, using the Manufacturer's Representative, shall provide a minimum of four (4) hours of demonstration and training to the STATE's operations personnel covering the following items:

1. Field joint preparation and installation.

2. Installation of field applied insulation.

3. Installation and repair of HDPE & PVC jackets.

4. Testing of installed field joints to ensure water-tight installation.

3.13 CLEANUP

A. Remove rubbish, debris and waste materials and legally dispose off of Project site.

3.14 PROTECTION

A. Protect the Work of this Section until Substantial Completion.

END OF SECTION 23 20 16

SECTION 23 25 00

HVAC WATER TREATMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Water treatment equipment for water systems.

1.02 DESIGN REQUIREMENTS

A. Provide equipment, chemicals, and services to provide a complete water treatment program. A single water treatment company shall provide products and services for the first year from initial start-up. The water treatment company shall be a recognized specialist in the field of chemical water treatment, that is or employs an experienced consultant, available during reasonable times during the course of the Work to consult with the STATE's Representative about water treatment. Technical service representative shall be trained in industrial water treatment, geographically located within 60 miles of the Project site, and have a minimum of three years direct experience in the treatment of industrial water systems.

B. Water treatment equipment shall feed and control chemicals to protect the following systems:

1. Chilled Water Systems: Corrosion control.

2. Heating Hot Water Systems: Corrosion control.

1.03 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTAL PROCEDURES.

B. Submit Shop Drawings indicating flow diagrams and operation, instruction manuals of systems.

1.04 QUALITY ASSURANCE

A. Comply with the provisions of Section 23 05 00, MECHANICAL GENERAL PROVISIONS.

B. Water treatment company shall submit proof of a fully documented, accredited, and operational quality assurance program.

PART 2 – PRODUCTS

2.01 WATER TREATMENT FOR CHILLED WATER AND HEATING HOT WATER SYSTEMS

A. For closed chilled water and heating hot water systems, scale and corrosion inhibition shall be achieved with a borate/nitrite formulation with a molybdenum additive. Control range shall be a minimum of 300 ppm nitrite and 10 ppm molybdenum.

B. For closed chilled water and heating hot water systems in area where the use of molybdenum is prohibited, scale and corrosion inhibition shall be a minimum of 1000 ppm nitrite.

C. In the event a complete make-up water analysis is not available, the local service representative of the water treatment service company shall designate type of chemical treatment most desirable. The treatment prescribed shall be based on local make-up water quality and the application of sound water treatment practice.

2.02 WATER TREATMENT

A. Provide a one-year supply of water treatment chemicals. Formulations shall be as prescribed for the various systems specified. Formulations shall not contain any ingredients, which may be harmful to system materials of construction and shall not endanger the health or safety of persons coming into contact with the materials. MSDS shall be provided for each chemical furnished. System shall not be operated without benefit of chemical protection unless specified. Once initial passivation is achieved, any additional chemical necessary to recharge the system due to water loss shall be provided as required.

2.03 TEST EQUIPMENT

A. Provide necessary test equipment and reagents to maintain chemicals in the control ranges specified. Test kits shall be furnished with carrying cases.

2.04 WATER TREATMENT SERVICE PROGRAM

A. Selected water treatment company shall provide consulting services for one year from the date of Substantial Completion. Services shall be provided by fully trained representatives of the water treatment company. Services provided shall include:

1. Installation and system start-up recommendations.

2. Initial water analysis and recommendations.

3. Training of operating personnel on proper feeding and control techniques.

4. Periodic field service and consulting meetings.

5. Log sheets and record forms.

6. Any required laboratory and technical assistance.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Installation of water treatment equipment and startup shall be performed under the observation of a representative of the water treatment equipment supplier.

B. Provide water treatment system as specified in this Section and of the type required for the treatment of water in the system for chilled water and heating hot water closed loop hydronic systems.

3.02 PRE-OPERATIONAL CLEANING

A. Provide assurance that no untreated water shall be circulated through heating and air conditioning system components for operation. Systems shall be flushed clean before operation. In the event untreated water causes contamination of the system, remove resulting scale or deposits from lines and equipment, and repair damage.

B. Provide chemical cleaning, flushing, and charging. Notify the Project Inspector when system is ready for operation and filling with water.

C. Prior to operation, chilled water and heating hot water systems shall be cleaned to remove oil, grease, and rust oxides by the following:

1. Flood system with a solution containing cleaning compound.

2. Circulate system at 150 to 180 degrees F for a period of not less than 12 hours and not in excess of 24 hours. If heat cannot be provided, dosage shall be doubled and circulated for two days.

3. Cleaning solutions shall be drained and flushed with clean water until stable pH is provided. Refill with treated water to stabilize water in system.

3.03 PROTECTION

A. Protect the Work of this Section until Substantial Completion.

3.04 CLEANUP

A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION 23 25 00

SECTION 31 10 00

SITE CLEARING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Removing above-grade and below-grade site improvements.

2. Disconnecting, capping, or sealing site utilities.

3. Temporary erosion and sedimentation control.

1.02 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.03 MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain STATE's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.04 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from STATE and authorities having jurisdiction.

2. Provide alternate routes around closed or obstructed trafficways if required by STATE or authorities having jurisdiction.

B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on STATE's premises where indicated.

C. Utility Locator Service: Utilize a utility locator service or professional surveyor to clearly identify existing underground utility locations.

D. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in

Section 31 20 00 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.01 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to the STATE's Representative.

3.02 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion-control and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.03 EXISTING UTILITIES

A. Locate, identify, relocate, seal or cap utilities indicated to be relocated or abandoned in place.

1. Refer to phasing plan to shut off indicated utilities.

B. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by the STATE or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify the STATE's Representative not less than two days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without the STATE's Representative's written permission.

C. Removal of underground utilities is included in earthwork sections; in applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and

security, and utilities sections; and in Section 02 41 16 "Demolition”.

3.04 SITE IMPROVEMENTS

A. Remove existing above-grade and below-grade improvements as indicated and necessary to facilitate new construction.

3.05 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off the STATE's property.

B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

3.06 RESTORATION OF SURFACES

A. Ensure that adjacent soil is restored to existing conditions or better.

END OF SECTION 31 10 00

SECTION 31 20 00

EARTH MOVING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Excavating and filling for rough grading the Site.

2. Preparing subgrades for concrete vault construction.

3. Excavating and backfilling for concrete vault construction.

4. Drainage course for concrete vault construction.

5. Excavating and backfilling trenches for utilities and pits for buried utility structures.

6. Steel Plates

1.02 DEFINITIONS

A. Backfill: Soil material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.

2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by the STATE's Representative. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

2. Unauthorized Excavation: Excavation below subgrade elevations or beyond

indicated lines and dimensions without direction by the STATE's Representative. Unauthorized excavation, as well as remedial work directed by the STATE's Representative, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

K. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct pre-excavation conference at Project site.

1.04 INFORMATIONAL SUBMITTALS

A. Material test reports.

1.05 FIELD CONDITIONS

A. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth-moving operations.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D2487 free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D2487

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

F. Drainage Course: Narrowly graded mixture of washed crushed stone or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and zero to 5 percent passing a No. 8 sieve.

PART 3 - EXECUTION

3.01 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.02 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.03 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1/4- inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

3.04 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.05 EXCAVATION FOR DIRECT-BURIED PIPING AND UTILITY VAULT TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations on the approved

plans.

B. Excavate trenches to uniform widths to provide the following clearance on each side of vault or pipe. Excavate trench walls vertically from trench bottom to 12 inches higher than top of 4” footing drain pipe unless otherwise indicated.

1. Horizontal Clearance: 12 inches each side of vault exterior wall.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of vault. Remove projecting stones and sharp objects along trench subgrade.

1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.06 SUBGRADE INSPECTION

A. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the STATE’s Representative, without additional compensation.

3.07 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by the STATE’s Representative.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by the STATE’s Representative.

3.08 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations.

3.09 DIRECT-BURIED PIPING AND UTILITY VAULT TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 03.

D. Trenches under Roadways: Provide 4-inch thick, concrete-base slab support for piping or conduit less than 18 inches below surface of roadways. After installing and testing,

completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course. Concrete is specified in Division 03.

E. Initial Backfill: Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

F. Final Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.

3.10 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.

2. Under walks and pavements, use satisfactory soil material.

3. Under steps and ramps, use engineered fill.

4. Under building slabs, use engineered fill.

5. Under footings and foundations, use satisfactory soil material.

3.11 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.

2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.12 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit

weight according to ASTM D1557.

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.

2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.

3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.

4. For utility trenches, compact each layer of initial and final backfill soil material at 90 percent.

3.13 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

B. Grading inside Vault Lines: Finish subgrade to a tolerance of 1/8 inch when tested with a 10-foot straightedge.

3.14 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course under pavements and walks as follows:

1. Shape subbase course to required crown elevations and cross-slope grades.

2. Place subbase course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.

3. Compact subbase course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D1557.

3.15 DRAINAGE COURSE ADJACENT TO UTILITY VAULT

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course against cast-in-place concrete utility vault per construction plans and as follows:

1. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.

2. Compact each layer of drainage course to required cross sections and thicknesses

to not less than 95 percent of maximum dry unit weight according to ASTM D1557.

3.16 FIELD QUALITY CONTROL

A. Testing Agency: The STATE will engage a qualified geotechnical engineering testing agency to perform compaction tests and inspections.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by the STATE's Representative.

D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.17 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off the STATE's property.

3.19 STEEL PLATES

A. Steel plates must be able to withstand HS-20-44 traffic loading without any movement.

B. Steel plates shall be fabricated to meet ASTM A36 steel requirements.

C. When two or more of plates are in place more than three consecutive days without the need to accomplish work or inspections, the plates shall be tack welded together at each corner to reduce or eliminate vertical movement. Other alternative methods to accomplish this will be considered for approval.

D. Steel plates shall be installed to resist bending, vibrations, etc., under traffic loads and when installed using a type 2 installation; shall be securely anchored with standard rail-road spikes or other round smooth headed pins pre-drilled into the corners of the plate, and driven into the pavement section a minimum of 6". If these conditions are not met, the applicant will be required to backfill and pave the excavation daily.

E. It is the responsibility of the Contractor to perform and document daily inspections of all active plate(s) or unattended plate(s) location(s), and where necessary take appropriate measures to protect the public safety until work is completed. This documentation shall be available to the inspector upon request. No unplated excavation shall be left unattended overnight.

F. In the event of improper installation of the steel plates that presents a nuisance or a public safety problem, the Contractor shall respond to all excavation restoration requests by the STATE's Representative immediately upon notification. Non-responses will result in the required restoration work be done by the STATE, with all expenses to be paid by the Contractor.

G. Steel plates must extend a minimum of 12-inches beyond the edges of the excavation.

H. Before steel plates are installed, the excavation shall be adequately shored to support the bridging and traffic loads.

I. Temporary paving or cold-mix asphalt concrete (cutback) shall not be allowed to secure or to prevent movement of trench plates unless prior approval is given by the STATE's Representative. Other alternative methods to accomplish this will be considered for approval.

J. When plates are removed, all anchor/pin holes in the pavement shall be backfilled with an asphalt mix to the satisfaction of the STATE's Representative.

END OF SECTION 31 20 00

SECTION 31 23 23

EXCAVATION AND FILL FOR UTILITIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Excavating, backfilling, and compacting utility trenches such as water, gas, irrigation, storm drain, sewer lines, concrete-encased conduits, and manholes, vaults, valve boxes, catch basins, underground tanks, thrust blocks, yard boxes, pull boxes and other utility appurtenances.

1.02 PROJECT REQUIREMENTS

A. Import and Export of Earth Materials:

1. Fees: Pay as required by authorities having jurisdiction over the area.

2. Haul Routes and Restrictions: Comply with requirements of authorities having jurisdiction over the area.

1.03 SUBMITTALS

A. Imported Soil: A geotechnical engineer, retained by the STATE as a STATE Consultant, shall obtain initial product Sample for testing in accordance with the terms of Article 3.05 of this section.

1.04 QUALITY ASSURANCE

A. Comply with the following as a minimum requirement: Standard Specifications for Public Works construction, current edition except as modified herein.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Bedding material from trench bottom to one foot above the pipe:

1. Sand, gravel, crushed aggregate or native free-draining granular material providing a sand equivalent of at least 30 or a coefficient of permeability greater than 1.4 inches per hour.

2. Sand complying with the Specifications for cement concrete aggregates.

B. Backfill Materials:

1. Excavated trench material to be installed for backfilling shall be clean, free of large clods, and stones larger than 2 -inch in any dimension.

2. Cement-sand slurry shall be provided with one sack of cement per cubic yard of the mixture.

3. Imported Fill Material: Imported fill material shall be a granular material with sufficient binder to form a firm and stable unyielding subgrade and shall not have more than 40 percent of fines passing a 200 mesh sieve. Material shall have an expansion index less than 2.5. Imported materials shall be clean and free of rubbish, debris, and toxic or hazardous contaminants. Adobe or clay soils are not permitted.

PART 3 - EXECUTION

3.01 GENERAL

A. Before excavation, contact the "Underground Service Alert of Southern California" (USASC) for information on buried public utilities and pipelines. For on-site utilities retain an underground locating service.

B. Barricade trenches, ditches, pits, sumps, and similar Work outside the barricaded working area with chain link fence as specified in Section 01 50 00 - Construction Facilities and Temporary Controls, and in accordance with Cal-OSHA standards and requirements.

C. Saw-cut concrete or bituminous paving for trench installation.

D. Trenches over 5 feet in depth shall conform to the Cal-OSHA.

E. Where indicated and required to excavate in lawn areas, protect adjoining lawn areas outside of the Work area. Replace or install removed sod upon completion of backfill by installing sod level with adjacent lawns. If installation of removed sod fails, furnish sod and install to match existing lawns.

F. Backfill over excavations to the required elevations with earth, gravel, sand, or concrete and compact as required. Provide excavations free from standing water by pumping, draining, or providing protection against water intrusion. Slope adjacent grades away from excavations to minimize entry of water.

G. Do not install piping lengthwise under concrete walks without review by the STATE's Representative.

H. Do not excavate trenches parallel to footings closer than 18 inches from the face of the footing or below a plane having a downward slope of two horizontal to one vertical, from a line 9 inches above bottom of footings.

1. Unless otherwise indicated on Drawings, depth of excavations outside the buildings shall allow for a minimum coverage above top of pipe, tank, or conduit measured from the lowest adjoining finished grade, as follows:

Steel Pipe:	24 inches below finished grade
Copper Water Tube:	18 inches below finished grade

Cast-Iron Pressure Pipe:	36 inches below finished grade
Plastic Pipe (other than waste):	30 inches below finished grade
Tanks or other structures:	36 inches below finished grade
Soil, Sewer & Storm Drain:	minimum 18 inches below finished grade, and as required for proper pitch and traffic load. (Install polypropylene sewer pipe with at least 24 inches coverage)
Irrigation Pipe:	nonpressure pipe 12 inches, pressure pipe 24 inches

2. Trench width shall provide ample space for fitting and joining. Excavate for piping bells and fittings, bell and spigot pipe and other fittings.

3. Unless indicated otherwise, excavate trenches to the required depths for utilities, such as pipes, conduit and tanks, with minimum allowances of 6 inches at the bottom and 6 inches at the sides for bedding of unprotected piping or as required for concrete encasement of conduits as indicated on Drawings. Grade bottom of trenches to a uniform smooth surface. Remove loose soil from the excavation before installing sand bedding or concrete encasement.

J. Provide excavations free from standing water by pumping, draining, or providing protection against water intrusion. If soil becomes soft, soggy, or saturated, excavate to firm undisturbed soil and fill as required. Slope adjacent grades away from excavations to minimize entry of water.

K. Provide a minimum clear dimension of 2 inches from sides of wall excavation to outer surfaces of buried pipes or conduits installed in the same trench or outside surfaces of containers and tanks.

L. Do not install backfill until required inspections and testing is completed.

M. Backfill electrical or other excavated utility trenches located outside of barricaded installation areas within 24 hours after inspection by the Project Inspector.

N. Install backfill materials in layers not exceeding 4 inches in thickness and compact to 90 percent of the maximum density. Jetting or flooding of backfill should not be permitted.

O. If materials excavated from the Project site are not permitted for trench backfill in paved areas, backfill trenches with a cement-sand slurry mix. Install backfill to an elevation of the existing undisturbed grade plus one inch.

P. Install and compact sand bedding to provide a uniform full length bearing under piping and conduits.

Q. Where portions of existing structures, walks, paving, or other improvements are removed or cut for piping or conduit installation, replace the material with equal quality, finished to match

adjoining existing improvements. Repair pavement as specified in Division 33.

3.02 IMPORT/EXPORT OF MATERIALS

A. Provide fill materials as specified in Part 2- Products. If excavated materials from the Project site are not of required quality or sufficient quantity, import additional materials as necessary.

B. Soils Import Requirement:

1. The Contractor shall provide test report, at his own cost, to indicate the soils are clean based on the requirements in EPA standards and subset DTSC “Clean Imported Fill Material”, October 2001.

2. The Contactor shall ensure that the import soil submittal complies with Greenbook standards.

3. The Contractor shall obtain paperwork from the LOR or a District Environmental agency confirming that the import fill material is characterized, handled, and documented in accordance with EPA and State of California regulations.

C. Imported fill materials shall be sampled by a geotechnical engineer, retained by the STATE as a STATE Consultant, for compliance with the requirements of Part 2 of this section.

D. The geotechnical engineer, retained by the STATE as a STATE Consultant, shall perform the tests by utilizing an independent approved testing laboratory.

E. Initial sampling shall be performed by the geotechnical engineer, retained by the STATE as a STATE Consultant, before importing material to the Project site. Identify the location of the source site in addition to the address, name of the person and/or entity responsible for the source site. The geotechnical engineer, retained by the STATE as a STATE Consultant, shall obtain both the initial sample and additional samples from the identified site and shall submit all samples to the approved independent testing laboratory.

F. The geotechnical engineer, retained by the STATE as a STATE Consultant, shall perform additional sampling during import operations. If the total quantity of import is determined to be greater than 1,000 cubic yards of material, one sample shall be obtained and submitted for testing for each 250 cubic yards of imported material. If the total quantity of import is determined to be less than 1,000 yards, one sample shall be obtained and submitted for testing for each 100 cubic yards of imported material.

G. The independent approved testing laboratory shall perform the required tests and report results of all tests noting if the tested material passed or failed such tests and shall furnish copies to the STATE’s Representative and others as required. Report shall state tests were conducted under the responsible charge of a licensed State of California professional engineer and the material was tested in accordance with applicable provisions of the Contract Documents, CBC and the DSA. Upon completion of the Work of this section, the independent testing laboratory and geotechnical engineer shall submit a verified report to the DSA as required by CBC.

H. Bills of lading or equivalent documentation will be submitted to the Project Inspector on a daily basis.

1. Upon completion of import operations, provide the STATE's Representative with a certification statement attesting that imported material has been obtained from the identified source site.

3.03 INSPECTION AND TESTING

A. The geotechnical engineer, retained by the STATE as a STATE Consultant, will inspect and test excavations, sample material quality as required in Part 2, observe installation and compaction of fill materials.

B. Compaction test shall be performed in accordance with ASTM D1557, method "C."

3.04 PROTECTION

A. Protect the Work of this section until Substantial Completion.

3.05 CLEANUP

A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION 31 23 23

SECTION 31 25 00

EROSION AND SEDIMENTATION CONTROL

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. This Work shall consist of temporary measures needed to control erosion and water pollution. These temporary measures shall include, but not be limited to, berms, dikes, dams, sediment basins, fiber mats, netting, gravel, mulches, grasses, slope drains, and other erosion control devices or methods. These temporary measures shall be installed at the locations where needed to control erosion and water pollution during the construction of the Project, and as directed by the STATE's Representative, and as shown on the Drawings.

B. The erosion control presented in the Drawings and Specifications serves as a minimum for the requirements of erosion control during construction. The Contractor has the ultimate responsibility for providing adequate erosion control and water quality throughout the duration of the Project. Therefore, if the provided plan is not working sufficiently to protect the Project areas, then the Contractor shall provide additional measures as required to obtain the required protection. The Contractor shall include in the bid price for erosion control a minimum of all items shown for erosion control and any additional items that may be needed to control erosion and water pollution.

1.02 RELATED SECTIONS

A. The following is a list of specifications, which may be related to this section:

1. Section 01 51 00: Temporary Facilities and Controls

1.03 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. California Stormwater Quality Association (CASQA).

1.04 SUBMITTALS

A. Submit the following information:

1. Erosion Control Plan.

2. Construction schedule for Erosion Control per Article Scheduling.

3. Sequencing Plan per Article Scheduling.

4. Plan for disposal of waste material per Article Scheduling.

5. Product data for materials proposed for use.

6. All applicable permits for Erosion Control.

1.05 REGULATORY REQUIREMENTS

A. Construction Dewatering Industrial Wastewater Permit (Construction Dewatering Permit):

1. The Contractor shall apply for and obtain a Construction Dewatering Permit.

2. All costs for this permit shall be the responsibility of the Contractor.

3. This permit requires that specific actions be performed at designated times.

4. The Contractor is legally obligated to comply with all terms and conditions of the permit including testing for effluent limitations.

5. The Contractor shall applicable authorities onto the so to check for compliance with the permit.

6. Non-compliance with the permit can result in stoppage of all Work.

B. In the event of conflict between these requirements and erosion and pollution control laws, rules, or regulations of other Federal, State, or local agencies, the more restrictive laws, rules, or regulations shall apply.

1.06 SCHEDULING

A. Sequencing Plan:

1. The Contractor shall submit a sequencing plan for approval for erosion control in conformance with the Contractor's overall Construction Plan for approval by the STATE's Representative.

2. Changes to the Erosion Control Sequencing Plan may be considered by the STATE's Representative only if presented in writing by the Contractor.

B. Temporary Erosion Control:

1. When so indicated in the Contract Documents, or when directed by the STATE's Representative, the Contractor shall prepare construction schedules for accomplishing temporary erosion control Work, including all maintenance procedures.

2. These schedules shall be applicable to clearing and grubbing, grading, structural Work, construction, etc.

C. The Contractor shall submit for acceptance the proposed method of erosion control on haul roads and borrow pits and a plan for disposal of waste material.

D. The Contractor shall be required to incorporate all permanent erosion control features into the Project at the earliest practicable time as outlined in the accepted schedule. Temporary erosion control measures shall then be used to correct conditions that

develop during construction.

E. Work shall not be started until the erosion control schedules and methods of operations have been accepted.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All materials shall be submitted for approval prior to installation.

B. Materials may include hay bales, straw, fiber mats, fiber netting, wood cellulose, fiber fabric, gravel, and other suitable materials, and shall be reasonably clean, free of deleterious materials, and certified weed free.

C. Grass Seed:

1. Temporary grass cover (if required) shall be a quick growing species, suitable to the area, in accordance with local criteria and permit requirements, which will provide temporary cover, and not compete with the grasses sown for permanent cover.

2. All grass seed shall be approved by the STATE's Representative and in accordance with local regulations prior to installation.

D. Fertilizer and soil conditioners shall be approved by the STATE's Representative and in accordance with local regulations prior to installation.

PART 3 - EXECUTION

3.01 GENERAL

A. All temporary and permanent erosion and sediment control practices shall be maintained and repaired as needed to ensure continued performance of their intended function.

B. The STATE's Representative will monitor the Contractor's erosion control and Work methods.

1. If the overall function and intent of erosion control is not being met, the STATE's representative will require the Contractor to provide additional measures as required to obtain the desired results.

2. Costs for any additional erosion control measures shall be paid for at contract unit prices.

C. The erosion control features installed by the Contractor shall be adequately maintained by the Contractor until the Project is accepted.

D. Working in or Crossing Watercourses and Wetlands:

1. Construction vehicles shall be kept out of watercourses to the extent possible.

2. Where in-channel Work is necessary, precautions shall be taken to stabilize the

Work area during construction to minimize erosion.

a. The channel (including bed and banks) shall always be restabilized immediately after in-channel Work is completed.

3. Where a live (wet) watercourse must be crossed by construction vehicles during construction, a Temporary Stream Crossing shall be provided for this purpose.

3.02 PROTECTION OF ADJACENT PROPERTIES

A. Properties adjacent to the site of a land disturbance shall be protected from sediment deposition.

B. In addition to the erosion control measures required on the Drawings and in the Specifications, perimeter controls may be required if damage to adjacent properties is likely, and may include, but is not limited to:

1. Vegetated buffer strip around the lower perimeter of the land disturbance.

a. Vegetated buffer strips may be used only where runoff in sheet flow is expected and should be at least twenty (20) feet in width.

2. Sediment barriers such as straw bales, erosion logs, and silt fences.

3. Sediment basins and porous landscape detention ponds.

4. Combination of above measures.

3.03 CONSTRUCTION

A. Stabilization of Disturbed Areas:

1. Temporary sediment control measures shall be established within five (5) days from time of exposure/disturbance.

2. Permanent erosion protection measures shall be established within five (5) days after final grading of areas.

B. Stabilization of Sediment and Erosion Control Measures:

1. Sediment barriers, perimeter dikes, and other measures intended to either trap sediment or prevent runoff from flowing over disturbed areas shall be constructed as a first step in grading and be made functional before land disturbance takes place.

2. Earthen structures such as dams, dikes, and diversions shall be stabilized within five (5) days of installation.

3. Stormwater outlets shall also be stabilized prior to any upstream land disturbing activities.

C. Stabilization of Waterways and Outlets:

1. All onsite stormwater conveyance channels used by the Contractor for temporary erosion control purposes shall be designed and constructed with adequate capacity and protection to prevent erosion during storm and runoff events.

2. Stabilization adequate to prevent erosion shall also be provided at the outlets of all pipes and channels.

D. Storm Sewer Inlet Protection: All storm sewer inlets, which are made operable during construction, or which drain stormwater runoff from a construction site, shall be protected from sediment deposition by the use of filters.

E. Construction Access Routes:

1. Wherever construction vehicles enter or leave a construction site, a Stabilized Construction Entrance is required.

2. Where sediment is transported onto a public road surface, the roads shall be cleaned thoroughly at the end of each day.

3. Sediment shall be removed from roads by shoveling or sweeping and be transported to a sediment-controlled disposal area.

4. Street washing shall be allowed only after sediment is removed in this manner.

3.04 DISPOSITION OF TEMPORARY MEASURES

A. All temporary erosion and sediment control measures shall be disposed of within thirty (30) days after final site stabilization is achieved or after the temporary measures are no longer needed as determined by the STATE's Representative.

B. Trapped sediment and other disturbed soil areas resulting from the disposition of temporary measures shall be permanently stabilized to prevent further erosion.

C. Substantial Completion of Erosion Control Measures:

1. At the time specified in the Contract Documents, and subject to compliance with specified materials and installation requirements, the Contractor shall receive a Substantial Completion Certificate for temporary erosion control measures.

2. Maintenance of Erosion Control Measures after Substantial Completion: The Contractor shall be responsible for maintaining temporary erosion control measures as specified in the Drawings, Specifications, and Contract Documents until such time as Work has been accepted by the STATE's Representative as specified in Section 01 77 00, Closeout Procedures.

D. Final Completion and Acceptance of Erosion Control Measures:

1. After the STATE's Representative has determined that the drainage area has stabilized, the Contractor shall remove all remaining temporary erosion control measures.

2. Any damage to the site shall be repaired to the satisfaction of the STATE's Representative and at no cost to the STATE.

END OF SECTION 31 25 00

SECTION 31 50 00

EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes temporary excavation support and protection systems.

1.02 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.03 ACTION SUBMITTALS

A. Shop Drawings: For excavation support and protection system, prepared by or under the supervision of a qualified professional engineer.

B. Delegated-Design Submittal: For excavation support and protection systems, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Professional Engineer: Experience with providing delegated-design engineering services of the type indicated, including documentation that engineer is licensed in the state in which Project is located.

B. Contractor Calculations: For excavation support and protection system. Include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Existing Conditions: Using photographs show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by inadequate performance of excavation support and protection systems. Submit before Work begins.

1.05 CLOSEOUT SUBMITTALS

A. Record Drawings: Identify locations and depths of capped utilities, abandoned-in-place support and protection systems, and other subsurface structural, electrical, or mechanical conditions.

1.06 FIELD CONDITIONS

A. Interruption of Existing Utilities: Do not interrupt any utility-serving facilities occupied by the STATE or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:

1. Notify the STATE's Representative no fewer than two days in advance of proposed interruption of utility.

2. Do not proceed with interruption of utility without the STATE's Representative's written permission.

B. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 41 00, QUALITY REQUIREMENTS, to design excavation support and protection systems to resist all lateral loading and surcharge, including but not limited to, retained soil, groundwater pressure, adjacent building loads, adjacent traffic loads, construction traffic loads, material stockpile loads, and seismic loads, based on the following:

1. Compliance with OSHA Standards and interpretations, 29 CFR 1926, Subpart P.

2. Compliance with AASHTO Standard Specification for Highway Bridges or AASHTO LRFD Bridge Design Specification, Customary U.S. Units.

3. Compliance with requirements of authorities having jurisdiction.

4. Compliance with utility company requirements.

5. Compliance with railroad requirements.

2.02 MATERIALS

A. Provide materials that are either new or in serviceable condition.

B. Structural Steel: ASTM A36/A36M, ASTM A690/A690M, or ASTM A992/A992M.

C. Steel Sheet Piling: ASTM A328/A328M, ASTM A572/A572M, or ASTM A690/A690M; with continuous interlocks.

1. Corners: Site-fabricated mechanical interlock.

D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of size and strength required for application, 6 inch.

E. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.

F. Reinforcing Bars: ASTM A615/A615M, Grade 60 deformed.

G. Tiebacks: Steel bars, ASTM A722/A722M.

H. Tiebacks: Steel strand, ASTM A416/A416M.

PART 3 - EXECUTION

3.01 INSTALLATION - GENERAL

A. Locate excavation support and protection systems clear of permanent construction, so that construction and finishing of other work is not impeded.

B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from the STATE's Representative and authorities having jurisdiction.

2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.

3.02 SOLDIER PILES AND LAGGING

A. Install steel soldier piles before starting excavation.

1. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement.

2. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging.

3. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.

B. Install wood lagging within flanges of soldier piles as excavation proceeds.

1. Trim excavation as required to install lagging.

2. Fill voids behind lagging with soil, and compact.

C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

3.03 SHEET PILING

A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock vertical edges to form a continuous barrier.

B. Accurately place the piling using templates and guide frames unless otherwise recommended in writing by the sheet piling manufacturer.

1. Limit vertical offset of adjacent sheet piling to 60 inches.

2. Accurately align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.

C. Cut tops of sheet piling to uniform elevation at top of excavation.

3.04 TIEBACKS

A. Drill, install, grout, and tension tiebacks.

B. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.

1. Have test loading observed by a qualified professional engineer responsible for design of excavation support and protection system.

C. Maintain tiebacks in place until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.05 BRACING

A. Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary, to move brace, install new bracing before removing original brace.

1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by the STATE's Representative.

2. Install internal bracing if required to prevent spreading or distortion of braced frames.

3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.06 MAINTENANCE

A. Monitor and maintain excavation support and protection system.

B. Prevent surface water from entering excavations by grading, dikes, or other means.

C. Continuously monitor vibrations, settlements, and movements to ensure stability of excavations and constructed slopes and to ensure that damage to permanent structures is prevented.

3.07 FIELD QUALITY CONTROL

A. Survey-Work Benchmarks: Resurvey benchmarks weekly during installation of excavation support and protection systems, excavation progress, and for as long as excavation remains open.

1. Maintain an accurate log of surveyed elevations and positions for comparison with original elevations and positions.

2. Promptly notify the STATE's Representative if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

B. Promptly correct detected bulges, breakage, or other evidence of movement to ensure that excavation support and protection system remains stable.

C. Promptly repair damages to adjacent facilities caused by installation or faulty performance of excavation support and protection systems.

3.08 REMOVAL AND REPAIRS

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and earth and hydrostatic pressures.

1. Remove in stages to avoid disturbing underlying soils and rock or damaging structures, pavements, facilities, and utilities.

2. Remove excavation support and protection systems to a minimum depth of 48 inches below overlying construction and abandon remainder.

3. Fill voids immediately with approved backfill compacted to density specified in Section 31 20 00, EARTH MOVING.

4. Repair or replace, as approved by the STATE's Representative, adjacent work damaged or displaced by removing excavation support and protection systems.

END OF SECTION 31 50 00

SECTION 32 01 00

CIVIL GENERAL PROVISIONS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This Section supplements all Sections of this Division and applies to all Work specified and indicated on the Contract Drawings. Provide for complete installation of Civil Engineering design.

1.02 SUBMITTALS

A. Refer to individual Civil Sections for submittals required.

B. If the equipment submitted under Division 33 requires changes in material or design from that required in the Contract Drawings and Specifications, such changes shall be submitted as shop drawings.

C. Operation and Maintenance Manual.

1.03 REFERENCE STANDARDS

A. The following abbreviations apply to all sections of Division 33:

1. ASTM: American Society of Testing and Materials.

2. lb: Pound.

3. PSI: Pounds per square inch.

4. CU: Cubic.

5. PVC: Polyvinyl chloride.

6. YD: Yard.

1.04 SERVICE MANUALS

A. Upon completion of the installation, and as a condition of its acceptance, prepare and submit an Operating and Maintenance Manual to the STATE's Representative for approval. Compile the manual from information supplied by equipment manufacturers and from test and balance data furnished. Each manual shall include the following:

1. Complete instructions on the operation of all mechanical equipment including all control settings, switch positions, timer operation, set points, throttling range.

2. Complete instructions regarding the maintenance of all mechanical equipment including periods and frequencies of all inspections, lubrications and filter replacement, etc.; type of lubricants required; and exact description of performance of

such maintenance and full description of inspections and corrections on a step-by-step basis. Furnish a chart listing each lubricated piece of equipment, the type of oil or grease required, and recommended frequency of lubrication.

3. Copy of all As-Built drawings and As-Built electrical and communication wiring diagrams.

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

5. Copy of all guarantees and warranties issued for components of the systems, showing all dates of expiration. Such dates shall not be sooner than the expiration of the completed installation guarantee specified herein.

6. Copy of Valve Chart:

   a. Format: Arrange format of valve charts by rooms and sequence all valve numbers starting with mechanical equipment rooms and finishing with "occupied spaces".

   b. Information: Furnish the following information typed on valve charts for each valve specified.

7. Room numbers and name where valve is located, i.e., "ZG Boiler Room".

8. Valve number assigned by Contractor and stamped on brass plate, i.e., "147".

9. Service medium using designation assigned to Drawings on mechanical symbols, i.e., "heating hot water supply" or "chilled water return".

10. Valve types as specified in Section 23 20 00, VALVES, i.e., "eccentric plug valve" or "gate valve".

11. Function valve serves, i.e., "strainer shut-off" or "balancing valve".

12. Zone identification, i.e., "AHU-2" or "auxiliary heating".

13. A complete index at the front furnishing immediate information as to location in the manual of all data regarding the installation. Numbered tab sheets shall be used.

14. Name, address and telephone number of Contractor and each subcontractor employed for work under this Division.

B. All material shall be neatly typed or shall be printed material. Instructions specified shall be in continuous narrative form not fragmented sections as prepared by individual equipment manufacturers.

C. Submit four (4) copies of manuals in binders along with two (2) digital copies with identification readable from the outside stating "HYDRONIC LOOP REPLACEMENT, DSH-Coalinga State Hospital."

   1. Submit in separate, multiples of two, 3-ring loose leaf binders, 2-inch size, with

chrome-plated piano hinges and black hard-coated covers.

2. Small or large literature not easily inserted in binders shall each be put in heavy manila envelopes.

3. Furnish each binder with plastic enclosed tabs on reinforced paper neatly arranged. Type each of the following on a separate tab:

   a. Operating instructions.

   b. Maintenance instructions.

   c. As-built controls & as-built wiring diagrams.

   d. Parts.

   e. Guarantees and warranties.

   f. Valve chart.

   g. Test & balance report.

   h. Index.

   i. List of contractors and subcontractors.

4. File under correct tabs. Clearly identify each piece of literature and envelope with equipment name and numbers.

1.05 MANUFACTURER'S DIRECTIONS

A. In all cases where manufacturers of articles used in this Contract furnish printed directions covering points not shown on Drawings or specified, such printed directions shall be followed.

1.06 DRAWINGS

A. Diagrammatic Drawings: For purposes of clarity and legibility, the Drawings are essentially diagrammatic and, although size and location of equipment is drawn to scale, Contractor shall make use of all data in all of the Contract Documents and verify this information at Project site.

B. Routing of Piping:

1. Drawings indicate required size and termination of pipes and suggest correct routes of piping to conform to the site and structures, to prevent obstructions and to preserve clearance.

2. It is not the intent to indicate all necessary offsets and it shall be Contractor's responsibility to install piping in such a manner as to conform to site and structures, prevent obstructions, preserve headroom, keep openings and passageways clear, and make all equipment requiring inspection, maintenance and repair, accessible

without further instructions or extra cost to the STATE.

C. Interferences:

1. No interferences shall occur which prevent grade lines from being established for the work.

2. Installed work which interferes with the work specified in other Sections of the Specifications shall be removed and rerouted at the discretion of the STATE's Representative.

1.07 SPARE PARTS AND SPECIAL TOOLS

A. Spare parts shall be furnished to the STATE's Representative as follows and receipts obtained and included with Service Manuals.

B. Special Tools: If any part of equipment furnished requires a special tool for assembly, adjustment, setting or maintenance thereof and such tool is not readily available on the commercial tool market, it shall be furnished with equipment as a standard accessory.

1.08 PRELIMINARY OPERATION AND EMERGENCY REPAIRS

A. The STATE reserves the right to operate portions of the mechanical system on a preliminary basis or make emergency repairs without voiding the guarantee or relieving the Contractor of its responsibilities.

1.09 INSTRUCTIONS IN OPERATION

A. After all tests and adjustments have been made and the service manual has been completed and submitted for approval, furnish one or more full-time qualified personnel as necessary to put the mechanical work in continuous operation for a period of not less than five (5) days, during which time the designated personnel's only purpose shall be to give complete operating and maintenance instructions to the STATE's operating personnel. Furnish all service necessary for the operation and protection of the mechanical systems. Fuel, power, and other supplies required during this period will be furnished by the STATE.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Delegated Design: Engage a qualified professional engineer to design excavation support and protection systems to resist all lateral loading and surcharge, including but not limited to, retained soil, groundwater pressure, adjacent building loads, adjacent traffic loads, construction traffic loads, material stockpile loads, and seismic loads, based on the following:

1. Compliance with OSHA Standards and interpretations, 29 CFR 1926, Subpart P.

2. Compliance with AASHTO Standard Specification for Highway Bridges or AASHTO LRFD Bridge Design Specification, Customary U.S. Units.

3. Compliance with requirements of authorities having jurisdiction.

PART 3 - EXECUTION

3.01 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.

1. Shore, support, and protect utilities encountered.

3.02 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations. Coordinate with the STATE's Representative and Hospital staff prior to utility disconnecting and capping.

B. Review Project Record Documents of existing construction or other existing conditions and hazardous material information provided by the STATE's Representative. The STATE does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Perform an engineering survey of construction area by a California licensed surveyor to verify existing utility locations.

D. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

E. Survey of Existing Conditions: Record existing conditions by use of measured drawings.

F. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.

3.03 EXCAVATION AND BACKFILL

A. General:

1. Prior to any excavation a thorough investigation of all underground utilities shall be conducted and documented. It will be the Contractors responsibility to verify all underground utility locations. Contractor shall use, potholing, surveying and as-built plans to help verify existing utility locations.

2. Protect and maintain erosion and sedimentation controls during earth-moving operations.

3. Perform all excavation and backfill outside of buildings' perimeters.

B. Excavation: Excavate soil for the construction of the concrete utility vault. See Section 31 20 00, EARTH MOVING for excavation specifications.

C. Excavation near existing utilities shall be done with hand tools rather than heavy equipment.

D. Backfilling: Do not backfill until final inspection and approval for the concrete vault installation by the STATE's Representative. Backfill material shall be as specified under pertinent sections.

E. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D698 and ASTM D1557:

1. Under structures, building slabs, steps, and pavements, recompact top 6 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent of maximum dry unit weight.

2. Testing agency will test compaction of soils in place according to ASTM D1556, ASTM D2167, ASTM D2937, and ASTM D6938, as applicable. Tests will be performed every 100' along the concrete utility vault.

3.04 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

B. Stockpile soil materials away from edge of excavations.

3.05 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off STATE's property.

B. Transport surplus satisfactory soil to designated storage areas on STATE's property. Stockpile or spread soil as directed by Owner.

1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off STATE's property.

3.06 DAMAGE TO EXISTING IMPROVEMENTS.

A. Damage to existing utilities, surfaces, structures shall be repaired and or replaced in kind at the Contractor's expense.

END OF SECTION 32 01 00

SECTION 33 01 00

ASPHALT PAVING

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Hot-mix asphalt paving.

2. Hot-mix asphalt patching.

3. Hot-mix asphalt paving overlay.

4. Asphalt surface treatments.

5. Pavement-marking paint.

6. Cold milling of existing hot-mix asphalt pavement.

B. Related Sections include the following:

1. Division 31 Sections on earthwork, excavation, and fill for aggregate subbase and base courses and for aggregate pavement shoulders.

1.02 REFERENCED STANDARDS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1. State of California, Department of Transportation:

a. Current Edition; Standard Specifications.

2. American Society for Testing and Materials (ASTM) Publications:

a. D 2172-81 - Quantitative Extraction of Bitumen from Bituminous Paving Mixtures.

1.03 DEFINITIONS

A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

B. DOT: Department of Transportation.

1.04 SYSTEM DESCRIPTION

A. Provide hot-mix asphalt paving according to materials, workmanship, and other applicable requirements of standard specifications of state or local DOT.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Manufacturer shall be a paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of the state in which Project is located.

B. Testing Agency Qualifications: Qualified in accordance with ASTM D3666 for testing indicated.

C. Regulatory Requirements: Comply with materials, workmanship, and other applicable local requirements for asphalt paving work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.06 FIELD CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Prime Coat: Minimum surface temperature of 60 deg F.

2. Tack Coat: Minimum surface temperature of 60 deg F.

3. Slurry Coat: Comply with weather limitations in ASTM D3910.

4. Revise temperature in "Asphalt Base Course (and Binder Course)" Subparagraph below to suit Project.

5. Asphalt Base Course Minimum surface temperature of 40 deg F and rising at time of placement.

6. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

PART 2 – PRODUCTS

2.01 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

1. The grading and proportioning of aggregates shall be such that the combined mineral aggregate conforms to the specified requirements or match the existing aggregate base in the adjacent pavement section.

B. Aggregate for asphaltic concrete shall conform to Section 39 of the Standard Specifications, Class B for individual test result conforming to 1/2 inch maximum size gradation, medium.

C. Coarse Aggregate: ASTM D692/D692M, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

D. Fine Aggregate: ASTM D1073 sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

E. Mineral Filler: ASTM D242/D242M, rock or slag dust, hydraulic cement, or other inert material.

2.02 ASPHALT MATERIALS

A. Consult state or local DOT for asphalt-binder recommendations.

B. Asphalt Binder: ASTM D6373 binder designation PG 58-28

C. Asphalt Cement: ASTM D3381/D3381M for viscosity-graded material

D. Cutback Prime Coat: ASTM D2027/D2027M, medium-curing cutback asphalt, MC-30

E. Consult state or local DOT for recommended asphalt-emulsion prime coat for local conditions.

F. Emulsified Asphalt Prime Coat: ASTM D977 emulsified asphalt, or ASTM D2397/D2397M cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

G. Tack Coat: ASTM D977emulsified asphalt, or ASTM D2397/D2397M cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

H. Fog Seal: ASTM D977emulsified asphalt, or ASTM D2397/D2397M cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.

I. Water: Potable.

J. Undersealing Asphalt: ASTM D3141/D3141M; pumping consistency.

2.03 AUXILIARY MATERIALS

A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt.

2.04 MIXES

A. Surface Course Limit: Recycled content no more than 10 percent by weight.

B. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where

Project is located.

2. Base Course: Match Existing Base Course.

3. Binder Course: Match Existing Binder Course.

4. Surface Course: Match Existing Surface Course.

C. Emulsified-Asphalt Slurry: ASTM D3910, Type 1.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Conduct a pre-construction meeting with Hospital staff before starting any work.

B. Verify that subgrade is dry and in suitable condition to begin paving.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.02 SURFACE PREPARATION

A. Protection: Provide protective materials, procedures, and worker training to prevent asphalt materials from spilling, coating, or building up on curbs, driveway aprons, manholes, and other surfaces adjacent to the Work.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.

2. Revise the minimum weight or type of vehicle in first subparagraph below if required.

3. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons

4. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by the STATE’s Representative, and replace with compacted backfill or fill as directed.

C. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.

3.03 COLD MILLING

A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.

1. Mill to a depth of 1-1/2 inches.

2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.

3. Control rate of milling to prevent tearing of existing asphalt course.

4. Repair or replace curbs, driveway aprons, manholes, and other construction damaged during cold milling.

5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.

6. Patch surface depressions deeper than 1 inch after milling, before wearing course is laid.

7. Coordinate first subparagraph below with requirements in Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.

8. Handle milled asphalt material in accordance with approved waste management plan required in Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.

9. Keep milled pavement surface free of loose material and dust.

10. Do not allow milled materials to accumulate on-site.

3.04 PATCHING

A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 24 inches into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.

1. Undersealing: Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.

2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.

C. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.

2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

D. Placing Single-Course Patch Material: Fill excavated pavement areas with hot- mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

E. Placing Two-Course Patch Material: Partially fill excavated pavements with hot- mix asphalt base course mix and, while still hot, compact. Cover asphalt base course with compacted layer of hot-mix asphalt surface course, finished flush with adjacent surfaces.

3.05 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.

1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch

1. Clean cracks and joints in existing hot-mix asphalt pavement.

2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.06 SURFACE PREPARATION

A. Ensure that prepared subgrade has been proof-rolled and is ready to receive paving. Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces.

B. Herbicide Treatment: Apply herbicide in accordance with manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.

C. Cutback Prime Coat: Apply uniformly over surface of compacted unbound- aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.

2. Protect primed substrate from damage until ready to receive paving.

D. Emulsified Asphalt Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.10 to 0.30 gal./sq. yd. per inch depth. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.

2. Protect primed substrate from damage until ready to receive paving.

E. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.

2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.07 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.

2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.

3. Offset transverse joints, in successive courses, a minimum of 24 inches.

4. Construct transverse joints as described in AI MS-22, "Construction of Hot Mix Asphalt Pavements."

5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.

6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.08 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.

1. Initial or breakdown rolling and the final rolling of the uppermost layer of the asphalt concrete shall be in accordance with Section 39 of the Standard Specifications. Compaction by vehicular traffic shall not be permitted.

2. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 96 percent of reference laboratory density according to AASHTO T 245, but not less than 94 percent nor greater than 100 percent.

2. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Joining Pavement: Carefully make joints between old and new pavements or between successive day's work made in such manner as to insure a continuous bond between old and new sections of the course. Expose and clean edges of existing pavement. Cut edge to straight, vertical surfaces. Paint all joints with a uniform coat of tack coat before the fresh mixture is placed. Prepare joints in the new pavement in accordance with Section 39 of the Standard Specifications.

3.09 RESTORATION OF SURFACES

A. Ensure that new pavement is restored to existing conditions or better.

3.10 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow excavated materials to accumulate on-site.

END OF SECTION 33 01 00

SECTION 33 02 00

CEMENT CONCRETE PAVING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes Concrete Paving

1. Driveways.

2. Roadways.

3. Parking lots.

4. Walks.

1.02 DEFINITIONS

A. Definition in "Cementitious Materials" Paragraph below refers to materials that make up the cementitious component of the w/c ratio.

B. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.

C. W/C Ratio: The ratio by weight of water to cementitious materials.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site

1. Review methods and procedures related to concrete paving, including but not limited to, the following:

a. Concrete mixture design.

b. Quality control of concrete materials and concrete paving construction practices.

2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:

a. Retain subparagraphs below for representatives required to be present.

b. Contractor's superintendent.

c. Independent testing agency responsible for concrete design mixtures.

d. Ready-mix concrete manufacturer.

e. Concrete paving Subcontractor.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified ready-mix concrete manufacturer and testing agency.

B. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.

2. Steel reinforcement and reinforcement accessories.

3. Fiber reinforcement.

4. Admixtures.

5. Curing compounds.

6. Applied finish materials.

7. Bonding agent or epoxy adhesive.

8. Joint fillers.

C. Material Test Reports: For each of the following:

1. Aggregates: Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

D. Field quality-control reports.

1.05 QUALITY ASSURANCE

A. Stamped Detectable Warning Installer Qualifications: An employer of workers trained and approved by manufacturer of stamped concrete paving systems.

B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual – Section 3, "Plant Certification Checklist").

C. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.

2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by the STATE's Representative and not less than 96 inches

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless the STATE's Representative specifically approves such deviations in writing.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.06 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.

2. Do not use frozen materials or materials containing ice or snow.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

C. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 – PRODUCTS

2.01 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.02 FORMS

A. Reference specifications sections in Division 03.

B. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less.

C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.03 STEEL REINFORCEMENT

A. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, fabricated from steel wire into flat sheets.

B. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

C. Epoxy-Coated Welded-Wire Reinforcement: ASTM A884/A884M, Class A, plain steel.

D. Reinforcing Bars: ASTM A615/A615M, Grade 60; deformed.

E. Galvanized Reinforcing Bars: ASTM A767/A767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A615/A615M, Grade 60 deformed bars.

F. Epoxy-Coated Reinforcing Bars: ASTM A775/A775M or ASTM A934/A934M; with ASTM A615/A615M, Grade 60 deformed bars.

G. Steel Bar Mats: ASTM A184/A184M; with ASTM A615/A615M, Grade 60 deformed bars; assembled with clips.

H. Plain-Steel Wire: ASTM A1064/A1064M.

I. Deformed-Steel Wire: ASTM A1064/A1064M.

J. Epoxy-Coated-Steel Wire: ASTM A884/A884M, Class A; coated, deformed.

K. Joint Dowel Bars: ASTM A615/A615M, Grade 60 plain-steel bars. Cut bars true to length with ends square and free of burrs.

L. Epoxy-Coated, Joint Dowel Bars: ASTM A775/A775M; with ASTM A615/A615M, Grade 60 plain-steel bars.

M. Tie Bars: ASTM A615/A615M, Grade 60 deformed.

N. Hook Bolts: ASTM A307, Grade 60, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

O. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

P. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

Q. Zinc Repair Material: ASTM A780/A780M.

2.04 CONCRETE MATERIALS

A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:

1. Portland Cement: ASTM C150/C150M, white portland cement Type II

2. Slag Cement: ASTM C989/C989M, Grade 100 or 120.

3. Blended Hydraulic Cement: ASTM C595/C595M, cement.

B. Normal-Weight Aggregates: ASTM C33/C33M, Class 4, uniformly graded. Provide aggregates from a single source with documented service-record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: ¾-inch nominal.

2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Exposed Aggregate: Selected, hard, and durable; washed; free of materials with deleterious reactivity to cement or that cause staining; from a single source, with gap-graded coarse aggregate as follows:

1. Aggregate Sizes: 1/2 to 3/4 nominal.

D. Air-Entraining Admixture: ASTM C260/C260M.

E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.

2. Retarding Admixture: ASTM C494/C494M, Type B.

3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.

4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.

5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.

6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

F. Color Pigment: ASTM C979/C979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

G. Water: Potable and complying with ASTM C94/C94M.

2.05 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd.

B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

2.06 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.

B. Cementitious Materials: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent. Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash or Pozzolan: 25 percent.

2. Slag Cement: 50 percent.

3. Combined Fly Ash or Pozzolan, and Slag Cement: 50 percent, with fly ash or pozzolan not exceeding 25 percent.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

1. Air Content: 5-1/2 percent plus or minus 1-1/2 percent for 1-1/2-inch nominal maximum aggregate size.

2. Air Content: 6 percent plus or minus 1-1/2 percent for 1-inch nominal maximum aggregate size.

3. Air Content: 6 percent plus or minus 1-1/2 percent for 3/4-inch nominal maximum aggregate size.

D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture plasticizing and retarding admixture in concrete as required for placement and workability.

2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

F. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd.

G. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

H. Concrete Mixtures: Normal-weight concrete.

1. Compressive Strength (28 Days): 5000 psi

2. Maximum W/C Ratio at Point of Placement: 0.40

3. Slump Limit: 5 inches plus or minus 1 inch

2.07 CONCRETE MIXING

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.

B. Proportion mixtures to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 5000 psi.

2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.40

3. Slump Limit: 4 inches, plus or minus 1 inch.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal- weight

concrete at point of placement having an air content as follows:

1. Air Content: 4-1/2 percent plus or minus 1.5 percent for 1-1/2-inch nominal maximum aggregate size.

2. Air Content: 4-1/2 percent plus or minus 1.5 percent for 1-inch nominal maximum aggregate size.

3. Air Content: 3-1/2 percent plus or minus 1.5 percent for 3/4-inch nominal maximum aggregate size

D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture in concrete, as required, for placement and workability.

2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

F. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements for concrete exposed to deicing chemicals. as follows:

1. Fly Ash or Pozzolan: 25 percent.

2. Ground Granulated Blast-Furnace Slag: 50 percent.

3. Combined Fly Ash or Pozzolan, and Ground Granulated Blast-Furnace Slag: 50 percent, with fly ash or pozzolan not exceeding 25 percent.

PART 3 – EXECUTION

3.01 PREPARATION

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

3.02 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage

3.03 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and

supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.

F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D3963/D3963M.

G. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.04 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.

2. Provide tie bars at sides of paving strips where indicated.

3. Butt Joints: Use epoxy-bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.

5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent

concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.

2. Extend joint fillers full width and depth of joint.

3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.

4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.

5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.

6. Curing concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows, to match jointing of existing adjacent concrete paving:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.

a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

a. Tolerance: Ensure that sawed joints are within either way from centers of dowels.

3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.05 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement dowels and joint devices.

H. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

3.06 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing or moisture-retaining-cover curing as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.

    b. Continuous water-fog spray.

    c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period, using cover material and waterproof tape.

3.07 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: ¾-inch.

2. Thickness: Plus 3/8-inch, minus ¼-inch.

3. Surface: Gap below 10-feet- long; unleveled straightedge not to exceed 1/2 inch.

4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.

5. Lateral Alignment and Spacing of Dowels: 1 inch.

6. Vertical Alignment of Dowels: 1/4 inch

7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.

8. Joint Spacing: 3 inches

9. Contraction Joint Depth: Plus 1/4 inch no minus.

10. Joint Width: Plus 1/8 inch no minus.

3.08 FIELD QUALITY CONTROL

A. Testing Agency: The STATE will engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C172/C172M shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd.

5000 sq. ft. or fraction thereof of each concrete mixture placed each day.

a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C231/C231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C31/C31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C39/C39M; test one specimen at seven days and two specimens at 28 days.

a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to the STATE's Representative, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by the STATE's Representative but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by the STATE's Representative.

G. Concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. Prepare test and inspection reports.

3.09 REPAIR AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by the STATE's Representative.

B. Drill test cores, where directed by the STATE's Representative, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

3.10 RESTORATION OF SURFACES

A. Ensure that new pavement is restored to existing conditions or better.

END OF SECTION 33 02 00

SECTION 33 03 00

STORM DRAINAGE

PART 1 - GENERAL

1.01 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Storm pipe: Include plans, elevations, and sizes.

PART 2 - PRODUCTS

2.01 PVC PIPE AND FITTINGS

A. Source Limitations: Obtain PVC pipe and fittings from single manufacturer.

B. NSF Marking: Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic storm drain and "NSF-sewer" for plastic storm sewer piping.

C. Adhesive Primer: ASTM F656.

2.02 PERFORATED-WALL PIPES AND FITTINGS

A. Perforated Polyethylene (PE) Pipe and Fittings:

1. Nominal Pipe Size (NPS) 6 and Smaller: ASTM F667 or AASHTO M 252, Type CP; corrugated, for coupled joints.

2. NPS 8 and Larger: ASTM F667; AASHTO M 252, Type CP; or AASHTO M 294, Type CP; corrugated; for coupled joints.

3. Couplings: Manufacturer's standard, band type.

2.03 GEOTEXTILE FILTER FABRICS

A. Description: Fabric of polyethylene (PE) or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. when tested according to ASTM D4491.

B. Structure Type: Nonwoven, needle-punched continuous filament.

1. Survivability: AASHTO M 288 Class 2.

2. Styles: Flat and sock.

PART 3 - EXECUTION

3.01 PIPING INSTALLATION

A. General Locations and Arrangements: Drawings and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install floor drain at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Provide fittings for branch connections unless a direct tap into existing storm catch basin or storm drain manhole is indicated on the approved plans.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Install gravity-flow, nonpressure drainage piping in accordance with the following:

1. Install piping pitched down in direction of flow.

2. Install piping with 24” minimum cover.

3. Join perforated PVC pipe and fittings with couplings according to ASTM D3212 with loose banded, coupled, or push-on joints.

3.02 DRAIN INSTALLATION

A. Install 4” NDS pipe drain #11 at vault low points and as indicated on plans.

B. Fasten grates to drain pipes.

C. Set drain frames and covers with tops flush with concrete floor surface.

3.03 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping to floor drain grates.

B. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 4-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

    a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.

    b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.04 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

    1. Submit separate reports for each system inspection.

    2. Defects requiring correction include the following:

        a. Alignment: Less than full diameter of inside of pipe is visible between structures.

        b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.

        c. Damage: Crushed, broken, cracked, or otherwise damaged piping.

        d. Infiltration: Water leakage into piping.

        e. Exfiltration: Water leakage from or around piping.

    3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.

    4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

    1. Do not enclose, cover, or put into service before inspection and approval.

    2. Test completed piping systems in accordance with requirements of authorities

having jurisdiction.

3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.

4. Submit separate report for each test.

3.05 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with water.

END OF SECTION 33 03 00

SECTION 33 04 00

CHAIN-LINK FENCES AND GATES

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Chain-Link Fences.

2. Gates: Motor operated, horizontal slide, swing.

B. Related Sections include the following:

1. Division 03 and Division 32 specifications Sections for post concrete fill.

2. Division 31 specifications Sections for site excavation, fill, and backfill where chain-link fences and gates are located.

C. Alternates: Refer to Division 1 Section "Alternates" for description of Work in this Section affected by alternates.

1.02 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide chain-link fences and gates capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Minimum Post Size and Maximum Spacing for Wind Velocity Pressure: Determine based on mesh size and pattern specified, and on the following minimum design wind pressures and according to CLFMI WLG 2445:

a. Wind Speed: 80 mph

b. Fence Height: 12 feet

c. Line Post Group: IA, ASTM F 1043, Schedule 40 steel pipe.

d. Wind Exposure Category: B

2. Determine minimum post size, group, and section according to ASTM F 1043 for framework up to 12 feet high, and post spacing not to exceed 10 feet.

1.03 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for chain-link fences and gates.

1. Fence and gate posts, rails, and fittings.

2. Chain-link fabric, reinforcements, and attachments.

3. Gates and hardware.

4. Gate operators, including operating instructions.

5. Accessories: Barbed wire, Barbed tape

6. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.

B. Shop Drawings: Show locations of fences, gates, posts, rails, tension wires, details of extended posts, extension arms, gate swing, or other operation, hardware, and accessories. Indicate materials, dimensions, sizes, weights, and finishes of components. Include plans, gate elevations, sections, details of post anchorage, attachment, bracing, and other required installation and operational clearances.

1. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.

2. Wiring Diagrams: Power and control wiring and communication, access-control features.

3. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Samples for Initial Selection: Manufacturer's color charts or 6-inch lengths of actual units showing the full range of colors available for components with factory-applied color finishes.

D. Samples for Verification: For each type of chain-link fence and gate indicated.

1. Polymer-coated steel wire in 6-inch lengths.

E. Product Certificates: For each type of chain-link fence, operator, and gate, signed by product manufacturer.

1. Strength test results for framing according to ASTM F 1043.

F. Qualification Data: For Installer.

G. Field quality-control test reports.

H. Maintenance Data: For the following to include in maintenance manuals:

1. Polymer finishes.

2. Gate operator.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed chain-link fences and gates similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

1. Engineering Responsibility: Preparation of data for chain-link fences and gates, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified according to NETA ETT, or the National Institute for Certification in Engineering Technologies, to supervise on-site testing specified in Part 3.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. UL Standard: Provide gate operators that comply with UL 325.

E. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction for automatic gate operators serving as a required means of access.

F. Preinstallation Conference: Conduct conference at Project site.

1.05 PROJECT CONDITIONS

A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

B. Interruption of Existing Utility Service: Do not interrupt utility services to facilities occupied by Hospital or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify the STATE’s Representative no fewer than two days in advance of proposed interruption of utility services.

2. Do not proceed with interruption of utility services without the STATE’s Representative 's written permission.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or equal:

1. Chain-Link Fences and Gates:

    a. Hebei Winner Chain Link Fence

2. Barbed Wire, Tape:

    a. Hebei Winner Chain Link Fence

2.02 CHAIN-LINK FENCE FABRIC

A. General: Height indicated on Drawings. Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist. Comply with ASTM A 392, CLFMI CLF 2445, and requirements indicated below:

1. Steel Wire Fabric: Metallic coated wire with a diameter of 0.192 inch.

    a. Mesh Size: 2 inches or match existing chain link fence mesh size.

    b. Weight of Aluminum Coating: ASTM A 491, Type I

    c. Weight of Metallic (Zinc) Coating: ASTM A 392, Type II, Class 1 with zinc coating applied before weaving.

    d. Weight of Zn-5-Al-MM Aluminum-Mischmetal Alloy Coating: ASTM F 1345, Type III, Class 1.

    e. Coat selvage ends of fabric that is metallic coated before the weaving process with manufacturer's standard clear protective coating.

2.03 INDUSTRIAL FENCE FRAMING

A. Posts and Rails: Comply with ASTM F 1043 for framing, ASTM F 1083 for Group IC round pipe, and the following:

1. Group: IA, round steel pipe, Schedule 40 or match existing.

2. Fence Height: Match existing

3. Strength Requirement: Heavy industrial according to ASTM F 1043.

4. Post Diameter and Thickness: According to ASTM F 1043 or match existing.

5. Post Size and Thickness: According to ASTM F 1043.

    a. Top Rail: 1.66 inches or match existing

    b. Line Post: 2.375 inches or match existing

    c. End, Corner and Pull Post: 2.875 inches or match existing

d. In first subparagraph below, retain first option for steel post; retain second or third for aluminum. See ASTM F 900 for additional sizes of gates and posts.

e. Swing Gate Post: According to ASTM F 900 2.375-inch diameter.

f. Horizontal-Slide Gate Post: According to ASTM F 1184.

1) Openings up to 12 Feet: Steel post, 2.875-inch diameter, and 4.64- lb/ft. weight.

2) Openings Wider Than 12 Feet: Steel post, 4-inch diameter, and 8.65-lb/ft. weight.

3) Guide posts for Class 1 horizontal-slide gates equal the gate post height, 1 size smaller, but weight is not less than 3.11 lb/ft.; installed adjacent to gate post to permit gate to slide in space between.

6. Coating for Steel Framing:

a. Metallic Coating:

1) Type A, consisting of not less than minimum 2.0-oz./sq. ft. average zinc coating per ASTM A 123/A 123M or 4.0-oz./sq. ft. zinc coating per ASTM A 653/A 653M.

2) Type B, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film.

3) External, Type B, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film. Internal, Type D, consisting of 81 percent, not less than 0.3-mil-thick, zinc pigmented coating.

4) Type C, Zn-5-Al-MM alloy, consisting of not less than 1.8-oz./sq. ft. coating.

5) Coatings: Any coating above.

2.04 TENSION WIRE

A. General: Provide horizontal tension wire at the following locations:

1. Location: Extended along top and bottom of fence fabric.

2. Location: Extended along top of barbed wire arms extended posts and top of fence fabric for supporting barbed tape.

3. Location: As indicated on plans for fence crossings.

B. Metallic-Coated Steel Wire: 0.177-inch- diameter, marcelled tension wire complying with ASTM A 817, ASTM A 824, and the following:

1. Metallic Coating: Type I, aluminum coated process, with the following minimum coating weight:

    a. Class 1: Not less than 0.8 oz./sq. ft. of uncoated wire surface.

    b. Class 2: Not less than 1.2 oz./sq. ft. of uncoated wire surface.

    c. Class 3: Not less than 2 oz./sq. ft. of uncoated wire surface.

    d. Match existing chain-link fencing

C. Aluminum Wire: 0.192-inch- diameter tension wire, mill finished, complying with ASTM B 211, Alloy 6061-T94 with 50,000-psi minimum tensile strength.

2.05 FITTINGS

A. General: Comply with ASTM F 626.

B. Post and Line Caps: Provide for each post.

1. Line post caps with loop to receive tension wire or top rail.

C. Rail and Brace Ends: Attach rails securely to each gate, corner, pull, and end post.

D. Rail Fittings: Provide the following:

1. Top Rail Sleeves: Pressed-steel or round-steel tubing not less than 6 inches long.

2. Rail Clamps: Line and corner boulevard clamps for connecting intermediate and bottom rails in the fence line-to-line posts.

E. Tension and Brace Bands: Pressed steel.

F. Tension Bars: Steel length not less than 2 inches shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.

G. Truss Rod Assemblies: Steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment.

H. Barbed Wire Arms: Pressed steel or cast iron, with clips, slots, or other means for attaching strands of barbed wire, and means for attaching to posts, integral with post cap; for each post, unless otherwise indicated, and as follows:

1. Line posts with arms that accommodate top rail or tension wire.

2. Corner arms at fence corner posts, unless extended posts are indicated.

3. Type I, single slanted arm.

4. Type II, single vertical arm.

5. Type III, V-shaped arm.

6. Type IV, A-shaped arm.

I. Tie Wires, Clips, and Fasteners: According to ASTM F 626.

1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, complying with the following:

a. Hot-Dip Galvanized Steel: 0.106-inch diameter wire; galvanized coating thickness matching coating thickness of chain-link fence fabric.

J. Finish:

1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz. /sq. ft. zinc.

2. Aluminum: Mill finish.

2.06 BARBED TAPE

A. Unreinforced Tape: 301 Series stainless steel hardened to Rockwell (30N) 45 to 50, 0.025 inch thick by 1.2 inch wide before fabrication; with 4-point, needle-sharp barbs.

B. Wire-Reinforced Tape: 430 Series stainless steel hardened to Rockwell (30N) 35 to 40, 0.025 inch thick by 1 inch wide before fabrication; with 4-point, needle-sharp barbs permanently cold clenched to a minimum of 230 deg F around a core wire.

1. Core wire: 0.098-inch- diameter, high-tensile-strength, zinc-coated steel complying with ASTM A 764 stainless steel complying with ASTM A 313/A 313M.

C. Clips: Stainless steel, 0.065 inch thick by 0.375 inch wide, capable of withstanding a minimum 150-lbf pull load to limit extension of coil, resulting in a concertina pattern when deployed.

D. Tie Wires: Stainless steel, 0.065 inch diameter.

E. Fabrication: Continuous coils of barbed tape as defined in ASTM F 1379 for the following characteristics:

1. Configuration: Double coil, or match existing.

2. Style: Helical pattern.

3. Coil Diameter(s): 24 inches, or match existing.

4. Coil Loop Spacing(s): 12 inches, or match existing.

5. Barb lengths below are defined as average plus or minus 5 percent, or match existing.

6. Barb Length Classification: Long, 1.2-inch barb. or match existing.

7. Barb Spacing: 4 inches o.c., or match existing.

8. Barb Set: Straight, or match existing.

2.07 CAST-IN-PLACE CONCRETE

A. Materials: Portland cement complying with ASTM C 150, Type I aggregates complying with ASTM C 33, and potable water for ready-mixed concrete complying with ASTM C 94/C 94M. Measure, batch, and mix Project-site-mixed concrete according to ASTM C 94/C 94M.

1. Concrete Mixes: Normal-weight concrete air entrained with not less than 3000- psi compressive strength (28 days), 3-inch slump, and 1-inch maximum size aggregate.

B. Materials: Dry-packaged concrete mix complying with ASTM C 387 for normal-weight concrete mixed with potable water according to manufacturer's written instructions.

2.08 GROUT AND ANCHORING CEMENT

A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.

B. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer, for exterior applications.

2.09 FENCE GROUNDING

A. Conductors: Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.

1. Material above Finished Grade: Aluminum.

2. Material on or below Finished Grade: Copper.

3. Bonding Jumpers: Braided copper tape, 1 inch wide, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.

B. Connectors and Grounding Rods: Comply with UL 467.

1. Connectors for Below-Grade Use: Exothermic welded type.

2. Grounding Rods: Copper-clad steel.

a. Size: 5/8 by 96 inches.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for a verified survey of site clearing, earthwork, pavement work, and other conditions affecting performance.

1. Do not begin installation before final grading is completed, unless otherwise permitted by the STATE's Representative.

2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.03 INSTALLATION, GENERAL

A. Install chain-link fencing to comply with ASTM F 567 and more stringent requirements specified.

1. Install fencing on established boundary lines inside property line.

3.04 CHAIN-LINK FENCE INSTALLATION

A. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.

B. Post Setting: Set posts in concrete footings at indicated spacing into firm, undisturbed soil.

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.

2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter, or match existing.

a. Exposed Concrete: Extend 2 inches above grade; shape and smooth to shed water.

b. Concealed Concrete: 60" below grade to allow covering with surface material.

c. Posts Set into Concrete in Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.

d. Posts Set into Voids in Concrete: Form or core drill holes not less than 5 inches deep and 3/4 inch larger than OD of post. Clean holes of loose

material, insert posts, and fill annular space between post and concrete with anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.

C. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of as indicated on Drawings.

D. Line Posts: Space line posts uniformly at 10 feet max. o.c., or match existing.

E. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Install braces at end and gate posts and at both sides of corner and pull posts, or match existing.

1. Locate horizontal braces at midheight of fabric 6 feet or higher, on fences with top rail and at 2/3 fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension, or match existing.

F. Tension Wire: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch- diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c. Install tension wire in locations indicated before stretching fabric, or match existing.

1. Top Tension Wire: Install tension wire through post cap loops.

2. Bottom Tension Wire: Install tension wire within 6 inches of bottom of fabric and tie to each post with not less than same diameter and type of wire.

G. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer, or match existing.

H. Bottom Rails: Install, spanning between posts.

I. Chain-Link Fabric: Apply fabric to inside of enclosing framework. Leave 1 inch between finish grade or surface and bottom selvage, unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released, or match existing.

J. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches o.c., or match existing.

K. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at 1 end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric per ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing, or match existing.

1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c., or match existing.

L. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side, or match existing.

M. Barbed Wire: Install barbed wire uniformly as indicated on Drawings, or match existing. Pull wire taut and install securely to extension arms and secure to end post or terminal arm, or match existing.

N. Barbed Tape: Install barbed tape uniformly in configurations indicated and fasten securely to prevent movement or displacement.

3.05 GROUNDING AND BONDING

A. Fence Grounding: Install at maximum intervals of 1500 feet except as follows:

1. Fences within 100 Feet of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet, or match existing.

a. Gates and Other Fence Openings: Ground fence on each side of opening.

1) Bond metal gates to gate posts.

2) Bond across openings, with and without gates, except openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.

B. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of 150 feet on each side of crossing.

C. Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2, unless otherwise indicated.

D. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at the grounding location, including the following:

1. Each Barbed Wire Strand. Make grounding connections to barbed wire with wire-to-wire connectors designed for this purpose.

2. Each Barbed Tape Coil: Make grounding connections to barbed tape with connectors designed for this purpose.

E. Bonding to Lightning Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning protection down conductor or lightning protection grounding conductor complying with NFPA 780.

3.06 FIELD QUALITY CONTROL

A. Grounding-Resistance Testing: Engage a qualified independent testing and inspecting agency to perform field quality-control testing.

1. Grounding-Resistance Tests: Subject completed grounding system to a megger test at each grounding location. Measure grounding resistance not less than two full days after last trace of precipitation, without soil having been moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural grounding resistance. Perform tests by two-point method according to IEEE 81.

2. Excessive Grounding Resistance: If resistance to grounding exceeds specified value, notify the STATE's Representative promptly. Include recommendations for reducing grounding resistance and a proposal to accomplish recommended work.

3. Report: Prepare test reports certified by a testing agency of grounding resistance at each test location. Include observations of weather and other phenomena that may affect test results.

3.07 DEMONSTRATION

A. Engage a factory-authorized service representative to train the STATE's personnel to adjust, operate, and maintain gates. Refer to Division 1 Section Project Closeout.

END OF SECTION 33 04 00

SECTION 33 05 00

PIPED UTILITIES

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems only. For specifications for Heating Hot Water (HHW) and Chilled Water (CHW) piping, refer to Division 23, specifically Section 23 20 13, ABOVE-GROUND PIPING and Section 23 20 16, UNDERGROUND PIPING.

2. Transition fittings.

3. Dielectric fittings.

4. Sleeves.

5. Identification devices.

6. Grout.

7. Piped utility demolition.

8. Utility Trenching

9. Concrete bases.

1.02 DEFINITIONS

A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.

B. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

C. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.

2. CPVC: Chlorinated polyvinyl chloride plastic.

3. PE: Polyethylene plastic.

4. PVC: Polyvinyl chloride plastic.

5. DIP: Ductile Iron Pipe

1.03 SUBMITTALS

A. Product Data: For the following:

1. Dielectric fittings.

2. Identification devices.

B. Samples of color, lettering style, and other graphic representation required for each identification material and device.

1.04 QUALITY ASSURANCE

A. Electrical Characteristics for Piped Utility Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is accepted in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

B. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Construction material delivery shall be first coordinated with the STATE's Representative and Hospital Staff.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.06 COORDINATION

A. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

B. Coordinate installation of identifying devices after completing covering and painting if devices are applied to surfaces.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 specifications Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.

b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.

2. CPVC Piping: ASTM F 493.

3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

4. PVC to ABS Piping Transition: ASTM D 3138.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.04 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.

b. Dresser Industries, Inc.; DMD Div.

c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.

d. JCM Industries.

e. Smith-Blair, Inc.

f. Viking Johnson.

g. Clow

2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.

3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.

4. Aboveground Pressure Piping: Pipe fitting.

B. Plastic-to-Metal Transition Fittings: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers:

a. Eslon Thermoplastics.

b. Nibco

C. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.

b. Fernco, Inc.

c. Mission Rubber Company.

d. Plastic Oddities, Inc.

e. ADS or NDS Inc.

2.05 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

1. Manufacturers:

a. Capitol Manufacturing Co.

b. Central Plastics Company.

c. Eclipse, Inc.

d. Epco Sales, Inc.

e. Hart Industries, International, Inc.

f. Watts Industries, Inc.; Water Products Div.

g. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

1. Manufacturers:

a. Capitol Manufacturing Co.

b. Central Plastics Company.

c. Epco Sales, Inc.

d. Watts Industries, Inc.; Water Products Div.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Manufacturers:

a. Advance Products & Systems, Inc.

b. Calpico, Inc.

c. Central Plastics Company.

d. Pipeline Seal and Insulator, Inc.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:

a. Calpico, Inc.

b. Lochinvar Corp.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psiginimum working pressure at 225 deg F.

1. Manufacturers:

a. Perfection Corp.

b. Precision Plumbing Products, Inc.

c. Sioux Chief Manufacturing Co., Inc.

d. Victaulic Co. of America.

2.06 SLEEVES

A. Mechanical sleeve seals for pipe penetrations are specified in Division 23 Section 23 05 16 "Basic Mechanical Materials and Methods."

B. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

C. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

D. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.07 IDENTIFICATION DEVICES

A. General: Products specified are for applications referenced in other Division 02 Sections. If more than single type is specified for listed applications, selection is Installer's option.

B. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.

1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.

2. Location: Accessible and visible.

C. Stencils: Standard stencils prepared with letter sizes complying with recommendations in ASME A13.1. Minimum letter height is 1-1/4 inches for ducts, and 3/4 inch for access door signs and similar operational instructions.

1. Material: Brass.

2. Stencil Paint: Exterior, oil-based, alkyd-gloss black enamel, unless otherwise indicated. Paint may be in pressurized spray-can form.

3. Identification Paint: Exterior, oil-based, alkyd enamel in colors according to ASME A13.1, unless otherwise indicated.

D. Snap-on Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap-on type. Include color-coding according to ASME A13.1, unless otherwise indicated.

E. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, color-coded, pressure-sensitive vinyl type with permanent adhesive.

F. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers, extending 360 degrees around pipe at each location.

G. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers, at least three times letter height and of length required for label.

H. Lettering: Manufacturer's standard preprinted captions as selected by the STATE’s Representative.

I. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.

1. Arrows: Either integrally with piping system service lettering to accommodate both directions of flow, or as separate unit on each pipe marker to indicate direction of flow.

J. Plastic Duct Markers: Manufacturer's standard laminated plastic, in the following color codes:

1. Green: Cold-air supply.

2. Yellow: Hot-air supply.

3. Blue: Exhaust, outside, return, and mixed air.

4. Hazardous Material Exhausts: Use colors and designs recommended by ASME A13.1.

5. Terminology: Include direction of airflow; duct service such as supply, return, and exhaust; duct origin; duct destination; and design flow.

K. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive vinyl tape, at least 3 mils thick.

1. Width: 1-1/2 inches on pipes with OD, including insulation, less than 6 inches; 2-1/2 inches for larger pipes.

2. Color: Comply with ASME A13.1, unless otherwise indicated.

L. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch sequenced numbers. Include 5/32-inch hole for fastener.

1. Material: 0.032-inch- thick, polished brass

2. Material: 0.0375-inch- thick stainless steel.

3. Material: 3/32-inch- thick plastic laminate with 2 black surfaces and a white inner layer.

4. Material: Valve manufacturer's standard solid plastic.

5. Size: 1-1/2 inches in diameter, unless otherwise indicated.

6. Shape: As indicated for each piping system.

M. Valve Tag Fasteners: Brass, wire-link or beaded chain; or brass S-hooks.

N. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.

1. Engraving: Engraver's standard letter style, of sizes and with terms to match equipment identification.

2. Thickness: 1/16 inch unless otherwise indicated.

3. Thickness: 1/16 inch, for units up to 20 sq. in. or 8 inches in length, and 1/8 inch for larger units.

4. Fasteners: Self-tapping, stainless-steel screws or contact-type permanent adhesive.

O. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in piped utility identification with corresponding designations indicated. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of piped utility systems and equipment.

1. Multiple Systems: Identify individual system number and service if multiple systems of same name are indicated.

2.08 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.

2. Design Mix: 5000-psi, 28-day compressive strength.

3. Packaging: Premixed and factory packaged.

PART 3-EXECUTION

3.01 PIPED UTILITY DEMOLITION

A. Refer to Division 01 and 02 Sections for general demolition requirements and procedures.

B. Disconnect, demolish, and remove piped utility systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.

2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.

3. Equipment to Be Removed: Disconnect and cap services and remove equipment.

4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make operational.

5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to the STATE's Representative.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.02 UTILITY TRENCHING

A. Utility trench excavation shall include the removal of all materials or obstructions and the control of water as necessary to construct the work as shown of specified on the approved plans. Unless otherwise shown or specified in the plans, excavation shall be open cut or as directed by the STATE's Representative.

B. Minimum and maximum trench width for new utilities shall be per the civil drawings.

C. The Contractor shall furnish and install sufficient shoring and bracing to ensure safety of personnel and public, protect the work and adjacent improvements.

D. Pipe bedding shall be placed as shown on the civil drawings. Pipe shall be placed on a firm layer of bedding material, and shall be bedded uniformly throughout its entire length. Pipe bedding material shall be placed at a minimum thickness of 3” for 10” and smaller dimeter pipe.

E. Initial Backfill shall be placed per the civil drawings. Contractor shall place the initial backfill to the spring line of the pipe, thoroughly compacting it by shovel or light tamping to support the pipe haunches.

F. Trench backfill shall consists of material placed between the initial backfill and subgrade in paved areas or to the top of the trench in unpaved areas. The trench backfill may be native material excavated at the work site if the trench depth is deeper than three feet (3’). Such material must be free of the organic or otherwise unsuitable material as determined by the STATE’s Representative. Rocks, stones exceeding 3” in greatest dimension must be removed from the trench.

G. Trench backfill material shall be placed in layers not to exceed eight inches (8”) in depth before compaction at or near optimum moisture content.

H. The backfill material for trench depths less than three feet (3’) measured from the top of pipe to the top of trench shall consist of imported granular material, uniformly graded class 2 aggregate base. See the civil drawings for requirements.

I. Trench backfill shall be compacted to a relative compaction of not less than ninety percent (90%) maximum dry density as determined by ASTM D 1557. Compaction testing will be performed by a Geotechnical Engineer during trench construction.

3.03 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping to permit valve servicing.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Select system components with pressure rating equal to or greater than system operating pressure.

I. Sleeves are not required for core-drilled holes.

J. Permanent sleeves are not required for holes formed by removable PE sleeves.

K. Install sleeves for relocated pipes passing under new concrete vault.

1. Cut sleeves to length for mounting flush with both surfaces.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

a. PVC Pipe Sleeves: For pipes smaller than NPS 6.

b. PVC Sleeves: For pipes NPS 6 and larger.

L. Verify final equipment locations for roughing-in.

M. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.04 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.

2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.

3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.

5. PVC Nonpressure Piping: Join according to ASTM D 2855.

6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.

2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.05 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.06 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment level and plumb, unless otherwise indicated.

B. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.

C. Install equipment to allow right of way to piping systems installed at required slope.

3.07 IDENTIFICATION

A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.

1. Stenciled Markers: According to ASME A13.1.

2. Plastic markers, with application systems. Install on insulation segment if required for hot noninsulated piping.

3. Locate pipe markers on exposed piping according to the following:

a. Near each valve and control device.

b. Near each branch, excluding short takeoffs for equipment and terminal units. Mark each pipe at branch if flow pattern is not obvious.

c. Near locations where pipes pass through walls or floors or enter inaccessible enclosures.

d. At manholes and similar access points that permit view of concealed piping.

e. Near major equipment items and other points of origination and termination.

B. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of equipment.

1. Lettering Size: Minimum 1/4 inch high for name of unit if viewing distance is less than 24 inches, 1/2 inch high for distances up to 72 inches, and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.

2. Text of Signs: Provide name of identified unit. Include text to distinguish among multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

C. Adjusting: Relocate identifying devices that become visually blocked by work of this or other Divisions.

3.08 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.

2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.

3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

5. Install anchor bolts to elevations required for proper attachment to supported equipment.

6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

7. Use 5000-psi 28-day compressive-strength concrete and reinforcement as specified in Division 03 specifications Sections.

3.09 GROUTING

A. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 33 05 00