TECHNICAL SPECIFICATIONS FOR WHITE ROCK BAY CAMPGROUND ANTELOPE ISLAND

(DFCM PROJECT NO. 22238510)

CONFORMANCE SET

Project:

White Rock Bay Campground
Antelope Island
4528 West 1700 South
Syracuse, Utah 84075

Ensign Project Number: 10970

Prepared For:

State of Utah – Division of State Parks
Attn: Chase Prince
1594 W. North Temple, Suite 116
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Date:
January 2022

Prepared By:

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01/12/2022
STATE OF UTAH

DIVISION OF FACILITIES CONSTRUCTION AND MANAGEMENT
REVIEWED FOR CODE COMPLIANCE
SIGNATURE:
DATE: 01/25/2022

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APWA INCLUSION DOCUMENT

DOCUMENT 01 10 01

AMERICAN PUBLIC WORKS ASSOCIATION
TECHNICAL SPECIFICATIONS

INCLUSION DOCUMENT

The General Conditions, Technical Specification and Standard Plan Documents that shall govern this Project are listed below:

American Public Works (APWA)
Manual of Standard Specifications and Manual of Standard Plans – 2017 Edition

The American Public Works Association (APWA), Manual of Standard Specifications and Standard Plans (2017 Edition) Documents are made a part of this Project by this reference.

The Divisions listed below are the Divisions that apply to this Project. See below for the appropriate Sections within each Division.

DIVISION 02 – EXISTING CONDITIONS
DIVISION 03 – CONCRETE
DIVISION 07 – THERMAL AND MOISTURE PROTECTION
DIVISION 31 – EARTHWORK
DIVISION 32 – EXTERIOR IMPROVEMENTS
DIVISION 33 – UTILITIES

The APWA Manual of Standard Specifications and Plans should be used in the preparation of the Bid for this Project. It is the Bidders responsibility to utilize these Documents and to know and understand them as they apply to this Project and to include in their Bid any costs associated with complying with the provisions provided therein.

It shall be required that these Documents be on site at all times during Construction.

The APWA Manual is available at the following locations which are listed below:

- **For Purchase at:** **Utah LTAP Center**
  Utah State University
  Logan, Utah 84322-8205
  Phone Number (800) 822-8878 or (435) 797-2931

The following Sections within the appropriate Division of the APWA Manual are included for the construction of the "*White Rock Bay Campground at Antelope Island*":

DIVISION 02 EXISTING CONDITIONS
02 41 14 Pavement Removal

DIVISION 03 CONCRETE
03 11 00 Concrete Forming
03 20 00 Concrete Reinforcing
03 30 04 Concrete

03 30 05	**Concrete Testing**
03 30 10	**Concrete Placement**
03 35 00	**Concrete Finishing**
03 39 00	**Concrete Curing**
03 40 00	**Precast Concrete**
03 61 00	**Cementitious Grouting**

DIVISION 07 THERMAL AND MOISTURE PROTECTION

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DIVISION 31 EARTH WORK

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DIVISION 32 EXTERIOR IMPROVEMENTS

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(End Inclusion Document)

TECHNICAL PROVISIONS

DIVISION 1 – GENERAL REQUIREMENTS

SECTION 01 11 00 – SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Construction Phasing.
3. Work covered by Contract Documents.
4. Owner Furnished Equipment
5. Access to site.
6. Coordination with occupants.
7. Work restrictions.
8. Specification and drawing conventions.
9. Miscellaneous provisions.

B. Related Requirements:

1. Section 01 50 00 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.2 PROJECT INFORMATION

A. Project Identification: Antelope Island White Rock Bay Campground (DFCM Project No. 22238510)

1. Project Location:

a. The Project is located on the northwest side of Antelope Island approximately 2.0 miles southwest of the Visitor Center off White Rock Bay Campground Road. More specifically shown in the project drawings.

B. Owner: Utah Department of Administrative Services – Division of Facilities Construction and Management and Utah State Parks

1. Owner's Representative: Lucas V. Davis, PMP, (801) 842-8210.
Offices Located at:
State Office Building, Suite #4110
Salt Lake City, Utah 84114-1160

C. Retain "Contractor" Paragraph below only if Contractor is selected by negotiation and subcontracts are subsequently bid.

D. Contractor: “TBD” has been engaged as Contractor for this Project.

E. Engineer: Ensign Engineering, Robert Rousselle, P.E. (801) 255-0529.

1. Engineer has been engaged for this Project to provide engineering services and to serve as Project's coordinator.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The following list has been furnished for the convenience of the Contractor and shall not be considered as representing all Work required in the Contract Documents. Contractor shall not take advantage of any errors or omissions in this listing and shall report any discrepancies or questionable items to the Engineer for clarification. The Work of Project is defined by the Contract Documents and consists of construction and installation of the following:

1. Mobilization
2. Construction Traffic Control
3. Erosion Control and Re-Vegetation
4. Clear, Grub, and Grading for Improvements
5. Sawcut and Removal of Asphalt
6. Park Well Head Improvements
7. Well House Improvements
8. 300K Gallon Tank Improvements
9. Bridger Bay Campground Booster Pump Station Improvements
10. Large, Small, and Large Restroom Improvements
11. Furnish, Place, and Install Campsite Sewer Drops
12. Furnish, Place, and Install Water and Power Connections for Non-Accessible Campsites
13. Furnish, Place, and Install Water and Power Connections for Accessible Campsites
14. Furnish and Install Wastewater Treatment System
15. Furnish and Install Wastewater Drain Field
16. Furnish and Install Restroom Wastewater Lift Station
17. Furnish and Install 8-inch HDPE Sanitary Sewer Main
18. Furnish and Install 1 ¼-inch HDPE Sanitary Sewer Force Main
19. Furnish and Install 4-inch SDR-35 PVC Sewer Laterals
20. Furnish and Install 6-inch SDR-35 PVC Sewer Laterals
21. Furnish and Install Sanitary Sewer Precast Manholes
22. Furnish and Install Sanitary Sewer Cleanouts
23. Furnish, Place, and Install 8-inch HDPE Drinking Water Main
24. Furnish and Install Drinking Water Yard Hydrant Services to Campsites
25. Furnish and Install Water Tower Service at RV Dump Station
26. Furnish and Install Drinking Water Services for Restrooms
27. Furnish and Install Combination Air/Vac Station
28. Furnish and Install Electrical, Telemetry, and Controls for Site, Campsite, Restroom, Wastewater System, and Drinking Water System Improvements
29. Furnish, Place, and Install Concrete Curb
30. Furnish, Place, and Install Monolithic Curb
31. Furnish, Place, and Compact Asphalt Pavement on UTBC
32. Furnish, Place, and Install PCC Pavement on UTBC
33. Furnish, Place, and Install Sidewalk on UTBC
34. Furnish, Place, and Install Mid-Block Pedestrian Ramp
35. Furnish, Place, and Compact UTBC
36. Furnish, Place, and Install Bollards

37. Furnish and Install RV Dump Station
38. Install Group Site Pavilion
39. Install Accessible Campsite Amenities including Pavilion, Fire Pit, and Sidewalk
40. Install Non-Accessible Campsite Amenities including Pavilion, Fire Pit, and Sidewalk
41. Furnish, Place, and Install Single and Dual Trash Enclosures
42. Construct Pull Through Campsite
43. Construct Accessible Pull Through Campsite
44. Construction Double Back-in Campsite
45. Construct Back-in Campsite
46. Construct Accessible Back-in Campsite
47. Furnish, Place, and Install Signage and Striping
48. Permitting Coordination

1. Project will be constructed under a single prime contract with bid items as indicated in the bid schedule.

1.4 OWNER FURNISHED EQUIPMENT

A. Owner furnished and installed equipment and materials are indicated in the project drawing. The Contractor will be expected to coordinate schedules and work priority with owner to facilitate access for owner furnished and installed equipment.

1.5 ACCESS TO SITE

A. Use of Site: Limit use of Project site to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Driveways, Walkways and Entrances: Keep driveways and entrances serving the existing tank and valve vault on the premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

    a. Schedule deliveries to minimize use of driveways and entrances by construction operations.

1.6 COORDINATION WITH OCCUPANTS

A. Full Owner Occupancy: Owner(s) will occupy sites and existing building(s) during entire construction period. Cooperate with Owner(s) during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities and accesses without written permission from Owner and approval of authorities having jurisdiction.

2. Notify Owner not less than **72 hours** in advance of activities that will affect Owner's operations.

1.7 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit work to normal business working hours of 7:00 a.m. to 7:00 p.m., Monday through Saturday, unless otherwise indicated and/or approved by the Owner.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:

1. Notify Owner not less than **three (3) business days** in advance of proposed utility interruptions.

D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.

1. Notify Owner not less than **three (3) business days** in advance of proposed disruptive operations.

E. Controlled Substances: Use of alcohol and marijuana products on Project site are not permitted.

1.8 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations.

These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.

2. Abbreviations: Materials and products are identified by abbreviations and scheduled on Drawings.

3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

1.9 QUALITY ASSURANCE/ QUALITY CONTROL

A. The Contractor shall perform QA/QC testing at the minimum frequencies listed in the PROJECT MANUAL and PROJECT DRAWINGS.

1.10 SCHEDULE

A. The Contractor is required to submit a construction schedule at the pre-construction meeting.

B. The Contractor is required to coordinate with State Park personnel throughout construction.

1.11 COORDINATION WITH DELIVERIES

A. Not Applicable.

1.12 PERMITS & INSPECTIONS

A. It is the Contractor's responsibility, at their expense, to maintain Erosion Control throughout construction.

B. It is the Contractor's responsibility, at their expense, to obtain a NPDES storm water permit by submitting a Notice of Intent (NOI) through Utah Department of Environmental Quality (UDEQ). It is the Contractor who will be responsible for compliance with this permit.

C. The Contractor is responsible to arrange for inspections and coordinate with the governing authorities. Contractor must submit copies of daily inspection/ construction reports to the Owner.

D. The Contractor shall perform construction materials testing at the minimum frequencies using methods described in the PROJECT MANUAL and as stated in Section 1.9.

1.13 WATER SAMPLING

A. The Owner will be responsible for water testing and sampling (if required). The Contractor will need to coordinate with the Owner for water sampling and testing.

1.14 QUALITY CONTROL

A. Contractor Responsibilities: Contractor will coordinate with testing firm to perform testing and inspection services.

B. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Any changes or deviations from the approved construction plans and specifications must be approved prior to commencing work on the change.

1.15 CONSTRUCTION STAKING

A. General: Contractor shall be responsible to engage a professional land surveyor to lay out the work using accepted surveying practices. The owner's Engineer, Ensign Engineering can provide this service at the contractor's expense upon request

1. Establish benchmarks and control points to set lines and levels at each site of construction and elsewhere as needed to locate each element of Project.

2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.

3. Check the location, level and plumb, of every major element as the Work progresses.

4. Notify Construction Manager when deviations from required lines and levels exceed allowable tolerances.

1.16 CONSTRUCTION WATER

A. The Contractor shall transport water, at their expense, from a fire hydrant at the Marina on the north side of Antelope Island or at a fire hydrant located by the Bridger Bay Restrooms. The State does not have a hydrant meter and will not need to measure the flow from the hydrant.

1.17 CONSTRUCTION TRAFFIC CONTROL

A. The Contractor shall provide a traffic control plan (as needed) and present it at the pre-construction conference.

1.18 EXCAVATED MATERIAL

A. Contractor shall strip topsoil and stockpile onsite for reuse on the project.

B. Contractor shall also stockpile rocks onsite for reuse on the project.

C. Contractor shall stockpile spoil material onsite for reuse as fill around campsites, restrooms, and any other areas requiring fill.

PART 2 – PRODUCTS

Not Applicable

PART 3 – EXECUTION

Not Applicable

END OF SECTION

SECTION 01 22 00 - MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section shall define the method to be used to measure and make payment for the work performed as described in the contract documents, technical specifications and design drawings, hereafter known as the PROJECT MANUAL.

1.2 DETAILS FOR PAYMENT OF BID ITEMS

A. General
   1. The amount of work to be done or materials to be furnished under the contract as noted in the Bid Schedule are estimates and are not to be taken as an expression or implied statement that the actual amount of work or materials will correspond to the estimate.
   2. The right is reserved to increase, decrease or entirely eliminate certain items from the work if found desirable or expedient, and the Contractor is cautioned against unbalancing of his bid by prorating his overhead and profit into one or two items only when there are a number of items on the bid. The overhead, indirect charges and profit shall be prorated on all items in the bid.
   3. The Contractor will be allowed no claims for anticipated profits, loss of profits or for damages because of any difference between the estimated and the actual amounts of work done, or materials furnished or used in the completed project.
   4. The Owner may order additions, deletions, or revisions to work. Credit or additions to bid items shall be allowed for any lump sum or unit price bid items based on the difference between the estimated and the actual amounts of work done, or materials furnished or used in the completed project.

B. Inclusions
   1. Payment for this schedule shall be at the unit price or lump sum as bid, which payment shall be full compensation for all required work necessary to complete this schedule as outlined in the PROJECT MANUAL.
   2. Unit prices and lump sum payments shall be considered full compensation for all direct and indirect costs, overhead, profit, insurance, bonds, taxes, fees, permits and for furnishing all materials, labor, equipment, tools and doing all work as shown on the project drawings, defined in the specifications and as stipulated herein. Bid prices shall include all protective and remedial measures to bring work into compliance with the PROJECT MANUAL.

1.3 BID ITEMS

A. BASE BID

Under this item the Contractor shall be paid the lump sum price bid as full compensation for all materials, labor, and equipment to complete the following work on the White Rock Bay Campground Project as noted in the project drawings and specifications:

1. Mobilization
2. Construction Traffic Control
3. Erosion Control and Re-Vegetation
4. Clear, Grub, and Grading for Improvements
5. Sawcut and Removal of Asphalt
6. Park Well Head Improvements
7. Well House Improvements
8. 300K Gallon Tank Improvements
9. Bridger Bay Campground Booster Pump Station Improvements
10. Large, Small, and Large Restroom Improvements
11. Furnish, Place, and Install Campsite Sewer Drops
12. Furnish, Place, and Install Water and Power Connections for Non-Accessible Campsites
13. Furnish, Place, and Install Water and Power Connections for Accessible Campsites
14. Furnish and Install Wastewater Treatment System
15. Furnish and Install Wastewater Drain Field
16. Furnish and Install Restroom Wastewater Lift Station
17. Furnish and Install 8-inch HDPE Sanitary Sewer Main
18. Furnish and Install 1 ¼-inch HDPE Sanitary Sewer Force Main
19. Furnish and Install 4-inch SDR-35 PVC Sewer Laterals
20. Furnish and Install 6-inch SDR-35 PVC Sewer Laterals
21. Furnish and Install Sanitary Sewer Precast Manholes
22. Furnish and Install Sanitary Sewer Cleanouts
23. Furnish, Place, and Install 8-inch HDPE Drinking Water Main
24. Furnish and Install Drinking Water Yard Hydrant Services to Campsites
25. Furnish and Install Water Tower Service at RV Dump Station
26. Furnish and Install Drinking Water Services for Restrooms
27. Furnish and Install Combination Air/Vac Station
28. Furnish and Install Electrical, Telemetry, and Controls for Site, Campsite, Restroom, Wastewater System, and Drinking Water System Improvements
29. Furnish, Place, and Install Concrete Curb
30. Furnish, Place, and Install Monolithic Curb
31. Furnish, Place, and Compact Asphalt Pavement on UTBC
32. Furnish, Place, and Install PCC Pavement on UTBC
33. Furnish, Place, and Install Sidewalk on UTBC
34. Furnish, Place, and Install Mid-Block Pedestrian Ramp
35. Furnish, Place, and Compact UTBC
36. Furnish, Place, and Install Bollards
37. Furnish and Install RV Dump Station
38. Install Group Site Pavilion
39. Install Accessible Campsite Amenities including Pavilion, Fire Pit, and Sidewalk
40. Install Non-Accessible Campsite Amenities including Pavilion, Fire Pit, and Sidewalk
41. Furnish, Place, and Install Single and Dual Trash Enclosures

42. Construct Pull Through Campsite
43. Construct Accessible Pull Through Campsite
44. Construction Double Back-in Campsite
45. Construct Back-in Campsite
46. Construct Accessible Back-in Campsite
47. Furnish, Place, and Install Signage and Striping
48. Permitting Coordination

The Contractor shall make his own determination of quantities required to complete the work. No additional payment will be made for work outside of the work listed in the base bid as shown on the project drawings.

B. ALTERNATE 1 – 300K GALLON TANK CHLORINE ANALYZER AND TANK MIXER

Under this item the Contractor shall be paid the lump sum price bid as full compensation for all materials, labor and equipment to complete the following work to install a tank mixer and chlorine analyzer at the 300K gallon tank by the Visitor Center as shown on the project drawings:

1. Mobilization
2. Erosion Control and Re-Vegetation
3. Clear, Grub, and Grading for Improvements
4. Chlorine Analyzer, Tubing, Hot Service Tap, Manhole, Control Panel, Fittings, and Appurtenances.
5. Tank Mixer, Wiring, Cable, Control Panel, Fittings, and Appurtenances.
6. Permitting Coordination

The Contractor shall make his own determination of quantities required to complete the work. No additional payment will be made for work outside of the work listed in Alternate 1 as shown on the project drawings.

C. ALTERNATE 2 – ASPHALT PAVEMENT FOR CAMPGROUND LOOP AND CAMPSITES

Under this item the Contractor shall be paid the lump sum price bid as full compensation for all materials, labor and equipment to complete the following work to asphalt pave the campground loop and campsites for the new White Rock Bay Campground as shown on the project drawings:

1. Mobilization
2. Construction Traffic Control
3. Erosion Control and Re-Vegetation
4. Clear, Grub, and Grading for Improvements
5. Furnish, Place, and Compact Asphalt Pavement on UTBC
6. Permitting Coordination

The Contractor shall make his own determination of quantities required to complete the work. No additional payment will be made for work outside of the work listed in Alternate 2 as shown on the project drawings.

D. ALTERNATE 3 – CONSTRUCT COVE ROAD

Under this item the Contractor shall be paid the lump sum price bid as full compensation for all materials, labor and equipment to complete the following work to construct the Cove Road as indicated on the project drawings:

1. Mobilization
2. Construction Traffic Control
3. Erosion Control and Re-Vegetation
4. Clear, Grub, and Grading for Improvements
5. Furnish, Place, and Compact UTBC
6. Rock Excavation
7. Permitting Coordination

The Contractor shall make his own determination of quantities required to complete the work. No additional payment will be made for work outside of the work listed in Alternate 3 as shown on the project drawings.

E. UNIT PRICES

The unit prices listed below are provided in case of an authorized adjustment to the scope of work listed in the Base Bid, Alternate 1 and Alternate 2.

1. BID ITEM NO. 1 – Back-in (Non-Accessible) Campsite
   a. Under this item the Contractor shall be paid the unit price bid as full compensation for all materials, labor and equipment to complete each back-in (non-accessible) Campsite for the White Rock Bay Campground:

      1) Mobilization
      2) Construction Traffic Control
      3) Erosion Control and Re-Vegetation
      4) Clear, Grub, and Grading for Improvements
      5) Furnish, Place, and Install Water and Power Connections for Non-Accessible Campsites
         Note: Because of the complexity of the feeder lines to the Campsite power pedestals the feeder line will be a separate unit price.
      6) Furnish and Install Drinking Water Yard Hydrant Services to Campsite
      7) Furnish and Install Electrical and Controls for Campsite
      8) Furnish, Place, and Install Sidewalk on UTBC
      9) Furnish, Place, and Compact UTBC
      10) Furnish, Place, and Install Bollards
      11) Furnish and Install Non-Accessible Campsite Amenities including Concrete Pad, Pavilion, Fire Pit, and Sidewalk
      12) Construct Back-in Campsite
      13) Furnish, Place, and Install Campsite Marker Post
      14) Permitting Coordination

The Contractor shall make his own determination of quantities required to complete the work.

2. BID ITEM NO. 2 – Pull Through (Non-Accessible) Campsite
   a. Under this item the Contractor shall be paid the unit price bid as full compensation for all materials, labor and equipment to complete each pull through (non-accessible) Campsite for the White Rock Bay Campground:

      1) Mobilization
      2) Construction Traffic Control
      3) Erosion Control and Re-Vegetation
      4) Clear, Grub, and Grading for Improvements
      5) Furnish, Place, and Install Water and Power Connections for Non-Accessible Campsites
         Note: Because of the complexity of the feeder lines to the Campsite power pedestals the feeder line will be a separate unit price.
      6) Furnish and Install Drinking Water Yard Hydrant Services to Campsite
      7) Furnish, Place, and Compact Asphalt Pavement on UTBC
      8) Furnish, Place, and Install Sidewalk on UTBC
      9) Furnish, Place, and Compact UTBC
      10) Furnish, Place, and Install Bollards
      11) Furnish and Install Non-Accessible Campsite Amenities including Concrete Pad, Pavilion, Fire Pit, and Sidewalk
      12) Construct Pull Through Campsite
      13) Furnish, Place, and Install Campsite Marker Post
      14) Permitting Coordination

   The Contractor shall make his own determination of quantities required to complete the work.

3. BID ITEM NO. 3 – Campsite Sanitary Sewer Service including Maintenance Accessible Sewer Drop
   a. Under this item the Contractor shall be paid the unit price bid as full compensation for all materials, labor and equipment to complete each campsite sanitary sewer service with maintenance accessible sewer drop for the White Rock Bay Campground:

      1) Mobilization
      2) Construction Traffic Control
      3) Erosion Control and Re-Vegetation
      4) Clear, Grub, and Grading for Improvements
      5) Furnish, Place, and Install Sewer Service Connections with Associated Pipe, Fittings, Maintenance Accessible Sewer Drop, and Appurtenances.
      6) Permitting Coordination

   The Contractor shall make his own determination of quantities required to complete the work.

4. BID ITEM NO. 4 – Small Restroom
   a. Under this item the Contractor shall be paid the unit price bid as full compensation for all materials, labor and equipment to complete each small restroom for the White Rock Bay Campground:

      1) Mobilization
      2) Construction Traffic Control
      3) Erosion Control and Re-Vegetation
      4) Clear, Grub, and Grading for Improvements
      5) Furnish, Place, and Install Water, Sewer, and Power Connections for Restrooms
         Note: Because of the complexity of the feeder lines to the restrooms the feeder line will be a separate unit price.
      6) Furnish, Place, and Install Sidewalk on UTBC
      7) Furnish, Place, and Install Concrete Pavement on UTBC
      8) Furnish, Place, and Compact UTBC
      9) Restroom Structure and Amenities
      10) Furnish and Install Mechanical, Plumbing, Electrical, and Controls for Restroom
      11) Striping and Signage
      12) Permitting Coordination

      The Contractor shall make his own determination of quantities required to complete the work.

5. BID ITEM NO. 5 – 3-inch Schedule 40 PVC Conduit
   a. Under this item the Contractor shall be paid the unit price bid as full compensation for each linear foot (L.F.) installed of 3-inch Schedule 40 PVC Conduit. The unit price bid shall also include all labor, equipment, and materials to perform the job.

6. BID ITEM NO. 6 – 2-inch Schedule 40 PVC Conduit
   a. Under this item the Contractor shall be paid the unit price bid as full compensation for each linear foot (L.F.) installed of 2-inch Schedule 40 PVC Conduit. The unit price bid shall also include all labor, equipment, and materials to perform the job.

7. BID ITEM NO. 7 – #10 THHN/THWN Copper Stranded Wire
   a. Under this item the Contractor shall be paid the unit price bid as full compensation for each one hundred linear foot (C.L.F.) installed of #10 THHN/THWN Copper Stranded Wire. The unit price bid shall also include all labor, equipment, and materials to perform the job.

8. BID ITEM NO. 8 – #8 THHN/THWN Copper Stranded Wire
   a. Under this item the Contractor shall be paid the unit price bid as full compensation for each one hundred linear foot (C.L.F.) installed of #8 THHN/THWN Copper Stranded Wire. The unit price bid shall also include all labor, equipment, and materials to perform the job.

9. BID ITEM NO. 9 – #6 THHN/THWN Copper Stranded Wire
    a. Under this item the Contractor shall be paid the unit price bid as full compensation for each one hundred linear foot (C.L.F.) installed of #6 THHN/THWN Copper Stranded Wire. The unit price bid shall also include all labor, equipment, and materials to perform the job.

10. BID ITEM NO. 10 – #4 THHN/THWN Copper Stranded Wire
    a. Under this item the Contractor shall be paid the unit price bid as full compensation for each one hundred linear foot (C.L.F.) installed of #4 THHN/THWN Copper Stranded Wire. The unit price bid shall also include all labor, equipment, and materials to perform the job.

11. BID ITEM NO. 11 – #3 THHN/THWN Copper Stranded Wire
    a. Under this item the Contractor shall be paid the unit price bid as full compensation for each one hundred linear foot (C.L.F.) installed of #3 THHN/THWN Copper Stranded Wire. The unit price bid shall also include all labor, equipment, and materials to perform the job.

12. BID ITEM NO. 12 – #2 THHN/THWN Copper Stranded Wire
    a. Under this item the Contractor shall be paid the unit price bid as full compensation for each one hundred linear foot (C.L.F.) installed of #2 THHN/THWN Copper Stranded Wire. The unit price bid shall also include all labor, equipment, and materials to perform the job.

13. BID ITEM NO. 13 – #1 THHN/THWN Copper Stranded Wire
    a. Under this item the Contractor shall be paid the unit price bid as full compensation for each one hundred linear foot (C.L.F.) installed of #1 THHN/THWN Copper Stranded Wire. The unit price bid shall also include all labor, equipment, and materials to perform the job.

14. BID ITEM NO. 14 – #2/0 THHN/THWN Copper Stranded Wire
    a. Under this item the Contractor shall be paid the unit price bid as full compensation for each one hundred linear foot (C.L.F.) installed of #2/0 THHN/THWN Copper Stranded Wire. The unit price bid shall also include all labor, equipment, and materials to perform the job.

15. BID ITEM NO. 15 – #3/0 THHN/THWN Copper Stranded Wire
    a. Under this item the Contractor shall be paid the unit price bid as full compensation for each one hundred linear foot (C.L.F.) installed of #3/0 THHN/THWN Copper Stranded Wire. The unit price bid shall also include all labor, equipment, and materials to perform the job.

16. BID ITEM NO. 16 – #4/0 THHN/THWN Copper Stranded Wire
    a. Under this item the Contractor shall be paid the unit price bid as full compensation for each one hundred linear foot (C.L.F.) installed of #4/0 THHN/THWN Copper Stranded Wire. The unit price bid shall also include all labor, equipment, and materials to perform the job.

17. BID ITEM NO. 17 – #250 THHN/THWN Copper Stranded Wire
    a. Under this item the Contractor shall be paid the unit price bid as full compensation for each one hundred linear foot (C.L.F.) installed of #250 THHN/THWN Copper Stranded Wire. The unit price bid shall also include all labor, equipment, and materials to perform the job.

18. BID ITEM NO. 18 – #350 THHN/THWN Copper Stranded Wire
    a. Under this item the Contractor shall be paid the unit price bid as full compensation for each one hundred linear foot (C.L.F.) installed of #350 THHN/THWN Copper Stranded Wire. The unit price bid shall also include all labor, equipment, and materials to perform the job.

PART 2 - PRODUCTS

Not applicable

PART 3 – EXECUTION

Not applicable

END OF SECTION

SECTION 01 33 00 – SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Requirements:
   1. Section 01 78 23 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
   2. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action.

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

1.3 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Engineer and additional time for handling and reviewing submittals required by those corrections.

B. Construction Schedule: Within fourteen (14) days after the date of Notice to Proceed, the Contractor shall submit a construction schedule providing the starting and completion dates of the various stages of the Work. The Contractor shall be prepared to discuss its construction schedule at the pre-construction conference.

C. Schedule of Values or lump sum price breakdown: Within fourteen (14) days after the date of Notice to Proceed, the Contractor shall submit a schedule of values or lump sum price breakdown for progress payment purposes.

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Engineer's Digital Data Files: Electronic copies of digital data files of the Contract Drawings will be provided by Engineer for Contractor's use in preparing submittals.

1. Engineer will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings.

    a. Engineer makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
    b. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Engineer.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Engineer and the Contractor reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow fifteen (15) days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow fifteen (15) days for review of each resubmittal.

D. Paper Submittals: Place a permanent label or title block on each submittal item for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Include the following information for processing and recording action taken:

    a. Project name.
    b. Date.
    c. Name of Engineer.
    d. Name of Construction Manager.
    e. Name of Contractor.
    f. Name of subcontractor.
    g. Name of supplier.
    h. Name of manufacturer.
    i. Submittal number or other unique identifier, including revision identifier.

        1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals

shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).

j. Number and title of appropriate Specification Section.
k. Drawing number and detail references, as appropriate.
l. Location(s) where product is to be installed, as appropriate.
m. Other necessary identification.

3. Paper Copies: Unless additional copies are required for final submittal, and unless Engineer observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

a. Submit four (4) copies of submittal to the Resident Engineer for review.

4. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Engineer will return without review submittals received from sources other than Contractor.

a. Transmittal Form for Paper Submittals: Use facsimile of sample form included in Project Manual.
b. Transmittal Form for Paper Submittals: Provide locations on form for the following information:

1) Project name.
2) Date.
3) Destination (To:).
4) Source (From:).
5) Name and address of Engineer.
6) Name of Construction Manager.
7) Name of Contractor.
8) Name of firm or entity that prepared submittal.
9) Names of subcontractor, manufacturer, and supplier.
10) Category and type of submittal.
11) Submittal purpose and description.
12) Specification Section number and title.
13) Specification paragraph number or drawing designation and generic name for each of multiple items.
14) Drawing number and detail references, as appropriate.
15) Indication of full or partial submittal.
16) Transmittal number.
17) Submittal and transmittal distribution record.
18) Remarks.
19) Signature of transmitter.

E. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.

2. Name file with submittal number or other unique identifier, including revision identifier.

    a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Engineer.

4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner**,** containing the following information:

    a. Project name.
    b. Date.
    c. Name and address of Engineer.
    d. Name of Construction Manager.
    e. Name of Contractor.
    f. Name of firm or entity that prepared submittal.
    g. Names of subcontractor, manufacturer, and supplier.
    h. Category and type of submittal.
    i. Submittal purpose and description.
    j. Specification Section number and title.
    k. Specification paragraph number or drawing designation and generic name for each of multiple items.
    l. Drawing number and detail references, as appropriate.
    m. Location(s) where product is to be installed, as appropriate.
    n. Related physical samples submitted directly.
    o. Indication of full or partial submittal.
    p. Transmittal number.
    q. Submittal and transmittal distribution record.
    r. Other necessary identification.
    s. Remarks.

5. Metadata: Include the following information as keywords in the electronic submittal file metadata:

    a. Project name.
    b. Number and title of appropriate Specification Section.
    c. Manufacturer name.
    d. Product name.

F. Options: Identify options requiring selection by Engineer or Owner.

G. Deviations: Identify deviations from the Contract Documents on submittals.

H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.

3. Resubmit submittals until they are marked with approval notation from Engineer's action stamp.

I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements:

1. Action Submittals: Submit four (4) paper copies of each submittal unless otherwise indicated. Engineer will return three (3) copies.
2. Informational Submittals: Submit two paper copies of each submittal unless otherwise indicated. Engineer will not return copies.
3. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

    a. Provide a digital signature with digital certificate on electronically-submitted certificates and certifications where indicated.
    b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

    a. Manufacturer's catalog cuts.
    b. Manufacturer's product specifications.
    c. Standard color charts.
    d. Statement of compliance with specified referenced standards.
    e. Testing by recognized testing agency.
    f. Application of testing agency labels and seals.
    g. Notation of coordination requirements.
    h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

a. Wiring diagrams showing factory-installed wiring.
b. Printed performance curves.
c. Operational range diagrams.
d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in the following format:

a. Four (4) paper copies of Product Data unless otherwise indicated. Engineer will return three (3) copies.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

a. Identification of products.
b. Schedules.
c. Compliance with specified standards.
d. Notation of coordination requirements.
e. Notation of dimensions established by field measurement.
f. Relationship and attachment to adjoining construction clearly indicated.
g. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
3. Submit Shop Drawings in the following format:

a. Two opaque (bond) copies of each submittal. Engineer will return one copy.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:

a. Generic description of Sample.
b. Product name and name of manufacturer.
c. Sample source.
d. Number and title of applicable Specification Section.

3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

a. Number of Samples: Submit two (2) full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Engineer will return submittal with options selected.

6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

a. Number of Samples: Submit two (2) sets of Samples. Engineer will retain one (1) Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record sample.

1) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Submit product schedule in the following format:

a. Four (4) paper copies of product schedule or list unless otherwise indicated. Engineer will return three (3) copies.

F. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 40 00 "Quality Requirements."

G. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 77 00 "Closeout Procedures."

H. Maintenance Data: Comply with requirements specified in Section 01 78 23 "Operation and Maintenance Data."

I. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of engineers and owners, and other information specified.

J. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

K. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

L. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

M. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

N. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

O. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

P. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

Q. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.

R. Schedule of Tests and Inspections: Comply with requirements specified in Section 01 40 00 "Quality Requirements."

S. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

T. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

U. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

V. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads.

Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit three (3) paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.

B. Project Closeout and Maintenance Material Submittals: See requirements in Section 01 77 00 "Closeout Procedures."

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents. In the case of shop drawings, each sheet shall be so dated, signed and certified.

3.2 ENGINEER'S ACTION

A. General: Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Engineer will review each submittal, make marks to indicate corrections or revisions required, and return it. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:

1. "NO EXCEPTIONS TAKEN" or "EXCEPTIONS AS NOTED" will require no formal revision and resubmission.

2. "REVISE AND RESUBMIT" or "REJECTED" will require the Contractor to revise said submittal and shall resubmit the required number of copies of said revised submittal to the Engineer.

C. Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Engineer will forward each submittal to appropriate party.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

F. Fabrication of an item shall commence only after the Engineer has reviewed the submittal and returned copies to the Contractor marked either "NO EXCEPTIONS TAKEN" or "EXCEPTIONS AS NOTED". Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as the basis of claims for extra work.

END OF SECTION

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
2. Requirements for Contractor to provide quality-assurance and -control services required by Engineer, Owner, Construction Manager, or authorities having jurisdiction are not limited by provisions of this Section.
3. Specific test and inspection requirements are not specified in this Section.

1.2 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Engineer or Construction Manager.

C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1. Laboratory Mockups: Full-size physical assemblies constructed at testing facility to verify performance characteristics.

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.

G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five (5) previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Engineer for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

1.4 INFORMATIONAL SUBMITTALS

A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Engineer.

2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Engineer.

B. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

1.5 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Field Reports: Prepare written information documenting tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
5. Other required items indicated in individual Specification Sections.

C. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.6 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Manufacturer's Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:

a. Provide test specimens representative of proposed products and construction.
b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
c. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.

d. When testing is complete, remove test specimens, assemblies, and mockups, and laboratory mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Engineer, through Construction Manager, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Engineer or Construction Manager.
2. Notify Engineer and Construction Manager seven (7) days in advance of dates and times when mockups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Engineer's and Construction Manager's approval of mockups before starting work, fabrication, or construction.

a. Allow seven (7) days for initial review and each re-review of each mockup.

5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed unless otherwise indicated.

K. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.

1.7 QUALITY CONTROL

A. Owner Responsibilities: The Owner will only provide testing and inspections by a 3rd party testing and inspection firm if Contractor fails to meet testing and inspection requirements.

1. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.

B. Contractor Responsibilities: Tests and inspections are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Engage a qualified testing agency to perform these quality-control services.
2. Retain first subparagraph below to assure validity of agencies' reports.
3. Notify testing agencies at least twenty-four (24) hours in advance of time when Work that requires testing or inspecting will be performed.
4. Submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.

6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a manufacturer's representative to observe and inspect the Work. Manufacturer's representative's services include examination of substrates and conditions, verification of materials, inspection of completed portions of the Work, and submittal of written reports.

D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

E. Testing Agency Responsibilities: Cooperate with Engineer, Construction Manager, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Engineer, Construction Manager, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.8 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Contractor, as indicated in Statement of Special Inspections attached to this Section, and as follows:

B. Special Tests and Inspections: Conducted by a qualified special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections and in Statement of Special Inspections attached to this Section, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
2. Notifying Engineer, Construction Manager, and Owner promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Engineer, through Construction Manager, with copy to Owner and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Engineer.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Engineer's and Construction Manager's reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

SECTION 01 42 14 – ABBREVIATIONS AND REFERENCE STANDARDS

PART 1 - GENERAL

1.1 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Engineer's action on Contractor's submittals, applications, and requests, "approved" is limited to Engineer's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Engineer. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

D. All work specified herein shall conform to or exceed the requirements of the referenced specifications, codes and standards to the extent that the provisions of such documents are not in conflict with the requirements of these Specifications.

E. References herein to "Building Code" or IBC shall mean the International Building Code of the International Conference of Building Officials (ICBO). The latest edition of the code, as of the date of award, as approved and adopted by the agency having jurisdiction, including all addenda, modifications, amendments or other lawful changes thereto, shall apply to the Work.

F. In case of conflict between codes, reference standards, drawings and the other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the Engineer for clarification and directions prior to ordering or providing any materials or labor. The Contractor shall bid the most stringent requirements.

G. Applicable Standard Specifications: The Contractor shall construct the Work specified herein in accordance with the requirements of the Contract Documents and the referenced portions of those referenced codes, standards and specifications listed herein; except, that wherever references to "Standard Specifications" are made, the provisions therein for measurement and payment shall not apply.

H. References herein to "OSHA Regulations for Construction" shall mean Title 29, Part 1926, Construction Safety and Health Regulations, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

I. References herein to "OSHA Standards" shall mean Title 29, Part 1910, Occupational Safety and Health Standards, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

J. References in the Contract Documents to "Standard Specifications" shall mean the "Manual of Standard Specifications as Published by the American Public Works Association, Nevada Chapter" including all current supplements, addenda and revisions thereof.

1.3 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

AA	Aluminum Association
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute (Formerly: ACI International)
ACPA	American Concrete Pipe Association
AGA	American Gas Association
AGC	Associated General Contractors
AHRI	Air-Conditioning, Heating, and Refrigeration Institute (The)
AI	Asphalt Institute
AIA	American Institute of Architects (The)
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Movement and Control Association International, Inc.
ANSI	American National Standards Institute
APA	APA - The Engineered Wood Association
APA	Architectural Precast Association
API	American Petroleum Institute
APWA	American Public Works Association
ASA	Acoustical Society of America
ASAE	American Society of Agriculture Engineer
ASCE	American Society of Civil Engineers
ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute (See ASCE)
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASLE	American Society of Lubricating Engineers
ASME	American Society of Mechanical Engineers
ASQC	American Society for Quality Control
ASSE	American Society of Safety Engineers (The)
ASSE	American Society of Sanitary Engineering
ASTM	American Society for Testing and Materials International
ATIS	Alliance for Telecommunications Industry Solutions
AWPA	American Wood Protection Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Industry Association (The)
BOCA	BOCA (Building Officials and Code Administrators International Inc.)
CDA	Copper Development Association
CGA	Compressed Gas Association
CLFMI	Chain Link Fence Manufacturers Institute
CMA	Concrete Masonry Association
CPA	Composite Panel Association
CRSI	Concrete Reinforcing Steel Institute
DASMA	Door and Access Systems Manufacturers Association
DHI	Door and Hardware Institute
ETL	Electrical Test Laboratories
GA	Gypsum Association
GANA	Glass Association of North America
HI	Hydraulic Institute
HMMA	Hollow Metal Manufacturers Association (See NAAMM)

HPVA	Hardwood Plywood & Veneer Association
ICBO	International Conference of Building Officials (See ICC)
ICC	International Code Council
ICEA	Insulated Cable Engineers Association, Inc.
ICPA	International Cast Polymer Alliance
ICRI	International Concrete Repair Institute, Inc.
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The)
IES	Illuminating Engineering Society
IPC	Institute of Printed Circuits
IPCEA	Insulated Power Cable Engineers Association
ISA	International Society of Automation
ISO	International Organization for Standardization
LPI	Lightning Protection Institute
MBMA	Metal Building Manufacturers Association
MCA	Metal Construction Association
MHIA	Material Handling Industry of America
MPI	Master Painters Institute
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc.
NAAMM	National Association of Architectural Metal Manufacturers
NACE	NACE International (National Association of Corrosion Engineers International)
NAIMA	North American Insulation Manufacturers Association
NBS	National Bureau of Standards
NCMA	National Concrete Masonry Association
NEC	National Electrical Code
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturers Association
NFPA	NFPA (National Fire Protection Association)
NFPA	National Forest Products Association
NFRC	National Fenestration Rating Council
NHLA	National Hardwood Lumber Association
NLGI	National Lubricating Grease Institute
NRCA	National Roofing Contractors Association
NRMCA	National Ready Mixed Concrete Association
NSF	NSF International (National Sanitation Foundation International)
NSPE	National Society of Professional Engineers
NSSGA	National Stone, Sand & Gravel Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Precast/Prestressed Concrete Institute
PDI	Plumbing & Drainage Institute
SDI	Steel Door Institute
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers (See ASCE)
SJI	Steel Joist Institute
SMA	Screen Manufacturers Association
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SPFA	Spray Polyurethane Foam Alliance
SPRI	Single Ply Roofing Industry
SSPC	Society for Protective Coatings
SSPC	Steel Structures Painting Council
SSPWC	Standard Specifications for Public Works Construction
SWPA	Submersible Wastewater Pump Association

UBC	Uniform Building Code (See ICC)
UL	Underwriters Laboratories Inc.
WASTEC	Waste Equipment Technology Association
WCRSI	Western Concrete Reinforcing Steel Institute
WDMA	Window & Door Manufacturers Association
WRI	Wire Reinforcement Institute, Inc.
WWPA	Western Wood Products Association

C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

COE	Army Corps of Engineers
CPSC	Consumer Product Safety Commission
DOC	Department of Commerce
DOD	Department of Defense
DOE	Department of Energy
EPA	Environmental Protection Agency
FG	Federal Government Publications
GSA	General Services Administration
HUD	Department of Housing and Urban Development
OSHA	Occupational Safety & Health Administration
SD	Department of State
TRB	Transportation Research Board
USDA	Department of Agriculture
USDJ	Department of Justice
USPS	United States Postal Service

END OF SECTION

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:

1. Section 01 11 00 "Summary of Work" for work restrictions and limitations on utility interruptions.

1.2 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Engineer, occupants of Project, testing agencies, and authorities having jurisdiction.

B. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.3 INFORMATIONAL SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire prevention program.

1.4 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.5 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts.

B. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top and bottom rails. Provide galvanized-steel bases for supporting posts.

C. Wood Enclosure Fence: Plywood, 6 feet high, framed with four 2-by-4-inch rails, with preservative-treated wood posts spaced not more than 8 feet apart.

2.2 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Engineer, Construction Manager, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly.

C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures. The Contractor shall provide fire extinguishers and other fire protection equipment to adequately protect new and existing facilities and temporary facilities against damage by fire. Hose connections and hose, water casks, chemical equipment or other sufficient means shall be provided for fighting fires in the new, existing and temporary

structures and other portions of the Work and responsible persons shall be designated and instructed in the operation of such fire apparatus so as to prevent or minimize the hazard of fire. The Contractor's fire protection program shall conform to the requirements of the OSHA Standards for Construction. The Contractor shall employ every reasonable means to prevent the hazard of fire.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 01 77 00 "Closeout Procedures".

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

1. Locate facilities to limit site disturbance as specified in Section 01 11 00 "Summary of Work."

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

1. The Contractor shall provide an adequate supply of water of a quality suitable for all domestic and construction purposes. Utility or plant effluent water may be used for hydraulic structures and pipeline testing as approved by the Engineer. Potable water up to 5,000 gallons per month will be furnished by the Owner without charge. Quantities of potable water over 5,000 gallons per month shall be paid for by the Contractor.

2. All drinking water on the site during construction shall be furnished by the Contractor and shall be bottled water or water furnished in approved metal dispensers unless specified in Section 011000 – Summary of Work. Notices shall be posted conspicuously throughout the site warning the Contractor's personnel that piped water may be contaminated.

3. The Contractor shall not make connection to, or draw water from, any fire hydrant or pipeline without first obtaining permission of the authority having jurisdiction over the use of said fire hydrant or pipeline and from the agency owning the water system. For each such connection made the Contractor shall first attach to the fire hydrant or pipeline a valve, backflow preventer and a meter, if required by the said authority, of a size and type acceptable to said authority and agency.

4. Before final acceptance of the Work all temporary water connections and piping installed by the Contractor shall be entirely removed, and all affected improvements shall be restored to their original condition, or better, to the satisfaction of the Engineer and to the agency owning the affected utility.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

1. Toilets: Fixed or portable chemical toilets shall be provided wherever needed for the use of employees. Toilets at construction job sites shall conform to the requirements of Subpart D, Section 1926.51 of the OSHA Standards for Construction. The Owner's toilet facilities shall <u>not</u> be used by the Contractor's work force.

2. The Contractor shall establish adequate and regular collection of all sanitary and organic wastes. All wastes and refuse from sanitary facilities provided by the Contractor or organic material wastes from any other source related to the Contractor's operations shall be disposed of in a manner satisfactory to the Engineer and in accordance with all laws and regulations pertaining thereto. Contractor may install temporary piping for toilet facilities to discharge into the incoming sewer.

E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

G. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.

H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

I. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line(s) for each field office. The Owner's telephone system shall not be used by the Contractor's work force.

1. Provide additional telephone lines for the following:

a. Provide a dedicated telephone line for each facsimile machine in each field office.

2. At each telephone, post a list of important telephone numbers.

a. Police and fire departments.
b. Ambulance service.
c. Contractor's home office.
d. Contractor's emergency after-hours telephone number.
e. Engineers' offices.
f. Owner's office.
g. Principal subcontractors' field and home offices.

3. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

J. Electronic Communication Service: Provide a computer in the primary field office adequate for use by Engineer and Owner to access project electronic documents and maintain electronic communications.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
2. Maintain support facilities until Engineer schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas as indicated on Drawings.

1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

C. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

D. Parking: Use designated areas of Owner's existing parking areas for construction personnel.

E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated on Drawings.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

a. Provide temporary, directional signs for construction personnel and visitors.

3. Maintain and touchup signs so they are legible at all times.

G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction.

H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

I. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

J. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.

1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.

K. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings.

D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.

G. Site Enclosure Fence: Prior to commencing earthwork, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.

H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.

I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

J. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.

L. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner and tenants from fumes and noise.

1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
2. Construct dustproof partitions with two layers of 6-mil polyethylene sheet on each side. Cover floor with two layers of 6-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant-treated plywood.

    a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches between doors. Maintain water-dampened foot mats in vestibule.

3. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
4. Insulate partitions to control noise transmission to occupied areas.
5. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
6. Protect air-handling equipment.
7. Provide walk-off mats at each entrance through temporary partition.

M. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire prevention program.

1. Prohibit smoking in construction areas.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 MOISTURE AND MOLD CONTROL

A. Contractor's Moisture Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.

B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect materials from water damage and keep porous and organic materials from coming into prolonged contact with concrete.

C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Discard or replace water-damaged and wet material.
4. Discard, replace, or clean stored or installed material that begins to grow mold.
5. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.6 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 77 00 "Closeout Procedures."

END OF SECTION

SECTION 015300 – PROTECTION OF EXISTING FACILITIES

PART 1 - GENERAL

1.1 GENERAL

A. The Contractor shall protect all existing utilities, piping and improvements not designated for removal and shall restore damaged or temporarily relocated utilities, piping and improvements to a condition equal to or better than they were prior to such damage or temporary relocation.

B. The Contractor shall verify the exact locations and depths of all underground piping and utilities shown and not shown and shall make exploratory excavations of all piping and utilities that may interfere with the Work. It shall be the Contractor's responsibility to ascertain the actual location of all existing utilities, piping and other improvements that will be encountered in its construction operations and to see that such utilities or other improvements are adequately protected from damage due to such operations.

C. Maintaining in Service: All pipelines, electrical, power, telephone, communication cables, gas and water mains shall remain continuously in service during all the operations under the Contract, unless other arrangements satisfactory to the Engineer are made with the Owner. Where the proper completion of the Work requires the temporary or permanent removal and/or relocation of an existing utility or other improvement the Contractor, after necessary scheduling and approval, shall remove and, without unnecessary delay, temporarily replace or relocate such utility or improvement in a manner satisfactory to the Engineer and the owner of the facility. In all cases of such temporary removal or relocation, the Work shall be accomplished by the Contractor in a manner that will restore or replace the utility or improvement to a new condition meeting the specification requirements.

D. All repairs to a damaged utility or improvement are subject to inspection and approval by an authorized representative of the improvement owner before being concealed by backfill or other work.

1.2 RIGHTS-OF-WAY

A. The Contractor shall not do any work or enter upon the rights-of-way of any oil, gas, sewer or water pipeline; any telephone or electric transmission line; any fence; or any other structure, until notified by the Engineer that the Owner has secured authority to do so. After authority has been obtained, the Contractor shall give the governing utility proper advanced notice of its intention to begin work.

1.3 RESTORATION OF PAVEMENT AND SIDEWALKS

A. All paved areas and sidewalks not designated for replacement, cut or damaged during construction shall be replaced with similar materials and of equal thickness to match the existing adjacent undisturbed areas unless otherwise noted. All sidewalks and pavements which are subject to partial removal shall be neatly saw-cut in straight lines.

1.4 UNDERGROUND UTILITIES NOT SHOWN OR INDICATED

A. If the Contractor damages existing utilities, piping or improvements that are not shown or the location of which was not made known to the Contractor prior to excavation and the damage was not due to failure of the Contractor to exercise reasonable care the Contractor shall immediately notify the Engineer. If directed by the Engineer repairs shall be made by the Contractor under the provisions for changes and extra work contained in Articles 13, 14 and 15 of the General Conditions.

1.5 NOTIFICATION BY THE CONTRACTOR:

A. Prior to any excavation in the vicinity of any existing underground facilities, including water, sewer, storm drain, gas, petroleum products, or other pipelines; all buried electric power, communications or telecommunication cables; all traffic signal and street lighting facilities; and all roadway and state highway rights-of-way, the Contractor shall notify the respective authorities representing the owners or agencies responsible for such facilities not less than three (3) working days prior to excavation so that a representative can be present during such work if they are required to do so.

PART 2 – PRODUCTS

Not Applicable

PART 3 - EXECUTION

Not Applicable

END OF SECTION 015300

SECTION 01 57 19 – TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 - GENERAL

1.1 DUST ABATEMENT AND RUBBISH CONTROL

A. The Contractor shall provide under the Contract all necessary measures to prevent its operation from producing dust in amounts damaging to property or causing a nuisance to Owner's plant personnel and operations or to persons living in or occupying buildings in the vicinity. The Contractor shall be responsible for damage resulting from any dust originating from its operations. The dust abatement measurers shall be continued throughout the length of the contract.

B. During the progress of the Work the Contractor shall keep the site of the Work and other areas used by it in a neat and clean condition and free from any accumulation of rubbish. The Contractor shall dispose of all rubbish and waste materials of any nature occurring at the Work site, and shall establish regular intervals of collection and disposal of such materials and waste. The Contractor shall also keep its haul roads free from dirt, rubbish and unnecessary obstructions resulting from its operations. Disposal of all rubbish and surplus materials shall be off the site of construction in accordance with local codes and ordinances governing locations and methods of disposal and in conformance with all applicable Safety Laws and Health Standards for Construction. The Owner's dumpster shall not be used by the Contractor.

1.2 SANITATION

A. The Contractor shall provide approved fixed or portable chemical toilets wherever needed for its employees. The Contractor shall establish regular intervals of collection of all sanitary and organic wastes. All wastes and refuse from sanitary facilities provided by the Contractor or organic material wastes from any other source related to the Contractor's operations shall be disposed of in a manner satisfactory to the Engineer and in accordance with all laws and regulations pertaining thereto. The Owner's toilet facilities shall not be used by the Contractor.

1.3 CHEMICALS

A. All chemicals used during project construction or furnished for project operation, whether soil sterilant, herbicide, pesticide, disinfectant, polymer, and reactant, or of other classification, shall show approval for use by either the U. S. Environmental Protection Agency or the U. S. Department of Agriculture. Use of all such chemicals and disposal of residues shall be in strict accordance with the printed instructions of the manufacturer.

1.4 CULTURAL RESOURCES

A. Contractor to contact Carl Aldrich with Antelope Island State Park, 801-927-0545, prior to any excavation or disturbance work for construction monitoring.

B. Existing burrows to be collapsed outside of the migratory bird nesting season. Antelope Island State Park staff to build artificial burrows to offset the loss of the collapsed burrows. Construction after March 1st will require SWCA or Antelope Island State Park staff to provide a biological monitor during active construction to monitor any migratory birds that begin nesting near the project, including the burrowing owl. The Contractor shall coordinate with the biological monitor during construction.

C. The Contractor's attention is directed to the National Historic Preservation Act of 1966 (16 U.S.C. 470) and 36 CFR 800 which provides for the preservation of potential historical architectural, archeological or cultural resources (hereinafter called "cultural resources"). If potential cultural resources are discovered during subsurface excavations at the site of construction, the following procedures shall be instituted:
   1. The Contractor shall immediately notify the Engineer.
   2. The Engineer will issue a Field Order directing the Contractor to cease all construction operations at the location of such potential cultural resources find.
   3. Such Field Order shall be effective until such time as a qualified archeologist can be called to assess the value of these potential cultural resources and make recommendations to the State Historical Society Archeologist.

D. If the archeologist determines that the potential find is a bona fide cultural resource, at the direction of the State Historical Society Archeologist, the Contractor shall suspend work at the location of the find under the provisions for changes contained in Articles 13, 14 and 15 of the General Conditions.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

Not Applicable

END OF SECTION

SECTION 01 67 13 – EQUIPMENT TESTING AND START-UP

PART 1 - GENERAL

1.1 GENERAL

A. Equipment testing and startup are required for satisfactory completion of the contract and shall be scheduled and completed within the contract time.

1.2 EQUIPMENT TESTING

A. Contractor Furnished & Installed Equipment

1. The Contractor shall provide the services of an experienced and authorized representative of the manufacturer of each item of equipment indicated in the equipment schedules that shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. The Contractor shall have the manufacturer's representative revisit the Work site as often as necessary until any and all problems are corrected. The Contractor shall require that each manufacturer's representative furnish to the Engineer a written report addressed to the Owner certifying that the equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchor bolts and has been operated satisfactorily under full-load conditions.

2. The Contractor shall be responsible for scheduling all operations testing. The Contractor shall furnish all personnel, power, water, chemicals, fuel, oil, grease and all other necessary equipment, facilities and services required for conducting the tests. The Contractor is advised that the Engineer and the Owner's operating personnel will witness operations testing and that the manufacturer's representative shall be required to instruct the Owner's operating personnel in correct operation and maintenance procedures. This instruction shall be scheduled with the Engineer and the Owner at least ten (10) days in advance and shall be provided while the equipment is fully operational. The Contractor shall have previously furnished the technical manuals required under Section 01 33 00 entitled, "Submittal Procedures".

B. Owner Furnished / Contractor Installed Equipment

1. The Contractor shall notify the Engineer when Owner furnished equipment is completely installed in accordance with the Owner furnished manufacturer's instructions and requirements of the Contract Documents and ready for operational testing. The Engineer will schedule the manufacturer's representative to visit the site of the Work and inspect, check, adjust if necessary and approve the equipment installation. If the manufacturer's representative cannot complete the testing and startup services due to the Contractor's negligence in installing the equipment, the Contractor shall be responsible for the costs of the service representatives' revisit to the site of the Work.

C. Owner Furnished & Installed Equipment

1. The Contractor shall not be held responsible for the completion, start-up or operation of Owner furnished and installed equipment except to the extent that delays and/or problems arise from contractor negligence, improper installation of associated appurtenances installed by the contractor, or otherwise improper workmanship.

1.3 STARTUP

A. The startup of the equipment is a coordinating operation requiring the combined technical expertise of the Contractor, suppliers, Engineer and the Owner. The Contractor shall provide the effective coordination of all parties necessary for successful plant, facilities and equipment startup.

B. The Contractor shall be required to startup and operate the various pieces of equipment for a continuous seven (7) day period under coordination direction of the Engineer and Owner. The start-up shall not be commenced until all required leakage tests, disinfection and equipment tests have been completed to the satisfaction of the Engineer.

C. All defects in materials or workmanship which appear during this test period shall be immediately corrected by the Contractor. The Contractor shall provide the services of authorized representatives of the manufacturer, in addition to those services required under equipment testing, as may be necessary, to correct faulty equipment operation. Time lost for equipment repairs, wiring corrections, control point settings or other reasons which actually interrupt the startup may, at the discretion of the Engineer, be justifiable cause for extending the startup test duration.

PART 2 – PRODUCTS

Not applicable

PART 3 – EXECUTION

Not applicable

END OF SECTION

SECTION 01 71 13 – MOBILIZATION

PART 1 - GENERAL

1.1 GENERAL

A. Mobilization shall include the obtaining of all permits; moving onto the project site(s), temporary buildings and other construction facilities; all as required for the proper performance and completion of the Work. Mobilization shall include, but not be limited to, the following principal items:

1. Moving onto the site of all Contractors' project items and equipment required for first month operations.

2. Installing temporary construction power, wiring and lighting facilities (As required).

3. Providing all on-site Contractor communication facilities.

4. Providing on-site Contractor's sanitary facilities.

5. Arranging and setting up the Contractor's work and storage yard.

6. Posting all OSHA required notices and establishment of safety programs.

7. Have Contractor's superintendent at the jobsite full time.

8. Submittal of Construction Schedule.

1.2 PAYMENT FOR MOBILIZATION

A. Refer to the Section 01 22 00 "Mobilization and Payment" for measurement and payment requirements.

END OF SECTION

SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Disposing of nonhazardous demolition and construction waste.

1.2 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

1.3 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 7 days of date established for commencement of the Work.

1.4 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Include the following information:

1. Material category.
2. Generation point of waste.
3. Total quantity of waste in tons.

B. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

C. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.5 QUALITY ASSURANCE

A. Waste Management Conference: Conduct conference at Project site.

1.6 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition site-clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.

PART 2 - PRODUCTS

2.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

B. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Section 01 50 00 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

2.2 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.

2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Burning of waste materials is permitted only at designated areas on Owner's property, provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.

C. Disposal: Remove waste materials and dispose of at designated spoil areas on Owner's property.

D. Disposal: Remove waste materials from Owner's property and legally dispose of them.

PART 3 - EXECUTION

Not Applicable

END OF SECTION

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.
5. Repair of the Work.

B. Related Requirements:

1. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.
2. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.2 ACTION SUBMITTALS

A. Product Data: For cleaning agents.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.3 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest control inspection.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.5 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 14 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Engineer. Label with manufacturer's name and model number where applicable.

    a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Engineer’s signature for receipt of submittals.

5. Submit test/adjust/balance records.
6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 14 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings.
6. Advise Owner of changeover in heat and other utilities.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements, including touchup painting.

10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 14 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Engineer and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Engineer, that must be completed or corrected before certificate will be issued.

1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

1.6 FINAL COMPLETION PROCEDURES

A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment.
2. Certified List of Incomplete Items: Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report and warranty.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection to determine acceptance. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.

3. Submit list of incomplete items in the following format:

    a. MS Excel electronic file. Engineer will return annotated copy.
    b. PDF electronic file. Engineer will return annotated copy.
    c. Three paper copies unless otherwise indicated. Engineer will return two copies.

1.8 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Engineer for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

C. Provide additional copies of each warranty to include in operation and maintenance manuals.

D. Releases from all parties who are entitled to claims against the subject project, property or improvement pursuant to the provisions of law.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

    a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
    d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    e. Remove snow and ice to provide safe access to building.
    f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    h. Sweep concrete floors broom clean in unoccupied spaces.
    i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
    j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
    k. Remove labels that are not permanent.
    l. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
    m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
    n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
    o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
    p. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 01 50 00 "Temporary Facilities and Controls." Prepare written report.

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.

    a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.

3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Product maintenance manuals.
5. Systems and equipment maintenance manuals.

1.2 CLOSEOUT SUBMITTALS

A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Engineer will comment on whether content of operations and maintenance submittals are acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operations and maintenance manuals in the following format:

1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Engineer.

    a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
    b. Enable inserted reviewer comments on draft submittals.

2. Four (4) paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. One set will be provided to the Engineer and three sets to the Owner.

C. Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Engineer will return copy with comments.

1. Correct or revise each manual to comply with Engineer's comments. Submit copies of each corrected manual within 15 days of receipt of Engineer's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information.

B. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

C. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.
7. Name and contact information for Engineer.
8. Name and contact information for Commissioning Authority.
9. Names and contact information for major consultants to the Engineer that designed the systems contained in the manuals.
10. Cross-reference to related systems in other operation and maintenance manuals.

D. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

E. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

F. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily

navigated file tree. Configure electronic manual to display bookmark panel on opening file.

G. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

    a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, subject matter of contents. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

    a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.2 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

2.3 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor is delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.

7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.4 PRODUCT MAINTENANCE MANUALS

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of operation and maintenance manuals.

F. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.

B. Related Requirements:

1. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one (1) set(s) of marked-up record prints.

B. Record Specifications: Submit one paper copy of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit one paper copy of each submittal.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised Drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
b. Record data as soon as possible after obtaining it.
c. Record and check the markup before enclosing concealed installations.

2. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Engineer and Construction Manager. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
3. Refer instances of uncertainty to Engineer through Construction Manager for resolution.
4. Engineer will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.

C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Identification: As follows:

    a. Project name.
    b. Date.
    c. Designation "PROJECT RECORD DRAWINGS."
    d. Name of Engineer and Construction Manager.
    e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. Note related Change Orders, record Product Data, and record Drawings where applicable.

B. Format: Submit record Specifications as paper copy.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, record Specifications, and record Drawings where applicable.

B. Format: Submit record Product Data as paper copy.

2.4 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as paper copy.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Engineer's and Construction Manager's reference during normal working hours.

END OF SECTION

DIVISION 2 – EXISTING CONDITIONS

SECTION 02 41 14
PAVEMENT REMOVAL

PART 1 GENERAL

1.1. **SECTION INCLUDES**

A. Remove roadway Pavement.

B. Remove curb, gutter, sidewalk, Driveway Approach, waterway and similar flat work.

1.2 **MEASUREMENT PROCEDURES**

A. Double saw cutting required for pavement removal or T-patches will not be measured or paid for separately.

1.3 **REFERENCES**

A. **APWA (Utah) Standards**:

Plan 256 Concrete pavement patch

1.4 **SUBMITTALS**

A. Traffic control plan, Section 01 55 26.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 **PREPARATION**

A. Implement traffic control plan requirements, Section 01 55 26.

B. Coordinate utility locations, Section 01 31 13.

C. Preserve all active utilities.

D. Notify neighborhood at least 48 hours before day and time of operation.

E. Mark existing utilities on redline drawings.

3.2 **PROTECTION**

A. Install Invert Covers, Section 01 71 13.

B. Trees:

1. Avoid or minimize damage to trees and tree roots.
2. Provide certified arborist observation of root cuts larger than four (4) inches diameter. Roots provide anchorage, storage of energy, and absorption and conduction of water and mineral elements. Loss of root connection affects health and stability of tree and safety of people and property. Notify ENGINEER of such root cut.

C. Existing Surfaces:

1. Protect adjacent surfaces including concrete walls, planters, carriage walks, driveway approaches, rock walls, rock gardents concrete steps, sidewalks, and curb cut assemblies. Replace damaged facilities at no additional cost to OWNER.
2. Use rubber cleats or Pavement pads when operating backhoes, outriggers, track equipment, or any other equipment on or crossing paved surfaces.
3. Restore paved surfaces that are damaged by removal operations at no additional cost to the OWNER. Match the existing Pavement surface plus 1 inch.

D. Environment:

1. Control dust, Section 01 57 00.
2. Protect plant and animal habitat. Follow federal, state or local protection requirements.

E. Repair or replace any damage at no additional cost to OWNER.

3.3 REMOVE PORTLAND CEMENT CONCRETE PAVEMENT

A. See APWA Plan 256 requirements.

B. Cutting:

1. DO NOT use machine mounted impact hammers.
2. Make concrete cuts straight, vertical, true, full-depth.
3. Cut along perimeter of panel to be removed. Where edge of existing surface is cracked, broken, or deteriorated, make the cut so the defective surface can be removed.
4. Cut along any edge that is damaged during construction, including cavities underneath caused by construction or concrete removal.

C. Removal:

1. Remove concrete to the nearest expansion joint or vertical saw cut.
2. Remove panels without damaging remaining panels.
3. Remove all bonding inhibitors.

3.4 REMOVE BITUMINOUS CONCRETE PAVEMENT

A. Cutting:

1. Use any method that produces a true, vertical, full-depth cut.
2. When bituminous pavement overlays Portland cement concrete Pavement, DO NOT use machine mounted impact hammers.
3. If an edge of an existing surface is cracked, broken, or deteriorated, make the cut so the defective surface can be removed.
4. Re-cut along any edge that is damaged during construction, and where cavities underneath pavement are caused by construction.

B. Remove Pavement: Remove pavement without damaging remaining.

3.5 **REMOVE CONCRETE FLAT WORK**

A. Saw cut flat work at weakened plane joints. Saw cut full depth.

B. Where edge of existing surface is cracked, broken, or deteriorated, make the cut so the defective surface can be removed.

C. Saw along any edge that is damaged during construction, including cavities underneath caused by construction.

D. If flat work that is not scheduled for removal is damaged, remove and replace the flat work at no additional cost to OWNER.

3.6 **CLEANING**

A. Remove all debris and dust. Clean surrounding rails, sidewalks, Driveways, Driveway approaches, landscaping, concrete flat work, and other objects in vicinity of work.

END OF SECTION

DIVISION 3 – CONCRETE

SECTION 03 11 00
CONCRETE FORMING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Formwork for cast-in-place concrete.

B. Openings in formwork for other affected work.

C. Form accessories such as snap ties, bracing, etc.

D. Stripping formwork.

1.2 REFERENCES

A. **ACI Standards**.

347 Recommended Practice for Concrete Formwork.

1.3 DEFINITIONS

A. **Shoring**: The activity to support formwork.

B. **Reshoring**: The activity to reduce the amount of formwork supporting concrete elements. As concrete sets and strength increases, less need for formwork occurs gradually until concrete becomes free standing.

1.4 SUBMITTALS

A. Shop Drawings: Fabrication and erection drawings of forms for specific finished concrete surfaces, as indicated. Show general construction of forms, jointing, special joints or reveals, location and pattern of form tie placement, and other items affecting exposed concrete visibility.

B. Form Release Agent: Where concrete surfaces are scheduled to receive special finishes or applied coverings which may be affected by agent submit manufacturer's instructions for use of agent.

1.5 QUALITY ASSURANCE

A. Designer's Qualifications: Structural design professional who complies with Utah licensing law, has experience in concrete formwork, and is acceptable to the authority having jurisdiction.

B. Design Forms:

1. With sufficient strength to maintain finished tolerances indicated in Section 03 35 00, to support loads, pressures, and allowable stresses as outlined in ACI 347 and for design considerations such as wind loads, allowable stresses, and other applicable requirements of local Laws and Regulations.
2. To permit easy removal.
3. For required finishes.

C. Design, engineering, and construction of formwork is CONTRACTOR's responsibility.

1.6 **JOB CONDITIONS**

A. For reference purposes, establish and maintain sufficient control points and bench marks to check tolerances. Maintain in an undisturbed condition and until final completion and acceptance of Work.

B. Regardless of tolerances specified, allow no portion of Work to extend beyond legal boundaries.

1.7 **FIELD SAMPLES**

A. Prepare field Samples and submit per Section 01 33 00.

B. Construct and erect sample formwork panel for architectural concrete surfaces receiving special treatment or finish as a result of formwork. Formwork to include vertical and horizontal form joints and typical rustication joints when required.

C. Size panel to indicate special treatment or finish required, including form release agent.

D. Remove formwork after casting concrete.

1.8 **ACCEPTANCE**

A. Secure ENGINEER's inspection of form layout for concrete flat work.

PART 2 PRODUCTS

2.1 **FORM MATERIALS**

A. Faced with material which will produce smooth and uniform texture on concrete, unless indicated otherwise.

B. Arrange facing material orderly and symmetrical, keeping number of seams to a minimum.

C. Do not use material with raised grain, patches, or other defects which will impair texture of concrete surface.

2.2 **FORMWORK ACCESSORIES**

A. Form Ties:

1. Use ties constructed so end fasteners can be removed without spalling concrete faces.

2. After end fasteners of ties have been removed, embedded portion of ties are to terminate not less than two (2) times the diameter or thickness of the fasteners from formed faces of concrete, but in no case greater than 3/4 inch.

3. When formed face on concrete is not exposed, form ties may be cut off flush with formed surfaces. Use ties with 3/4 inch diameter cones on both ends or an approved equal for water retaining structures.

B. Premolded Expansion Joint Filler: F1 sheet, Section 32 13 73 unless

indicated elsewhere.

C. Form Release Agent: Colorless material which will not stain concrete, absorb moisture, impair natural bonding or color characteristics of concrete. To prevent contamination, agents used on potable water structures are subject to review by ENGINEER before use.

D. Fillets for Chamfered Corners: Wood strips 1 inch x 1 inch size, maximum length possible.

PART 3 EXECUTION

3.1 INSPECTION

A. Verify lines, levels, and measurements before proceeding with formwork.

3.2 FORM CONSTRUCTION

A. Make forms sufficiently tight to prevent loss of concrete.

B. Unless indicated otherwise, place chamfer strips in corners of forms to produce beveled edges on permanently exposed exterior corners.

C. To maintain specified finish tolerances, camber formwork to compensate for anticipated deflections.

D. Provide positive means of adjustment using wedges, jacks, Shores, and struts to take up all settlement during concrete placing operation.

E. Provide temporary ports in formwork to facilitate cleaning and Inspection. Locate openings at bottom of forms to allow flushing water to drain.

F. At construction joints, overlap forms over hardened concrete at least six (6) inches. Hold forms against hardened concrete to prevent offsets or loss of mortar at construction joint and to maintain true surface.

G. Construct wood forms for wall openings to facilitate loosening, or counteract swelling.

H. Fasten wedges used for final adjustment of forms before concrete placement in position after final check.

I. Anchor formwork to Shores, supporting surfaces or members to prevent upward or lateral movement and deflection of any part of formwork system during concrete placement.

J. Provide runways for moving equipment with struts or legs, supported directly on formwork or structural member without resting on reinforcing.

K. Position expansion joint material and other embedded items accurately and support to prevent displacement.

L. To prevent entry of concrete, fill voids in sleeves, inserts, and anchor slots temporarily with readily removable material.

M. For architectural concrete, limit deflection of facing materials between studs as well as deflection of studs and walers to 0.0025 times span.

N. For underground concrete work, do not use soil walls for forming unless authorized by ENGINEER.

3.3 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings for elements embedded in or passing through concrete.

B. Coordinate work of other sections for the forming and setting of openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.

C. Install accessories per manufacturer's instructions. Ensure items are not disturbed during concrete placement.

3.4 FORM FINISHES

A. Use forms with smooth rubbed, scrubbed, sand floated finishes that meet ACI 347 unless indicated otherwise.

B. For As-cast Finishes:

1. Install form panels in orderly arrangement with joints planned in approved relation to building elements.
2. Where panel joints are recessed or otherwise emphasized, locate form ties within joints, not within panel areas.
3. Where an as-cast finish is required, no grouting will be permitted in the finishing operation.

C. Textured Finishes: As indicated.

3.5 APPLICATION OF FORM RELEASE AGENT

A. Apply form release agent on formwork per manufacturer's instructions. Apply before placing reinforcing steel, anchoring devices, and embedded items.

3.6 FORM REMOVAL

A. Do not pry against face of concrete. Use only wooden wedges.

B. When repair of surface defects or finishing is required at an early age, remove forms as soon as concrete has hardened sufficiently to resist damage from removal operations.

C. Remove top forms on sloping surfaces of concrete as soon as concrete has attained sufficient stiffness to prevent sagging. Perform needed repairs or treatment required on such sloping surfaces at once, followed by specified curing.

D. Loosen wood forms for wall openings as soon as it can be accomplished without damage to concrete.

E. Formwork for columns, walls, sides of beams, and other members not supporting weight of concrete may be removed as soon as concrete has hardened sufficiently to resist damage from removal.

F. Where no Reshoring is planned, leave forms and Shoring used to support weight of concrete in beams, slabs, and other concrete members in place until concrete has attained its specified strength.

G. Where Reshoring is planned, supporting formwork may be removed

when concrete has reached 70 percent of specified strength, provided Reshoring is installed immediately.

H. When Shores and other vertical supports are so arranged that non-load carrying, form-facing material may be removed without loosening or disturbing Shores and supports, facing material may be removed at an earlier age.

3.7 **RESHORING**

A. When Reshoring is permitted or required, plan operations in advance and obtain approval.

B. During Reshoring do not subject concrete in beam, slab, column, or any other structural member to combined dead and construction loads and live loads in excess of loads permitted for developed concrete strength at time of Reshoring.

C. Place Reshores as soon as practical after stripping operations are complete, but in no case later than end of working day on which stripping occurs.

D. Tighten Reshores to carry required loads without over-stressing.

E. Leave Reshores in place until the concrete being supported has reached its specified strength.

F. For floors supporting Shores under newly placed concrete, level original supporting Shore or Reshore:

1. Reshoring system shall have a capacity to resist anticipated loads in all cases equal to at least 1/2 the capacity of the Shoring system.
2. Unless otherwise specified locate Reshores directly under a Shore.
3. In multistory buildings, extend Reshoring through a sufficient number of stories to distribute the weight of newly placed concrete, forms, and construction live loads in such a manner that design loads of floors and supporting Shores are not exceeded.

G. Design, engineering, and construction of Shoring and Reshoring is the responsibility of the CONTRACTOR.

3.8 **REMOVAL STRENGTH**

A. When removal of formwork or Reshoring is based on concrete reaching a specified strength, it shall be assumed that concrete has reached this strength when either of the following conditions has been met:

1. When test cylinders, field cured along with the concrete they represent, have reached the specified strength.
2. When concrete has been cured per Section 03 39 00 for the same length of time as the site-cured cylinders that reached specified strength. Determine the length of time the concrete has been cured in the structure by cumulative number of days or fractions thereof, not necessarily consecutive, during which the air temperature is above 50 deg F and concrete has been damp or sealed from evaporation and loss of moisture.

3.9 **REUSE OF FORMS**

A. Do not reuse forms if there is any evidence of surface wear or defect which would impair quality of concrete surface.

B. Thoroughly clean and properly coat forms before reuse.

3.10 **FIELD QUALITY CONTROL**

A. Before commencing a pour, verify connections, form alignment, ties, inserts and Shoring are placed and secure.

B. Observe formwork continuously while concrete is being placed to verify that the forms are plumb and there are no deviations from desired elevation, alignment, or camber.

C. If during construction any weakness develops and false-work shows undue settlement or discoloration, stop work, remove affected construction if permanently damaged, and strengthen false-work.

END OF SECTION

SECTION 03 15 16 – CONCRETE CONSTRUCTION JOINTS

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall construct all construction joints, expansion joints and control joints in concrete at the locations shown and formed in accordance with the details shown in the drawings.

B. Waterstops shall be provided in all construction and expansion joints of hydraulic or below grade structures unless specifically noted otherwise on the drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Cast-In-Place Concrete. 033000

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Federal Specifications:

TSS-S-00227E(3)	Sealing Compound, elastomeric type, multi-component (for Caulking, Sealing, Glazing Buildings and Other Structures)

B. Commercial Standards:

ASTM C 920-86	Specification for Elastomeric Joint Sealants
ASTM D 624-81	Test Method for Rubber Property - Tear Resistance
ASTM D 1752-84	Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

1.4 CONTRACTOR SUBMITTALS

A. Waterstop: Prior to production of the waterstop material required under this Contract, the Contractor shall submit for review complete product date, including qualification samples of extruded sections of each size and shape to be used. The submittal shall also include the manufacturer's certification that the water stop material meets the physical requirements as outlined under paragraph 2.01, herein.

1.5 QUALITY ASSURANCE

A. Waterstop Inspection: Waterstop installation shall be subject to rigid inspection. No waterstop shall be cast in concrete without the Engineer's inspection. Not less than twenty-four (24) hours notice shall be provided to the Engineer for scheduling such inspections.

B. Waterstop Field Samples: Prior to use of the waterstop material in the field, a sample of a fabricated mitered cross and a tee constructed of each size or shape of material to be used shall be submitted to the Engineer for review. These samples shall be fabricated so that the material and workmanship represent in all respects the fittings to be furnished under this Contract. Field samples of fabricated fittings (crosses, tees, etc.) may be selected at random by the Engineer for testing by a laboratory at the Owner's expense. When tested, they shall have a tensile strength across the joints equal to at least 600 psi.

C. All field joints in waterstops shall be subject to rigid inspection for misalignment, bubbles, inadequate bond, porosity, cracks, offsets and other defects. All defective joints shall be replaced and all weathered, damaged or otherwise faulty material shall be removed from the site and disposed of by the Contractor at its own expense.

D. Waterstops shall be stored on site where it will not be subjected to freezing temperatures or exposed to the direct rays of the sun.

E. Construction Joint Sealant: The Contractor shall prepare adhesion and cohesion test specimens as specified herein from each shipment of material received at the jobsite. Sealant shall be stored at room temperature and shall not be stored longer than seventy-five percent of the manufacturer's stated shelf life.

F. The sealant material shall show no signs of adhesive or cohesive failure when tested in accordance with the following procedure:

1. Sealant specimen shall be prepared between two concrete blocks (1-inch by 2-inch by 3-inch). Spacing between the blocks shall be 1/2-inch. Coated spacers (2-inch by 1-1/2 inch by 1/2-inch) shall be used to ensure sealant cross-sections of 1/2-inch by 2-inches with a width of 1/2-inch.

2. Sealant shall be cast and cured according to manufacturer's recommendations except that curing period shall not exceed twenty-four (24) hours.

3. Following curing period, the gap between blocks shall be widened to 1-inch. Spacers shall be used to maintain this gap for twenty-four (24) hours prior to inspection for failure.

1.6 GUARANTEE

A. The Contractor shall provide a three (3) year written guarantee of the entire joint sealant installation against faulty and/or incompatible materials and workmanship, together with a statement that it agrees to repair or replace, to the satisfaction of the Owner, at no additional cost to the Owner, any such defective areas which become evident within said three (3) year guarantee period.

PART 2 - PRODUCTS

2.1 PVC WATERSTOPS

A. General: Waterstops shall be extruded from an elastomeric plastic compound consisting of virgin polyvinylcloride and additional plasticizers and stabilizers necessary to meet or exceed the requirements and performance criteria of these Specifications and the Corps of Engineers Specifications CRD-C572. No reclaimed scrap or reprocessed material shall be used.

B. Flatstrip, Center-Bulb and Multi-Rib Waterstops: Flatstrip, center-bulb and multi-rip waterstops shall be detailed and as manufactured by: Vinylex Corp or approved equal; provided, that at no place shall the thickness of flat strip waterstops, including the center-bulb type, be less than 3/8-inch. Prefabricated joint fittings shall be used at all intersections of the ribbed-type waterstops.

C. Physical Properties: When tested in accordance with the specified test standards, the waterstop material shall meet or exceed the following requirements:

Physical Property, Sheet Material	Value	ASTM Test Method
Tensile Strength-Min (psi)	1750	D 638
Ultimate Elongation-Min (percent)	350	D 638
Low Temp. Brittleness-Max (-35 Deg F)	Pass	D 746
Stiffness in Flexure-Min (psi)	400	D 747
Accelerated Aging (CRD-C572)		
Tensile Strength-Min (psi)	1500	D 638
Ultimate Elongation-Min (percent)	300	D 638

2.2 HYDROPHILIC WATERSTOPS

A. General: Hydrophilic waterstops may be substituted for PVC waterstops upon submittal to, and approval of the Engineer. Hydrophilic waterstops may not contain bentonite.

B. Hydrophilic waterstops shall be manufactured by: Asadi Denka Kogyo K.K. distributed by Mitsubishi International Corp; SYNKO-FLEX Products, Huston Texas; Sika Corporation Santa Fe Springs, CA; or approved equal. Hydrophilic waterstops shall be installed according to the manufacture's recommendations.

C. Physical Properties: When tested in accordance with the specified test standards, the waterstop material shall meet or exceed the following requirements:

ASTM TEST

Physical Property	Value	Method
Hardness	30	2240
Tensile Strength	100	D412
Elongation Percent	500	D412
Specific Gravity	1.18	D792

PART 3 - EXECUTION

3.1 GENERAL

A. Unless otherwise shown, waterstops of the type specified herein, shall be fully continuous for the extent of the joint. The Contractor shall take suitable precautions and means to support and protect the waterstops during the progress of the work and shall repair or replace at its own expense any waterstops damaged during the progress of the work.

B. Suitable precautions shall be taken to shade and protect the exposed waterstop from direct rays of the sun during the entire exposure and until the exposed portion of the waterstop is embedded in concrete.

C. Splices in waterstops shall be performed by heat sealing the adjacent waterstop sections in accordance with the manufacturer's printed recommendations. It is essential that the splices have a tensile strength of not less than sixty percent of the unspliced materials tensile strength and the continuity of the waterstop ribs and of its tubular center axis be maintained.

3.2 INSTALLATION OF WATERSTOP

A. All joints with waterstops involving more than two (2) ends to be jointed together and all joints which involve an angle cut, alignment change or the joining of two (2) dissimilar waterstop sections shall be prefabricated by the Contractor prior to placement in the forms, allowing not less than 24-inch long strips of waterstop material beyond the joint. Upon being inspected and approved, such prefabricated waterstop joint assemblies shall be installed in the forms and the ends of the 24-inch strips shall be butt welded to the straight run portions of waterstop in place in the forms.

B. Adequate provisions must be made to support the waterstops during the progress of the work and to ensure the proper embedment in the concrete. The symmetrical halves of the waterstops shall be equally divided between the concrete pours at the joints. The center axis of the waterstops shall be coincident with the joint openings. Maximum density and imperviousness of the concrete shall be ensured by thoroughly working it in the vicinity of all joints.

C. Adequate means shall be provided to prevent waterstops from being folded over by the concrete as it is placed. Unless otherwise shown, all waterstops shall be held in place with light wire ties on 12-inch centers which shall be passed through the edge of the waterstop and tied to the curtain of reinforcing steel. In placing concrete around horizontal waterstops, with their flat face in a horizontal plane, concrete shall be carefully worked under the waterstops so as to avoid the formation of air and rock pockets.

D. Where a bentonite waterstop is called for in the Contract Documents, it shall be installed in accordance with the manufacturer's instructions. The bentonite waterstop shall be located at the center of the joint and it shall be continuous around the entire joint. Bentonite waterstop shall not be used in joints with only one curtain of reinforcing steel. Where a bentonite waterstop is used in combination with PVC waterstop, the bentonite waterstop shall overlap the PVC waterstop for a minimum of 6-inches.

3.3 JOINT CONSTRUCTION

A. Joint Location: Construction joints, expansion joints and control joints shall be provided where shown. When not shown, construction joints shall be provided at 25-foot maximum spacing for all concrete construction, unless noted otherwise. The location of all joints shall be submitted for acceptance by the Engineer.

B. Special care shall be used in preparing concrete surfaces at joints where bonding between two (2) sections of concrete is required. Unless otherwise shown, such bonding will be required at all horizontal joints in walls and wall to slab joints. Surfaces shall be prepared by sandblasting and washing for removal of laitance or any objectional material. Joints shall be kept clean until the concrete is placed. Vertical joints shall be clean and free of concrete fins, rock pockets or any objectional material.

C. Sealant grooves shall be formed as shown on the drawings and shall be protected from damage until final application of the sealant. Care shall be taken to prevent chipping of the sealant grove during removal of forms.

END OF SECTION

SECTION 03 20 00

CONCRETE REINFORCING

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Reinforcing steel bars, wire fabric or rod mats for cast-in-place concrete.

B. Support chairs, bolsters, bar supports, and spacers for supporting reinforcement.

1.2 **REFERENCES**

A. **AASHTO Standards**:

M254 Corrosion Resistant Coated Dowel Bars.

B. **ACI Standards**:

301 Structural Concrete for Buildings.

315 Concrete Reinforcement.

C. **ASTM Standards**:

A82 Steel Wire, Plain, for Concrete Reinforcement.

A185 Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement.

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

A706 Low-Alloy Steel Deformed Bars for Concrete Reinforcement.

C1116 Fiber-Reinforced Concrete and Shotcrete.

D3963 Epoxy-Coated Reinforcing Steel.

D. **AWS Standards**:

D1.1 Structural Welding Code Steel.

D1.4 Structural Welding Code Reinforcing Steel.

E. **CRSI Standards**:

Manual of Standard Practice.

1.3 **SUBMITTALS**

A. **Manufacturer's Certificate**: Submit mill test certificates of supplied concrete reinforcement, indicating physical and chemical analysis.

B. **Welder's certification**.

C. **Shop Drawings**:

1. Indicate sizes, spacings, locations, and quantities of reinforcing steel, wire fabric, bending and cutting schedules, splicing, stirrup spacing, supporting, and spacing devices.
2. When required, prepare Shop Drawings by an engineer who complies with Utah licensing law and is acceptable to agency having jurisdiction.

1.4 **QUALITY ASSURANCE**

A. Perform concrete reinforcement work per CRSI Manual of Standard Practice.

B. Comply with ACI 301.

C. Welders: Certified to comply with AWS D1.1 or AWS D1.4 as applicable.

1.5 **ACCEPTANCE**

A. Unless specified otherwise, chairs for supporting reinforcement in flat slabs are spaced as follows:

1. Three (3) feet maximum for No. 5 and smaller bars.
2. Five (5) feet maximum for bars larger than No. 5.

B. Dowels are placed on dowel baskets and properly aligned.

C. Epoxy and galvanized coatings are not chipped or cut. Ends of cut bars are epoxy coated or galvanize painted before placement.

D. Minimum covering over reinforcement is as specified.

PART 2 PRODUCTS

2.1 **MATERIALS**

A. Fiber Reinforcement: Glass, ASTM C1116.

B. Reinforcement:

1. Grade 60 ksi deformed steel bars, ASTM A615 and supplementary requirements S1 or ASTM A706 for welding.
2. Welded wire fabric. Plain steel type, ASTM A185 in flat sheets or coiled rolls. Dimensions of the mesh 4”x 4” or as indicated.

C. Stirrups: Steel, ASTM A82.

D. Dowel Bars for Expansion Joints: Grade 60 ksi smooth steel bar, ASTM A615.

1. Galvanized or epoxy coated in roadway Pavements.
2. Provide plastic cap to permit longitudinal movement of dowel bar within concrete section equal to joint width plus 1/4 inch.
3. For load transfer joints, paint bars with 1 coat of paint conforming to AASHTO M254 and coat 1/2 with grease.

E. Coatings for Corrosion Protection:
   1. Epoxy coat, ASTM D3963.
   2. Galvanized, Section 05 05 10.

2.2 **ACCESSORY MATERIALS**

A. Tie Wire: Minimum 16 gage annealed type or an acceptable patented system.

B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during installation and placement of concrete.

2.3 **FABRICATION**

A. Fabricate reinforcement, ACI 315 providing for concrete cover.

B. Locate reinforcing splices not indicated on Drawings at points of minimum stress. Indicate location of splices on Shop Drawings.

C. Weld reinforcing bars; with AWS D1.4.

PART 3 EXECUTION

3.1 **PLACING**

A. All reinforcement to be free of loose mill scale, loose or thick rust, dirt, paint, oil or grease.

B. Place all reinforcement in the exact position indicated. With tie wire, tie bars together at all intersections except where spacing is less than 12 inches in each direction, in which case tie alternate intersections.

C. Maintain the distance from vertical forms and between layers of reinforcement by means of prefabricated chairs, ties, hangers, or other approved devices. Placing and fastening of reinforcement in each section of the Work must be approved before concrete is placed.

D. Overlap sheets of metal mesh one square plus six (6) inches to maintain a uniform strength. Securely fasten at the ends, edges, and supports to maintain clearances.

E. Flat Slab Work:
   1. Support reinforcing steel of formed flat slabs with plastic chairs, precast concrete blocks or other non-oxidizing slab bolsters.
   2. Size chairs or bolsters to position the steel in the exact location indicated.
   3. Space chairs and bolsters not more than five (5) feet on centers in each direction.
   4. Coat metal supports in contact with forms to prevent rust.
   5. Tie down deck steel to beams or forms at regular intervals of not more than five (5) feet on centers along the beams or forms to prevent movement of steel during concrete placement.

3.2 SPLICING

A. Furnish all reinforcement in the full lengths indicated unless otherwise permitted. Splicing of bars, except where indicated is not permitted without ENGINEER's knowledge. Stagger splices where possible.

B. Unless indicated otherwise, overlap reinforcing bars a minimum of 30 diameters to make the splice. In lapped splices, place the bars and wire to maintain the minimum distance for clear spacing to the surface of the concrete.

C. Do not use lap splices on bars greater than No. 11 diameter unless approved.

D. Weld reinforcing steel only if indicated or if authorized in writing. Weld in conformance to AWS D1.4.

E. Do not bend reinforcement after embedding in hardened concrete.

F. Do not permit reinforcement or other embedded metal items bonded to the concrete, to extend continuously through any expansion joint, except dowels in floors bonded on only one side of joints.

3.3 PLACING EMBEDDED ITEMS

A. Place all sleeves, inserts, anchors and embedded items before concrete placement. Temporarily fill voids in embedded items to prevent entry of concrete.

B. Give all trades whose work is related to the concrete section (Section 03 30 04) ample notice and opportunity to introduce or furnish embedded items before concrete placement.

END OF SECTION

SECTION 03 30 04
CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Material requirements.

1.2 REFERENCES

A. **ACI Standards**:

- 211.1 Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
- 211.2 Selecting Proportions for Structural Lightweight Concrete.
- 211.3 Standard Practice for Selecting Proportions for No-Slump Concrete.
- 214 Evaluation of Strength Test Results of Concrete.
- 301 Specifications for Structural Concrete for Buildings.
- 305 Hot Weather Concreting.
- 306 Cold Weather Concreting.
- 318 Building Code Requirements for Reinforced Concrete.

B. **ASTM Standards**:

- C33 Concrete Aggregates.
- C39 Compressive Strength of Cylindrical Concrete Specimens.
- C88 Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
- C94 Ready-Mixed Concrete.
- C117 Material Finer than 75µ (No. 200) Sieve in Mineral Aggregates by Washing.
- C123 Lightweight Particles in Aggregate.
- C138 Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
- C142 Clay lumps and Friable Particles in Aggregates.
- C143 Slump of Hydraulic-Cement Concrete.
- C150 Portland Cement.
- C172 Sampling Freshly Mixed Concrete.
- C227 Potential Reactivity of Cement-Aggregate Combinations (Mortar Bar Method).
- C231 Air Content of Freshly Mixed Concrete by the Pressure Method.

C260 Air-Entraining Admixtures for Concrete.

C289 Potential Reactivity of Aggregates (Chemical Method).

C295 Petrographic Examination of Aggregates for Concrete.

C441 Effectiveness of Mineral Admixtures or Ground Blast-Furnace Slag in Preventing Excessive Expansion of Concrete Due to The Alkali-Silica Reaction.

C494 Chemical Admixtures for Concrete.

C535 Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

C595 Blended Hydraulic Cements.

C618 Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.

C1064 Temperature of Freshly Mixed Portland Cement Concrete.

C1077 Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.

C1116 Fiber-Reinforced Concrete and Shot Crete.

C1157 Blended Hydraulic Cement.

C1240 Use of Silica Fume as a Mineral Admixture in Hydraulic Cement Concrete, Mortar, and Grout.

C1260 Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).

C1293 Concrete Aggregates by Determination of Length Change of Concrete Due to Alkali-Silica Reaction.

C1567 Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).

C1602 Mixing Water Used in The Production of Hydraulic Cement Concrete.

STP 15-C Manual on Quality Control of Materials.

1.3 **SUBMITTALS**

A. **Quality Assurance**:

1. Independent Laboratory: Submit names, certification levels, and years of experience of testing agency's field technicians that are assigned to the Work. Verify laboratory complies with ASTM and ACI standards.
2. Mixing Equipment: Submit certification of plant equipment.

B. **Mix Design**: Allow ENGINEER 10 days to evaluate the submittal. Provide the following information.

1. Date of mix design. If older than 365 days from date of submission recertify mix design.
2. Physical properties of the aggregate (this section article 2.3). Test results shall not be older 455 days from the date of submission. The

information is for suitability of source and not for project control. A new report may be required if aggregate source is changed.

3. Identify whether mix is for hot, cold, or normal weather placement.
4. Cement source, type and chemical composition.
5. Aggregate soundness and potential reactivity.
6. Average Strength (f_{cr}), per quality control chart.
7. Allowable range of slump and air content.
8. Water cement ratio.
9. Proportions of materials in the mix.
10. Unit weight.
11. Analysis of water if water is not potable.
12. Mortar bar or prism test results if a pozzolan is included in the mix.
13. Technical data sheets for additives to be used at the plant and at the job site. Certify additives are compatible with each other.

C. **Pre-approved Mix Design**: Submit name and address of Supplier and Suppliers mix design number if available.

D. **Before Changing Mix Design**: Submit a new design and allow ENGINEER 10 days to evaluate the changes.

1.4 **QUALITY ASSURANCE**

A. **General**:

1. Use a laboratory that follows and complies with ASTM C1077.
2. Reject concrete that does not meet requirements of this section.
3. If requested, submit a quality control and testing report describing source and field quality assurance activities performed by CONTRACTOR and Suppliers.

B. **At Source**:

1. Do not change material sources, type of cement, air-entraining agent, water reducing agent, other admixtures except as allowed by mix design.
2. Store bagged and bulk cement in weatherproof enclosures. Exclude moisture and contaminants.
3. Prevent segregation and contamination of aggregate stockpiles.
4. Avoid contamination, evaporation, or damage to admixtures. Protect liquid admixtures from freezing.

C. **At Site**: Use of admixtures will not relax hot or cold weather placement requirements.

1.5 **ACCEPTANCE**

A. **Materials**:

1. Aggregate Source:
   a. Verify suitability of aggregate source.
   b. Verify aggregate gradation.
   c. Verify percent of combined aggregate passing No. 200 sieve.
2. At the Site:
   a. Verify mix identification, batch time, slump, air content, and temperature.
   b. Verify drum rotation is less than 300 revolutions.
3. At the Laboratory: Verify strength in 28 days.

B. **Defective Material**: Popouts, scaling, etc.

1. Price adjustment, Section 01 29 00 and Section 03 30 10.
2. Dispute resolution, Section 01 35 10.

PART 2 PRODUCTS

2.1 **CEMENT**

A. **General**:

1. Do not use air entraining cement except for hand mixed applications.
2. Do not use cement containing lumps or is partially set.
3. Do not mix cement originating from different sources.

B. **Standard Set Cement**:

1. Type II cement per tables 1 and 3 in ASTM C150, or Type V when necessary, or
2. Low-alkali cement per Table 2 in ASTM C150.

C. **Blended Hydraulic Cement**: The following are cement equivalencies when substituting blended cement for a Portland cement.

Table 1 – Cement Equivalencies

Portland Cement ASTM C150	Blended Cement ASTM C595	Blended Cement ASTM C1157
Type I	IP	GU
Type II	IP (MS)	MS
Type III	--	HE
Type IV	--	--
Type V	--	HS

D. **Rapid Set Cement**: As above and as follows:

1. Initial set time: 15 minutes minimum.

2. Color: Acceptable to the ENGINEER.

2.2 **WATER**

A. Clean, non-staining, non-detrimental per ASTM C1602.

B. Screen out extraneous material.

C. Do not use alkali soil water.

2.3 **AGGREGATES**

A. Gravel, crushed gravel, crushed stone, crushed concrete, slag, sand or combination with the following physical properties.

Table 2 – Physical Properties

		Standard	Min	Max
Coarse Aggregate				
Wear (hardness or toughness), percent (a)		(a)	--	50
Soundness (5 cycles), percent	Na_2SO_4	C88	--	12
	Mg_2SO_4	C88	--	18
Coal and lignite (SG = 2.4 min.), percent (b)		C123	0.5	1.0
Clay lumps, friable particles, chert, percent		C142	--	7
Material finer than 200 sieve, percent		C117	--	1.0
Fine Aggregate				
Soundness (5 cycles), percent	Na_2SO_4	C88	--	10
	Mg_2SO_4	C88	--	15
Fineness modulus		C33	2.3	3.1
Coal and lignite (SG = 2.4 min.), percent (b)		C123	0.5	1.0
Clay lumps, friable particles, chert, percent		C142	--	3.0
Aggregate blend (meets one of the following)				
1. Average prism length change in 12 months, percent (c)		C1293	--	0.04
2. Average mortar bar length change in 16 days, percent (c)		C1260	--	0.10
3. Petrography limits, percent				
Quartz.....(d)		C295	--	5.0
Chert or chalcedony			--	3.0
Tridymite or cristobalite.....			--	1.0
Opal.....			--	0.5
Natural glass in volcanic rock			--	3
4. Historical data acceptable to ENGINEER				

NOTES

(a) Wear retained on No. 8 sieve. For aggregate less than 1 1/2" use ASTM C131. For larger aggregates use ASTM C535.

(b) Organic impurities producing a dark color concrete may cause rejection.

(c) Prism length change and mortar bar length change based upon unmodified ASTM tests.

(d) Quartz must NOT be optically strained, micro-fractured, or microcrystalline in nature.

2.4 ADDITIVES

A. Calcium Chloride: Not allowed in reinforced concrete.

B. Air Entrainment: ASTM C260. For extrusion enhancement use non-vinsal resin.

C. Set Enhancement and Water Reducing Agents: ASTM C494.

1. Type A: Water reducing.
2. Type B: Set retarding.
3. Type C: Set accelerating.
4. Type D: Water reducing and set retarding.
5. Type E: Water reducing and set accelerating.
6. Type F: High range water reducing (super plasticizer). *
7. Type G: High range water reducing and set retarding. *

* Keep the relative durability factor of water reducing additives not less than 90 and the chlorides content (as Cl^-) not exceeding 1 percent by weight of the admixtures.

D. Pozzolan:

1. Natural or fly ash per ASTM C618.
2. Silica fume per ASTM C1240.

E. Special Admixtures: Allowed if mix design submittal is accepted:

1. Lithium nitrate based solution for control of reactive aggregates.
2. Calcium nitrite based solution for corrosion protection of reinforced structures subject to chloride-induced corrosion.
3. Shrinkage reducer for controlling drying shrinkage in concrete.
4. Viscosity modifier for enhancement of self consolidating concrete or for workability.

2.5 MIX DESIGN

A. **Class**: Unless specified elsewhere, as follows.

1. Above Ground: 5000 minimum.
2. At Ground Level: 4000 minimum.
3. Underground: 4000 minimum.

B. **Selection of Cement**: ASTM C150 or C1157.

1. For sulfate resistance, use Type V Portland cement, or Type II with Class F fly ash. Class F fly ash may be used as an addition to Type V Portland cement.
2. Do not use fly ash with Type IP(MS) or Type III Portland cement.

C. **Selection of Aggregates**:

1. Maximum Particle Size:
   a. 1/5 of narrowest dimension between forms.
   b. 1/3 of depth of slab.

c. 3/4 of minimum clear spacing between reinforcing bars.

2. Gradation: ASTM C33.

a. Coarse Aggregate: Choose from the following grades. Gradations are based upon percent of material passing sieve by weight.

Table 3 – Coarse Aggregate Gradation				
Sieve	**Grade**			
	357 (2")	**467 (1.5")**	**57 (1")**	**67 (3/4")**
2-1/2"	100	--	--	--
2 Inch	95 - 100	100	--	--
1-1/2"	--	95 – 100	100	--
1"	35 – 20	--	95 – 100	100
3/4"	--	35 – 70	--	90 – 100
1/2"	10 – 30	--	25- 60	--
3/8"	--	10 – 30	--	20 – 55
No. 4	0 – 5	0 – 5	0 – 10	0 – 10

b. Fine Aggregate:

Table 4 – Fine Aggregate Gradation	
Sieve	**Percent Passing by Weight**
3/8"	100
No. 4	95 to 100
No. 16	45 to 80
No. 50	10 to 30
No. 100	2 to 10

c. Silts and Clays: The amount of material smaller than the No. 200 sieve in any combined gradation sample is limited to the following percentages by weight of the combined sample:

1) 1.75 percent maximum for concrete subject to abrasion.

2) 3.0 percent maximum for all other concrete.

D. **Selection of Pozzolan**:

1. General: If a blended aggregate passes an unmodified ASTM C1293 test, use of a pozzolan is CONTRACTOR's choice. If aggregate does not pass ASTM C1293, select a pozzolan (or blended cement, or both) and determine the effective dosage to meet one of the following tests:

a. ASTM C1567. The expansion of a cement-pozzolan-aggregate job-mix mortar bar is less than or equal to 0.10 percent at 16 days. Do not use this test if a lithium admixture is used in the job-mix.

b. ASTM C441. The expansion of a test mixture at 56 days is less than or equal to a control mixture prepared with cement with equivalent alkalis between 0.5 and 0.6 percent.

2. Fly Ash (Class F): Allowed as a cement replacement under the following conditions:
   a. Before replacement is made, use the minimum cement content in the design formula to establish the water/cement ratio.
   b. Replace up to 20 percent of the cement by weight on a one (1) part fly ash to one (1) part cement basis.
   c. Submit to ENGINEER a quality history of the fly ash identifying a minimum of 20 of the most current ASTM C618 analysis.
3. Natural Pozzolan (Class N): Allowed as a cement replacement if the 14 day expansion test (ASTM C1567) with job aggregates, job cement and natural pozzolan does not exceed the 14 day expansion test of job aggregates, job cement and Class F fly ash.
4. Silica Fume: Allowed as a cement replacement if replacement of hydraulic cement on a 1 part silica fume to 1 part cement does not exceed 10 percent, and water/cement ratio is established before cement is replaced with silica fume.

E. **Selection of Mix Properties**: Select and proportion the mix to produce appropriate strength, durability and workability. Use ACI 211.1, 211.2, or 211.3, and meet the following properties and limitations:

Table 5 – Mix Properties and Limitations

Properties		Standard	Class 2000	Class 3000	Class 4000	Class 5000
Compressive Strength (f_c') at 28 days, psi, minimum		C39	2000	3000	4000	5000
Compressive Strength at 7 days, psi, (for reference only)		C39	1340	2010	2680	3350
Average Strength, psi (f_{cr})		214	(a)	(a)	(a)	(a)
Cement content, bags, minimum (b)		--	4.5	5.5	6.5	7.5
Water-cement ratio (by weight), maximum (c)		318	(d)	(d)	0.44	
Entrained air, percent (based upon aggregate size) (e)	2"	C231	3.0 to 6.0	4.5 to 7.5	4.0 to 7.0	
	1-1/2"		"	"	4.5 to 7.5	
	1"		"	"	5.0 to 7.5	
	3/4"		"	"	5.0 to 7.5	
Slump		C143	(d)	(d)	(d)	(d)

NOTES

(a) The amount by which average strength (f_{cr}) exceeds compressive strength (f_c') is based upon statistical assurance that no more than 1 test in 100 tests will fall below compressive strength (f_c').

(b) Unless allowed otherwise by ENGINEER.

(c) Before pozzolan substitution.

(d) Specific to exposure conditions and finishing need.

(e) Comply with ACI 211.1 if air content is changed.

(f) 1 bag of cement = 94 pounds.

1. Cold Weather: ACI 306. Unless allowed otherwise by ENGINEER, increase cement content in the mix design by 1 class between **October 1 and March 1,** i.e. Class 3000 becomes Class 4000, Class 4000 becomes Class 5000, etc.
2. Hot Weather: ACI 305. Reduce temperature of mix ingredients or use an admixture appropriate to job conditions when air temperature is over 75 deg F.
3. Concrete Deposited Under Water: Increase cement content one (1) class for concrete placed above water or use viscosity modifying admixture.

F. **Selection of Fiber Reinforcement**: The basis for determining material proportions of fiber-reinforced concrete is the Supplier's responsibility per ASTM C1116 subject to mix property requirements of this Section. Unless specified otherwise provide synthetic fibers.

2.6 **SOURCE QUALITY CONTROL**

A. **General**: Collect Samples randomly. Do not change source quality control sampling point.

B. **Aggregate**:

1. Soundness, ASTM C88.
2. Alkali-silica reactivity, ASTM C289, C1567, C1260, C227 and C1293.
3. Petrographically examine fine and coarse aggregate sources once every three (3) years, ASTM C295.

C. **Concrete Mix**: Obtain samples per ASTM C172 and run the following tests:

1. Compressive strength, ASTM C39.
2. Unit weight, ASTM C138.
3. Slump, ASTM C143.
4. Air, ASTM C231.
5. Temperature, ASTM C1064.

D. **Concrete Quality Charts**: Comply with ACI 214 and ACI 301. Plot new results and identify trends on quality control charts that comply in form to ASTM STP 15-C. Show the Specified Strength (f_c'), the required Average Strength (f_{cr}), and the compressive strength versus date of Sample.

E. **Equipment**: Certify at least every two (2) years through the services of a design professional licensed in the State of Utah, that plant equipment complies with requirements of the National Ready Mixed Concrete Association and ASTM C94.

1. Transit Trucks: Equip transit trucks with plates indicating total volume, agitating volume and mix volume.
2. Weights and Measures: Comply with regulatory requirements of State of Utah.

PART 3 EXECUTION

3.1 INSTALLATION

A. Placement, Section 03 30 10.

3.2 FIELD QUALITY CONTROL

A. Truck Mixed Concrete (Dry Batch): ASTM C94.

1. Truck Mixer: Fill drum no more than 63 percent of the gross drum volume and no less than two (2) cubic yards. Use drum manufacturer's recommended mixing speed (between 12 – 18 rpm).
2. Truck Agitator: Do not fill drum greater than 80 percent of the gross drum volume. Use drum manufacturer's recommended agitating speed (between 2 – 6 rpm).

B. Mixing Plant: ASTM C94.

1. Use option C and requirements in this Section for preparing ready-mixed concrete.
2. Use scales certified by the State of Utah. Do not use volume measurement except for water and liquid admixtures.
3. Mixing time must exceed 80 seconds after adding air entrainment admixture.

C. Hand Mixing:

1. Do not hand mix batches larger than 0.5 cubic yard.
2. Hand mix only on a watertight platform.
3. Ensure all stones are thoroughly covered with mortar and mixture is of uniform color and consistency before adding water.

END OF SECTION

SECTION 03 30 05
CONCRETE TESTING

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Concrete sampling and testing requirements.

1.2 **REFERENCES**

A. **ACI Standards**:

318 Building Code Requirements for Reinforced Concrete.

B. **ASTM Standards**:

C31 Making and Curing Concrete Test Specimens in the Field.

C39 Compressive Strength of Cylindrical Concrete Specimens.

C42 Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

C78 Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).

C136 Standard Method for Sieve Analysis of Fine and Coarse Aggregates.

C138 Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.

C143 Slump of Portland Cement Concrete.

C172 Sampling Freshly Mixed Concrete.

C173 Air Content of Freshly Mixed Concrete by Volumetric Method.

C231 Air Content of Freshly Mixed Concrete by the Pressure Method.

C567 Unit Weight of Structural Lightweight Concrete.

C1064 Temperature of Freshly Mixed Portland Cement Concrete.

C1077 Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.

1.3 **SUBMITTALS**

A. **Concrete Supplier**: If requested, submit reports and material certificates verifying concrete quality control.

B. **Laboratory**: Promptly submit test data results for seven (7) and 28 day breaks to Supplier, CONTRACTOR and ENGINEER**.**

1.4 **QUALITY ASSURANCE**

A. Provide an ASTM C1077 compliant and ACI certified laboratory.

B. Provide level I ACI certified field sampling technicians.

1.5 **SITE CONDITIONS**

A. **Assist ENGINEER**: Furnish labor to assist ENGINEER in obtaining and handling acceptance Samples at site or sources.

B. **Store and Cure Test Specimens**: Safely store and cure concrete test specimens and acceptance test specimens for first 24 hours:

1. Follow ASTM C31 in making and curing cylinders or beams at site. Do not move the cylinders or beams for the initial 16 hour cure period. Provide initial cure temperature as follows:

   a. 60 to 80 deg F for Class 4,000 or less.

   b. 68 to 78 deg F for Class 5,000 or greater.

2. Equip storage device with an automatic 24 hour temperature recorder with an accuracy of plus or minus two (2) deg F

3. Use water containing hydrated lime if water is to be in contact with cylinders or beams.

4. Ensure the device(s) can accommodate the required number of test cylinders or beams. Lack of capacity will cause the placement of concrete to cease.

5. Have the storage devices available at the point of placement at least 24 hours before placement.

6. A 24 hour test run may be required.

1.6 **ACCEPTANCE**

A. At the Laboratory:

1. Compressive strength, ASTM C31.

2. Flexure strength, ASTM C78.

B. At the Site:

1. Acceptance: Reject non-complying batches until two (2) consecutive batches are compliant then proceed in random batch testing for acceptance.

2. Sampling Protocol: ASTM C172. Unless indicated otherwise follow Table 1 sampling frequency requirements. Collect sample at discharge chute before placement, or at pumper hose after priming grout has been wasted.

Table 1 – Sampling Frequency				
Rate of Placement (Cubic Yard / Day)	**Temperature**	**Air**	**Slump**	**Strength**
0 - 8	1	1	1	Determined by ENGINEER
0 - 50	1	1	1	1
Each additional 50 cu. yd. or fraction thereof	1	1	1	1

3. Testing Protocol:
   a. Temperature, ASTM C1064.
   b. Air content, ASTM C231 or ASTM C173 if lightweight aggregate is used.
   c. Slump, ASTM C143.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 PRECAST PRODUCTS

A. Obtain composite Samples from different portions of the batch.
B. Make and cure concrete test specimens for acceptance, ASTM C31.
C. Cure all precast products with water vapor or water.
D. Do not damage precast products by stripping forms or handling before the concrete reaches its specified strength.

3.2 CAST-IN-PLACE PRODUCTS

A. Obtaining Samples:
   1. Batch samples, ASTM C172.
   2. Core samples, ASTM C42.
B. Identify location of tests on test reports.
C. Compressive strength, ASTM C39:
   1. Mold four (4) test specimens, ASTM C31.
   2. For strength test perform slump, air, unit weight, and temperature test.
   3. Break 1 cylinder at seven (7) days and three (3) cylinders at 28 days. The average strength of three (3) cylinder breaks shall be considered the test result.

4. If any one cylinder in a 28 days test shows definite evidence of improper sampling, molding, handling, curing, or testing, discard the cylinder. The average strength of the remaining cylinders shall be considered the test result.

D. Tensile (flexural) strength, ASTM C78:
   1. Mold four (4) test specimens, ASTM C31.
   2. For strength test perform slump, air, unit weight, and temperature test.
   3. Break 1 beam at seven (7) days and three (3) beams at 28 days. The average strength of the three (3) beam breaks shall be considered the test result.
   4. If any one beam in a 28 days test shows definite evidence of improper sampling, molding, handling, curing, or testing, discard the beam. The average strength of the remaining beams shall be considered the test result.

E. Aggregate, ASTM C136 for fine and coarse aggregate.

F. Slump test, ASTM C143.

G. Air Test:
   1. Normal weight concrete, ASTM C231.
   2. Light weight concrete, ASTM C173.

H. Unit Weight:
   1. Normal weight concrete, ASTM C138.
   2. Light weight concrete, ASTM C567.

I. When requested, test in-place concrete by impact hammer, sonoscope, or other non-destructive device:
   1. To determine relative strengths in various locations in Work.
   2. To aid in evaluating concrete strength.
   3. To select areas to be cored.
   4. To verify quality control in the absence of control testing.

3.3 RETESTING DEFECTIVE CONCRETE STRENGTH

A. If CONTRACTOR desires to do a retest, a request to ENGINEER for retesting must be made within 35 days from time of concrete placement. No coring or retesting shall be done after 40 days have elapsed from the time of placement:
   1. Choose three (3) random test locations and verify choice with ENGINEER. Obtain retest samples per ASTM C42 and test compressive strength per ASTM C39 or flexure strength per ASTM C78.
   2. Establish a chain of custody for all test samples.
   3. If concrete placed in the Work will be dry under service condition, air dry cores for seven (7) days before tests. Unless otherwise specified, use air temperature 60 to 80 deg F and relative humidity less than 60 percent.

4. If concrete placed in the Work will be more than superficially wet under service conditions, test cores after moisture conditioning (liquid or vapor water cure).
5. If more than 1 core shows evidence of having been damaged before testing provide replacement cores, otherwise evaluation will be done on two (2) or more core samples.
6. Evaluate cores in accordance with ACI 318 requirements.
7. If core tests are inconclusive, or impractical to obtain, or if structural analysis does not confirm the safety of the Work, load test may be used and evaluated in accordance with ACI 318 requirements.

B. Coat sides of core hole with concrete epoxy resin adhesive. Fill core holes with non-shrink concrete mortar. Match color and texture of surrounding concrete.

C. Within 40 days from time of placement publish the chain of custody record and the results of retesting.

END OF SECTION

SECTION 03 30 10

CONCRETE PLACEMENT

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Concrete placement for slabs on grade, slabs on fill, structural building frame, and other concrete components.

1.2 **REFERENCES**

A. **ACI Standards**:

301 Structural Concrete for Buildings.

305 Hot Weather Concreting.

306 Cold Weather Concreting.

309 Consolidation of Concrete.

B. **ASTM Standards**:

C881 Epoxy-Resin-Base Bonding Systems for Concrete.

C1059 Latex Agents for Bonding Fresh to Hardened Concrete.

1.3 **SUBMITTALS**

A. **Batch Delivery Ticket**: For each batch delivered to site, identify:

1. Date and Project description.
2. Producer and plant.
3. Name of contractor.
4. Serial number of ticket.
5. Mix identification number or code.
6. Truck number and time dispatched.
7. Volume of concrete.
8. Type and amount of cement.
9. Total water and water/cement ratio.
10. Water added for receiver of concrete and receiver's initials.
11. Admixture types.
12. Separate weights of fine and coarse aggregate.
13. Statement of whether batch is pre-mixed at plant or mixed in transit.

B. **Record of Placed Concrete**: Identify date of record, location of pour, quantity, air temperature, and CONTRACTOR’s quality control test Samples taken.

C. **Bonding Compound**: Identify product name, type, and chemical analysis.

1.4 **QUALITY ASSURANCE**

A. Provide ACI certified finishers.

B. Remove and replace any placed concrete suffering hot or cold weather damage.

C. For control testing follow Section 03 30 05 requirements.

1.5 **ACCEPTANCE**

A General:

1. Price adjustment, Section 01 29 00. CONTRACTOR may request ENGINEER determine appropriate Modifications or payment adjustments to pay for Defective work.
2. Retesting by CONTRACTOR, Section 01 35 10 and Section 03 30 05.

B. Concrete work that fails to meet any of the following requirements will be considered defective. Replace Defective Work at no additional cost to OWNER:

1. Placement:
   a. Reinforcing steel size, quantity, strength, position, damage, or arrangement is not as specified or does not comply with code.
   b. Formwork differs from required dimensions or location in such a manner as to reduce concrete's strength or load carrying capacity or physical esthetics.
   c. Workmanship likely to result in deficient strength.
2. Finishing:
   a. Concrete exposed to view has defects that adversely affect appearance.
   b. Slab tolerances of Section 03 35 00 are not met.
3. Protection:
   a. Method of curing is not as specified.
   b. Inadequate protection of concrete during early stages of hardening and strength development from:
      1) temperature extremes.
      2) rapid moisture loss.
   c. Mechanical injury, construction fires, accidents, or premature removal of formwork likely to result in deficient strength development.

PART 2 PRODUCTS

2.1 **MATERIALS**

A. Concrete: Section 03 30 04. Class as indicated:

1. For roadway cuts, Section 33 05 25.

B. Bonding Compound: ASTM C1059. Either polyvinyl acetate base or acrylic base latex:

1. Use type I in areas not subject to high humidity or immersion in water with minimum bond strength of 400 psi.
2. Use type II in areas subject to high humidity or immersion in water with minimum bond strength of 1250 psi.

C. Vapor Retarder: 10 mil thick clear polyethylene sheet. Type recommended for below grade application.

D. Forms: Section 03 11 00.

E. Reinforcement: Section 03 20 00.

F. Coverings and Curing Compound: Section 03 39 00.

G. Shrinkage Compensating Grouts: Section 03 61 00.

H. Epoxy Adhesive: Section 03 61 00.

PART 3 EXECUTION

3.1 **EXAMINATION**

A. Verify items to be cast into concrete are accurately placed and held securely.

B. Verify slump, air content range, mix identity, and batch time on delivery ticket matches mix design.

C. Verify slab steel mats are supported by steel chairs, precast concrete blocks, or other slab bolsters. Do not pour if absent.

3.2 **PREPARATION**

A. Implement traffic control plan requirements, Section 01 55 26.

B. Notify ENGINEER no later than 24 hours before commencement of concrete placement.

C. Do not allow construction loads to exceed structural capacity.

D. Clean previously placed concrete. Apply bonding compound per manufacturer's instructions.

E. At locations where new concrete is dowelled to existing work, drill, remove dust, insert and pack steel dowels with shrink compensating grout, and expansion caps where required.

3.3 DELIVERY

A. Concrete Temperature: Keep mixed concrete temperature before placement between 60 deg F. and 90 deg F.

B. Slump and Air Content: Keep within allowable ranges.

C. Transport Time:

Air Temperature	Time After Initial Batching
Less than 90 deg F	1–1/2 hours
Greater than 90 deg F	1–hour (without retarder)
Greater than 90 deg F	1–1/2 hours (with retarder)

To increase time past 1-1/2 hours, a hydration stabilizer that is acceptable to Supplier may be used.

D. Tempering:

1. Water may be added if all following conditions are met:
   a. The mix design water/cement ratio is not exceeded.
   b. The delivery ticket allows for addition of water based upon water/cement ratio.
   c. The amount of water added is accurately measured to within 1 gallon of the design addition.
   d. Water addition is followed by three (3) minutes of mixing at mixing speed before discharge.
   e. Supplier and CONTRACTOR mutually agree on who is authorized to add water.
2. **Do not add water after 1 cubic yard of concrete has discharged from the delivery vehicle.**

E. Super-plasticizer: Comply with manufacturer's requirements. If none, then as follows:

1. If added at site, add agent using injection equipment capable of rapidly and uniformly distributing admixture to concrete. Before discharge, mix for a minimum of five (5) minutes at a drum rate not less than 12 rpm or more than 15 rpm.
2. If added at plant, do not deliver to site unless batch delivery ticket displays water/cement ratio before super-plasticizer addition.

3.4 CONCRETE PLACEMENT

A. In General: ACI 301.

1. Do not disturb reinforcement, inserts, embedded parts, and formed joints.
2. Do not break or interrupt successive pours such that cold joints occur.
3. Honeycomb or embedded debris in concrete is not acceptable.

B. Hot Weather Placement: ACI 305. If the rate of evaporation approaches 0.2 lb./ft^2/hr. precautions against plastic shrinkage cracking are necessary. (i.e. dampening Subgrade and forms; placing concrete at the

lowest possible temperature; erecting windbreaks and sunshades; fog sprays; use of evaporation retardants; or rescheduling time of placement).

C. Cold Weather Placement: ACI 306. Accelerating admixture may be used in concrete work placed at ambient temperatures below 50 deg F Use of admixtures will not relax cold weather placement, curing, or protection requirements. . If air temperature is forecasted to fall below 32 deg F. within 14 days of placement, proceed as follows:

1. Provide cold weather protection (cover, insulation, heat, etc.).
2. Do not use chemical "anti-freeze" additives in the concrete. (NOTE: this does not apply to normal accelerators.)
3. Do not proceed with the placement of concrete until the temperature of all contact surfaces is 35 degrees F and ambient temperature is ascending.
4. Protect the concrete from freezing until a compressive strength of at least 90 percent of design strength has been achieved, determined by either:
   a. Maturity meter. Refer to AASHTO T 325, or.
   b. Field cured cylinders.
5. Adequately vent combustion-type heaters that produce carbon monoxide.
6. When applying external heat, maintain moist conditions to avoid excessive moisture loss from concrete.
7. When removing heat, limit drop in temperature of concrete surfaces to 20 degrees F during any 12 hour period until the surface temperature of the concrete reaches that of the atmosphere.

D. Concrete Temperature: Keep mixed concrete temperature at time of placement between 60 deg F and 90 deg F

E. Do not disturb reinforcement, inserts, embedded parts, and formed joints.

F. Do not break or interrupt successive pours such that cold joints occur.

G. Honeycomb or embedded debris in concrete is not acceptable.

3.5 JOINTS AND JOINT SEALING

A. Steel edging and jointing tools are acceptable. Preferred are magnesium, aluminum or wood tools

B. Pavement joint sealing, Section 32 13 73.

3.6 CONSOLIDATION

A. Keep spare vibrator available during concrete placement operations.

B. Follow ACI 309 requirements.

3.7 CURING

A. Section 03 39 00. Use a membrane forming compound unless specified otherwise.

3.8 **FINISHING**

A. Section 03 35 00 and as follows.

Table 1 – Finishes	
Type of work	**Finish**
Sidewalks, garage floors, ramps, exterior concrete Pavement	Broom or belt
Exterior platforms, steps, and landings, exterior and interior pedestrian ramps, not covered by other finish materials	Non-slip
Surfaces intended to receive bonded applied cementitious applications	Scratched
Surfaces intended to receive roofing, except future floors, waterproofing membranes, and roof surfaces that are future floors or sand bed terrazzo	Floated
Floors and roof surfaces that are floors intended as walking surfaces or to receive floor coverings	Troweled
Unpainted concrete surfaces not exposed to public view	Rough as-cast form finish
Unpainted concrete surfaces exposed to public view	Smooth as-cast form finish
Concrete surfaces to receive paint or plaster	Grout cleaned finish

3.9 **PROTECTION AND REPAIR**

A. Protection, Section 01 66 00:

1. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, graffiti, and mechanical injury.
2. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

B. Repair:

1. Modify or replace concrete not conforming to required levels, lines, details, and elevations.
2. Structural analysis and additional testing may be required at no additional cost to OWNER when the strength of a structure is considered potentially deficient.
3. To patch imperfections refer to Section 03 35 00 requirements.
4. Remove graffiti and mechanical injury.

END OF SECTION

SECTION 03 35 00

CONCRETE FINISHING

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Finishing interior and exterior concrete surfaces.

1.2 **REFERENCES**

A. **ACI Standards**:

303 Guide to Cast-in-Place Architectural Concrete Practice.

1.3 **SUBMITTALS**

A. Name, type, chemical analysis and manufacturer's recommended rate of application for liquid chemical hardener.

1.4 **PROJECT CONDITIONS**

A. Protect adjacent materials and finishes from dust, dirt and other surface or physical damage during finishing operations. Provide protection as required and remove from site at completion of Work.

PART 2 PRODUCTS

2.1 **MATERIALS**

A. Masonry Mortar and Grout: Section 04 05 16.

B. Dry Shake: Blend of metallic or mineral aggregate with Portland cement concrete in proportions recommended by manufacture.

C. Proprietary Materials: If permitted or required, proprietary compounds may be used in lieu of or in addition to foregoing blended materials. Use such compounds per manufacturer's recommendations.

D. Liquid-Chemical Hardener: Colorless, aqueous solution containing a blend of magnesium fluosilicate, zinc fluosilicate and a wetting agent. Mixture contains not less than two (2) pounds fluosilicate per gallon and does not interfere with adhesives and bonding.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Examine areas and conditions under which work of this section will be performed.

B. Correct conditions detrimental to timely and proper finishing.

C. Do not proceed until unsatisfactory conditions are corrected.

3.2 **FINISHING HORIZONTAL SLABS**

A. **Do not apply water (i.e. sprinkle) to any surface of concrete when finishing slabs.**

B. Edges and Joints: Tools may be made out of steel. Preferred is wood, aluminum or magnesium.

C. Tolerances:

1. Class A: 1 in 1000.
2. Class B: 1 in 500.
3. Class C: 1 in 250.

D. Float Finish: After concrete has been placed, consolidated, struck-off, and leveled, do not work further until ready for floating:

1. Begin floating when water sheen has disappeared and surface has sufficient stiffness.
2. During or after first floating, check planeness of entire surface with a 10 feet long straightedge applied at two (2) or more different angles.
3. Cut down high spots and fill low spots to the required tolerance.
4. Refloat slab immediately to a uniform sandy texture.

E. Trowel Finish:

1. Do not use steel trowel or a power trowel on exterior concrete or on concrete that contains more than three (3) percent air.
2. First troweling shall produce smooth surface relatively free of defects but which may still show some trowel marks.
3. Second troweling after surface has stiffened shall make finished surface essentially free of trowel marks, uniform in texture and appearance.
4. On surfaces intended to support floor coverings, grind off defects that would show through floor covering.

F. Broom or Belt Finish: Sweep surface with brushes, rakes, tines or burlap belt before final set.

G. "Dry Shake" Finish: Give the surface a floated finish. Evenly apply approximately 2/3 of a blended unsegregated material:

1. Begin floating immediately after application of first "dry shake".
2. After material has been embedded by floating, apply remainder of blended material to surface at right angles to previous application.
3. Make second application heavier in any areas not sufficiently covered by first application.
4. Immediately follow with second floating.
5. After selected material has been embedded by second floating, complete operation with a broomed, floated, or troweled finish, as indicated.

H. Non-slip Finish: Give surface a "dry shake" application, using crushed ceramically bonded aluminum oxide particles. Apply at 25 pounds per 100 square feet.

I. Exposed Aggregate Finish: Immediately after surface of concrete has been leveled to tolerance and surface water has dissipated, spread aggregate uniformly over surface to provide complete coverage to the depth of a single stone:

1. Embed aggregate into surface by light tamping.
2. Float surface until embedded aggregate is fully coated with mortar and surface has been brought to tolerance.
3. Start exposure of aggregate after matrix has hardened sufficiently to prevent dislodgment.
4. Flow ample quantities of water, without force, over surface of concrete while matrix encasing aggregate is removed by brushing with a fine bristle brush.
5. Continue until aggregate is uniformly exposed.
6. An approved chemical retarder sprayed onto freshly floated surface may be used to extend working time.

J. Chemical-Hardener Finish: Apply liquid chemical-hardener finish to interior concrete floors where indicated. Do not apply liquid chemical hardener on floor areas scheduled to receive synthetic matrices terrazzo, setting beds for tile, terrazzo, vinyl flooring, or like items. Apply hardener after complete curing and drying of concrete surface per manufacturer's recommendations. Evenly apply each coat, and allow 24 hours for drying between coats. After final coat of chemical-hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water.

3.3 FINISHING FORMED SURFACES

A. General:

1. Allow concrete to cure not more than 72 hours before commencing surface finish operations, unless approved otherwise.
2. Revise the finishes as needed to secure approval.

B. As-Cast Form Finish:

1. Rough: Patch defects, chip or rub off fins exceeding 1/4 inch height.
2. Smooth: Patch tie holes and defects and remove fins completely:
   a. When surface texture is impaired and form joints misaligned, grind, bush-hammer, or correct affected concrete.
   b. Slurry grout areas evidencing minor mortar Leakage to match adjacent concrete.
   c. Repair major mortar Leakage as a defective area.
   d. When workmanship is less than acceptable standard, provide one of rubbed finishes at no additional cost to OWNER.

C. Rubbed Finishes:
   1. Smooth: Remove forms and perform necessary patching as soon after placement as possible:
      a. Finish newly hardened concrete no later than 24 hours following form removal.
      b. Wet surfaces and rub with carborundum brick or other abrasive until uniform color and texture are produced.
   2. Grout Cleaned: Undertake no cleaning operations until all contiguous surfaces are completed and accessible:
      a. Wet surface of concrete sufficiently to prevent absorption of water from grout.
      b. Apply grout uniformly.
      c. Immediately after grouting, scrub surface with cork float or stone to coat surface and fill voids.
      d. While grout is still plastic, remove excess grout by working surface with rubber float or sack.
      e. After surface whitens from drying, rub vigorously with clean burlap.
      f. Keep damp for at least 36 hours after final rubbing.
   3. Cork Floated: Remove forms within two (2) to three (3) days of placement where possible:
      a. Remove ties.
      b. Remove all burrs and fins.
      c. Dampen wall surface.
      d. Apply mortar with firm rubber float or with trowel, filling all surface voids.
      e. Compress mortar into voids.
      f. If mortar surface dries too rapidly to permit proper compaction and finishing, apply a small amount of water with fog sprayer.
      g. Produce final texture with cork float using a swirling motion.

D. Unformed Finish:
   1. After concrete is placed, strike smooth, tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces.
   2. Float to texture that is reasonably consistent with formed surfaces.
   3. Continue final treatment on formed surfaces uniformly across uniformed surfaces.

E. Blasted Finish:
   1. Perform abrasive blasting within 24 to 72 hours after casting.
   2. Coordinate with form work construction, concrete placement schedule, and formwork removal to ensure that surfaces are blasted at the same age for uniform results.

3. Reapply curing protection after blast finishing

F. Architectural Finish, ACI 303:

1. Tooled Finish:

a. Dress thoroughly cured concrete surface with electric, air, or hand tools to uniform texture, and give a bush hammered surface texture.

b. Remove sufficient mortar to exposed coarse aggregate in relief and to fracture coarse aggregate for tooled finish.

G. Patched Finish:

1. Repair defective areas:

a. Remove honeycomb and defective concrete to sound concrete.

b. Make edges perpendicular to surface or slightly undercut.

c. Feather edges are not permitted.

d. Dampen area to be patched and at least six (6) inches surrounding it to prevent absorption of patching mortar water.

e. Prepare bonding grout.

f. Mix to consistency of thick cream.

g. Brush into surface.

2. Tie Holes: Unless indicated otherwise, after being cleaned and thoroughly dampened, fill tie hole solid with patching mortar.

3. Make patches in concrete closely match color and texture of surrounding surfaces. Determine mix formula for patching mortar by trial and obtain a good color match with concrete when both patch and concrete are cured and dry:

a. Mix white and gray Portland cement as required to match surrounding concrete to produce grout having consistency of thick paint.

b. Use a minimum amount of mixing water.

c. Mix patching mortar in advance and allow to stand without frequent manipulation, without addition of water, until it has reached stiffest placeable consistency.

d. After initial set, dress surfaces of patches manually to obtain same texture as surrounding surfaces.

4. After surface water has evaporated from patch area, brush bond coat into surface:

a. When bond coat begins to lose water sheen, apply patching mortar.

b. Thoroughly consolidate mortar into place and strike-off to leave patch slightly higher than surrounding surface.

c. Leave undisturbed for at least one (1) hour before final finish.

d. Keep patched area damp for 72 hours or apply curing compound.

e. Do not use metal tools in finishing an exposed patch.

5. Where as-cast finishes are indicated, total patched area may not exceed 1 in 500 of as-cast surface. This is in addition to form tie patches, if ties are permitted to fall within as-cast areas.

6. In any finishing process which is intended to expose aggregate on surface, patched areas must show aggregate:

   a. Outer 1 inch of patch shall contain same aggregate as surrounding concrete.

   b. For aggregate transfer finish, patching mixture shall contain same selected colored aggregates.

   c. After curing, expose aggregates together with aggregates of adjoining surfaces by same process.

END OF SECTION

SECTION 03 39 00

CONCRETE CURING

PART 1 GENERAL

1.1. **SECTION INCLUDES**

A. Concrete curing requirements.

1.2 **REFERENCES**

A. **ACI Standards**:

301 Structural Concrete for Buildings.

305 Hot Weather Concreting.

306 Cold Weather Concreting.

B. **ASTM Standards**:

C171 Sheet Materials for Curing Concrete.

C1315 Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

1.3 **SUBMITTALS**

A. Curing agent data sheet.

B. Curing plan. Describe estimated cure quantity and procedure.

C. Manufacturer certificates, Section 01 33 00 that shows product meets performance criteria.

D. Manufacturer's recommended installation procedures which, when accepted by ENGINEER, will become the basis for accepting or rejecting installed product.

1.4 **QUALITY ASSURANCE**

A. Use workers knowledgeable of ACI 301, 305, 306.

1.5 **PRODUCT HANDLING**

A. Protect materials of this Section before, during, and after installation.

B. Protect the work and materials of other trades.

C. In the event of damage, immediately make replacements and repair at no additional cost to OWNER.

1.6 **WEATHER LIMITATIONS**

A. Above 75 deg F, ACI 305

B. Below 55 deg F, ACI 306.

PART 2 PRODUCTS

2.1 COVERS

A. Water or Fog-spay: Clean, non-staining and non-detrimental to concrete.

B. Sheet Coverings: White waterproof paper, polyethylene film, or polyethylene coated burlap sheet complying with ASTM C171.

C. Mat Coverings: Clean roll goods of cotton or burlap fabric.

D. Insulating Coverings: Non-staining curing blankets.

2.2 MEMBRANE FORMING COMPOUND

A. Material:
   1. Styrene-acrylic.
   2. Styrene-butadiene.
   3. Alpha-methylstyrene.

B. Reference: ASTM C1315:
   1. Type II Class A or B (white pigmented).
   2. Type ID Class A (clear with fugitive dye).

C. Volatile Organic Compounds (VOC): Comply with local, state and federal requirements.

PART 3 EXECUTION

3.1 PREPARATION

A. *DO NOT DILUTE CURING COMPOUNDS.*

B. Do not use membrane forming curing compound on surfaces that are to receive hardeners.

C. Commence curing operation within 20 minutes after finishing.

3.2 APPLICATION – COVERS

A. Water: Apply water-fog spray or ponding.

B. Absorptive Mat: Place absorptive mat to provide coverage of concrete surfaces and edges. Lap over adjacent absorptive covers. Thoroughly saturate with water and keep continuously wet.

C. Moisture-Retaining Sheet: Place cover in widest practicable width with sides and ends lapped and sealed to prevent moisture loss. Repair any holes or tears during curing period.

D. Formed Surface Curing: Cure formed concrete surfaces, including underside of beams, supported slabs and other similar surfaces by moist curing with forms in place for full curing period. If forms are removed before curing completion, applying cure film or penetrant or use methods indicated above, as applicable.

3.3 APPLICATION – MEMBRANE FORMING COMPOUND

A. Apply coating continuously and uniformly. Follow manufacturer's recommendations.

B. Protect continuity of film coatings and repair damage during cure period.

C. If forms are removed before expiration of cure period, apply coating to unprotected areas.

3.4 CONCRETE CURE TEMPERATURE

A. During cure period, eliminate thermal shock of concrete by keeping cure temperature even throughout extent and depth of concrete.

3.5 SCHEDULE

A. Concrete Exposed to Potable Water (as in Water Storage reservoirs):
   1. Moisture cover curing, or
   2. Acrylic cure, or
   3. Styrene acrylic silane co-polymer cure.

END OF SECTION

SECTION 03 40 00

PRECAST CONCRETE

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Pre-cast concrete, complete with required connecting and supporting devices.

1.2 **REFERENCES**

A. **ACI Standards**:

318 Building Code Requirements for Reinforced Concrete. This reference standard includes ASTM material standards.

B. **ASTM Standards**:

A36: Structural Steel.

C478 Precast Reinforced Concrete Manhole Sections.

C857 Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.

C858 Underground Precast Concrete Utility Structures.

C891 Installation of Underground Precast Concrete Utility Structures.

C. **AWS Standards**:

D1.1 Structural Welding Code Steel.

D1.4 Structural Welding Code Reinforcing Steel.

D. **PCI Standards**:

Design Handbook.

MNL-116 Quality Control and Assurance for Plant Production of Prestressed Concrete.

MNL-117 Quality Control and Assurance for Plant Production of Architectural Precast Concrete.

1.3 **DESIGN CRITERIA**

A. Design structural precast concrete units, ACI 318 and PCI design handbook.

B. Design utility precast units, ASTM C857 and C858.

C. Under direct supervision of a design professional who is fully experienced in design of units.

D. Design units to support required stripping and handling loads, and live, dead and construction loads.

E. Design component connections to provide adjustment to accommodate misalignment of structure during installation.

1.4 **SHOP DRAWINGS**

A. Prepare Shop Drawings under seal of a licensed design professional.

B. Submit Shop Drawings, Section 01 33 00.

C. Indicate unit locations, unit identification marks, fabrication details, reinforcement, connection details, pertinent dimensions, and erection support points. Unit identification marks to appear on all manufactured units.

D. Do not proceed with fabrication until Shop Drawings have been accepted.

1.5 **QUALITY ASSURANCE**

A. Manufacturer:
   1. Prestressed: PCI certified.
   2. Precast Concrete Units: PCI or NPCA certified
   3. Precast Utility Structures and Pipe: ACPA certified.

B. Transporter: Acceptable to manufacturer.

C. Erector:
   1. Prestressed: PCI certified.
   2. Precast: Has five (5) years minimum experience in erecting precast units.

D. Welders: Certified, AWS D1.1 and AWS D1.4.

1.6 **DELIVERY, STORAGE AND HANDLING**

A. Handle precast units in positions consistent with their shape and design. Lift and support only from support points indicated on Shop Drawings.

B. Embedded Lifting or Handling Devices: Capable of supporting units in positions anticipated during manufacture, storage, transportation, and erection.

C. Block and laterally brace units while stored at manufacturers. Provide lateral bracing that is sufficient to prevent bowing and warping that is clean, nonstaining, and will not inhibit uniform curing of exposed surfaces.

D. Provide edges of units with adequate protection to prevent staining, chipping, or spalling of concrete.

E. Unless otherwise approved in writing, do not deliver units to job site until required for installation.

PART 2 PRODUCTS

2.1 **CONCRETE**

A. Above Ground: 5000 psi minimum, Section 03 30 04 and ACI 318.

B. Underground: Class 4000 minimum, Section 03 30 04 and ASTM C478 or ASTM C858.

2.2 ACCESSORIES

A. Connecting and Supporting Devices: Steel, ASTM A36.

B. Bolts, Nuts, and Washers: High-strength steel. Section 05 05 23.

C. Reinforcement: Grade 60 billet steel bars, Section 03 20 00 plain finish

2.3 FABRICATION

A. Maintain plant records and quality control program during production of structural precast concrete. Make records available to ENGINEER.

B. Use molds which are rigid and constructed of material that will result in uniform finished products.

C. If self consolidating concrete is NOT used, vibrate concrete to ensure proper consolidation, elimination of unintentional cold joints, and minimize entrapped air on surface.

D. Fabricate required connecting devices, plates, angles, items fit to steel framing members, bolts and accessories.

E. Ensure reinforcing steel, anchors, inserts, plates, angles, and other cast-in items are sufficiently embedded, anchored and property located.

F. Ensure finished surfaces of precast structural units are uniform.

G. Cure units under identical conditions to develop specified concrete quality, and minimize appearance blemishes such as non-uniformity, staining or surface cracking.

2.4 DESIGN DEVIATIONS

A. Deviation: Provide installation equivalent to basic intent without additional cost to OWNER. Deviations from exact required cross-section will be permitted only with approval.

B. Manufacturer's Proposed Design: Supported by complete design calculations and drawings. When requested, submit design calculations for review bearing seal and signature of a licensed design professional.

2.5 OPENINGS

A. Provide required openings, six (6) inches or larger. If approved, smaller sizes may be field constructed by coring or sawing.

2.6 FINISHES

A. General: Required finish will be described in one of the following paragraphs. If no finish is indicated or selected by ENGINEER, provide Standard Finish.

B. Standard Finish: Produced in forms such as plastic or metal lined that impart a smooth finish to the concrete. Small surface holes, normal form joint marks, minor chips and spall are acceptable if approved. Major or unsightly imperfections, honeycomb or structural defects are not acceptable.

C. Commercial Finish: Produced in forms such as plywood or lumber that impart texture to concrete. Remove fins and large projections. Fill holes over 3/8 inch. Make faces true and well defined. Correct exposed ragged edges by rubbing or grinding.

D. Architectural Grade A Finish: Produced in forms such as plastic or metal lined that impart smooth finish to concrete. Fill holes over 1/4 inch in diameter with sand-cement paste. Grind smooth form offsets or fins over 1/8 inch. Coat with neat cement paste using float. After paste coat has dried, rub with burlap to remove loose particles.

E. Architectural Grade B Finish: Produced in forms such as plastic or metal lined that impart smooth finish to concrete. Fill holes over 1/4 inch in diameter with sand-cement paste. Grind smooth form offsets or fins over 1/8 inch.

F. Special Finishes: Sandblasting, acid washing, retarders or form liners as approved by ENGINEER. Special finishes require submittal of two 12 x 12 inch Samples showing a representative color and texture to be used.

G. Painted Finishes: On concrete to be painted, use a form release agent acceptable to the paint manufacturer.

2.7 **REPAIR**

A. Repair of damaged units is acceptable if structural integrity or appearance is not impaired.

2.8 **ALLOWABLE TOLERANCES**

A. Length: Plus or minus 3/4 inch, or plus or minus 1/8 inch per 10 feet of length, whichever is greater, or as indicated.

B. End Squareness: 1/2 inch maximum.

C. Blockouts: 1 inch of centerline location indicated.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Do not install precast units until concrete has attained its design compressive strength.

B. Install members plumb, level, and in alignment within PCI MNL-116 or PCI MNL-117 and indicated limits of erection tolerances.

C. Clean weld marks or other marks, debris, or dirt from exposed surfaces of units.

D. Install underground utility precast units per ASTM C891.

3.2 **PERFORMANCE REQUIREMENTS**

A. Conduct inspections, perform testing, and make repairs or replace unsatisfactory precast units as required.

B. Rejection: Units may be rejected for any one of the following:
   1. Exceeding specified installation tolerances.
   2. Damaged during construction operations.
   3. Exposed-to-view surfaces which develops surface deficiencies.
   4. Other defects as listed in PCI MNL-116 or PCI MNL-117.

END OF SECTION

SECTION 03 61 00

CEMENTITIOUS GROUTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pre-mixed non-metallic shrinkage resistant grout, pre-mixed water stop hydraulic cement grout, epoxy grout, and Portland cement grout:

1. Grout for leveling beds of structural steel plates.
2. Sealing of joints and gaps between piping and structures.
3. Sealing of joints between construction components.

1.2 REFERENCES

A. **ASTM Standards**:

C109	Compressive Strength of Hydraulic Cement Mortars (Using 2 in. or 50 mm Cube Specimens).
C144	Aggregate for Masonry Mortar.
C150	Portland Cement.
C190	Tensile Strength of Hydraulic Cement Mortars.
C207	Hydrated Lime for Masonry Purposes.
C472	Physical Testing of Gypsum Plasters and Gypsum Concrete.
C595	Blended Hydraulic Cements.
C881	Epoxy - Resin - Base Bonding Systems for Concrete.
C1090	Measuring Changes in Height of Cylindrical Specimens from Hydraulic-Cement Grout.
C1107	Packaged Dry Hydraulic Cement (Non-Shrink).
C1157	Blended Hydraulic Cement.
D570	Water Absorption of Plastics.
D638	Tensile Properties of Plastics.
D695	Compressive Properties of Rigid Plastics.

1.3 SUBMITTALS

A. Grout mix components. Indicate proportions used, environmental conditions, and admixture limitations. Indicate material "Type", "Grade", and "Class" which suits Project requirements.

B. Manufacturer's data for latex bonding agent.

PART 2 PRODUCTS

2.1 MATERIALS - GENERAL

A. Cement:
   1. Portland: Natural color Type II (normal) or Type IIA (air entrained), ASTM C150.
   2. Blended: ASTM C595 or C1157.

B. Lime: Type S, hydrated, ASTM C207.

C. Water: Clean, non-staining, non-detrimental.

D. Aggregate: Standard masonry type, ASTM C144.

2.2 PORTLAND CEMENT GROUT

A. Proportions by Volume: One part Portland cement, and sand equal to 2-1/2 to three times sum of volumes of cement and lime.

B. Mix thoroughly with water to form a stiff workable plastic putty.

C. Compressive Strength: 2800 psi in 28 days, ASTM C109.

2.3 GYPSUM PLASTER GROUT

A. Premixed, prepackaged, wood fiber gypsum plaster with an ASTM C472 minimum average dry compressive strength of 2000 psi in 28 days.

B. Mix with water per manufacturer's instructions for intended use to form a stiff plastic mix required for workability.

2.4 CEMENT BASED SHRINKAGE RESISTANT GROUT

A. Grade B or Grade C: ASTM C1107. Premixed, non-metallic, non-gaseous product at a fluid consistency (flow cone) of 20 to 30 seconds. Thirty-minute-old grout shall flow through flow cone after slight agitation, in temperatures of 40 deg F to 90 deg F

B. Bleeding: None.

C. Compressive Strength: 6500 to 9000 psi in 28 days, ASTM C109.

D. Non-shrink percentage: 0.5 percent, ASTM C1090.

2.5 EPOXY ADHESIVE GROUT

A. Two component material, ASTM C881. Suitable for use on dry or damp surfaces, 100 percent solids, high modulus, moisture insensitive:
   1. Tensile Strength: 5000 psi minimum in 14 days, ASTM D638.
   2. Tensile Elongation: Two (2) percent minimum, ASTM D638.
   3. Compressive Strength: 6500 psi minimum in 24 hours and 70 deg F, 12,500 psi in 28 days and 70 deg F , ASTM D695.
   4. Water Absorption: One percent maximum, ASTM D570.
   5. Bond Strength:

a. Direct Shear: 400 psi.

b. Direct Tension: 250 psi.

c. Beam Break: 800 psi.

6. Pot Life: Five minutes maximum at 70 deg F

2.6 **BONDING GROUT**

A. Of approximately one part cement to one part fine sand passing a No. 30 sieve with approved latex bonding agent when allowed.

2.7 **PNEUMATICALLY PLACED PLASTER ("GUNITE" OR "SHOTCRETE")**

A. Materials: Portland cement, lime, water and sand.

B. Compressive Strength: 2800 psi in 28 days, ASTM C109.

C. Proportioning: One part cement to not more than five parts sand.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Fill joints, voids, and pockets, completely.

B. Comply with manufacturer's instructions and UBC Chapter 47.

C. Finish surfaces exposed to view smooth.

D. Pneumatically Placed Plaster: Screened and reused rebound material in an amount not greater than 25 percent of the total sand in any batch.

END OF SECTION

DIVISION 4 - MASONRY

SECTION 04 22 00 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish all materials and construct the brick masonry work for the project, complete, including the furnishing, fabrication and placing of reinforcing steel, clips, ties, anchors and the setting of embedded items all in accordance with the requirements of the Contract Documents.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Submittal Procedures – Section 01 33 00

B. Concrete - Section 03 30 04

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. The latest edition of the International Building Code (IBC) published by the International Conference of Building Officials, Chapter 21.

B. ASTM C-90.

C. ASTM C404 Std. Spec. for Aggregates for masonry grout.

D. ASTM A 615-86 - Standard Specifications for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

E. ASTM C270 Std. Spec. for Mortar for Unit Masonry.

F. ASTM A-92-85 - Standard Specification for Steel Wire, Plain for Concrete Reinforcement.

G. ASTM C144 - Standard Spec. for Aggregates for masonry mortar.

H. ASTM C150 Std. Spec. for Portland Cement.

I. ASTM C207 Std. Spec. for Hydrated lime for masonry.

1.4 CONTRACTOR SUBMITTALS

A. Submit full-sized samples of concrete masonry units of each type, color and texture required. Also submit certification that the product meets ASTM C90, Type I moisture controlled, Grade N units.

B. The Contractor shall prepare in accordance with UBC Standard No. 24-26, a set of five (5) masonry prisms using a representative test batch of mortar and masonry materials to be used in the structure. These prisms shall be tested by a certified testing laboratory. Samples of the trial batch mortar used in preparing the prisms shall also be taken in

accordance with UBC Standard No. 24-22 and tested by a certified testing laboratory. The prism and mortar test reports shall be submitted to the Engineer prior to beginning masonry construction. All costs for these preliminary tests shall be paid for by the Contractor.

1.5 QUALITY ASSURANCE

A. The size, color and texture of the masonry units shall be as specified herein under Part 2, Products. The color of the mortar shall be determined in the field, prior to construction, as best matches masonry and approved by the Engineer.

B. During construction, a set of three (3) masonry prisms shall be built and tested in accordance with UBC Standard No. 24-26 for each 5,000 square feet of wall area, but not less than one (1) set of three (3) masonry prisms per individual structure. The costs of sampling, testing and test reports shall be paid for by the Contractor. The compressive strength of masonry determined in accordance with UBC Standard No. 24-26 for each set of prisms shall equal or exceed the minimum strengths specified herein.

C. During masonry construction, filling grout shall be sampled and tested in accordance with UBC Standard No. 24-28. The following schedule shall be followed:

1. During grouting operations one (1) test shall be taken per lift. The tests shall consist of three (3) specimens which are made in accordance with UBC Standard No. 24-28. Grout compressive strength shall equal or exceed the minimum strengths specified herein.

D. All prism, mortar and grout testing shall be performed by a certified testing laboratory that shall be subject to the approval of the Engineer. All costs of sampling, testing and reporting shall be paid for by the Contractor. Additional tests requested by the Engineer will be paid for by the Owner, except that tests indicating non-compliance with the Contract Documents shall be paid for by the Contractor.

PART 2 - PRODUCTS

2.1 CMU

A. Hollow concrete masonry units shall be . . .

1. Grade: N
2. Type: I
3. Size: 8-inch x 8-inch x 16-inch
4. Color: Color Selected by Owner
5. The minimum masonry assemblage compressive strength, f'm, at age of 28 days shall be 1500 psi.
6. Finish:
   a. Standard Finish - not textured.
      1) Integrally colored to match engineer's sample, for walls on exterior of building.
      2) Standard color.
   b. Split Face Textured Units with single score.

1) Integrally colored to match engineer's sample for walls on exterior of building.

b. Smooth Face Textured Units with single score.

1) Integrally colored to match engineer's sample for walls on exterior of building.

2.2 REINFORCEMENT AND METAL ACCESSORIES

A. Reinforcement steel and metal accessories for all reinforced hollow clay masonry shall conform to the following requirements:

1. Reinforcing bars shall be Grade 60 and shall conform to the requirements of ASTM A 615-86 for deformed billet steel for concrete reinforcement.

2. Joint reinforcement shall be manufactured with wire conforming to UBC Standard No. 24-15 and ASTM A 82-85. Joint reinforcement wire shall be formed from wire that has been zinc coated in accordance with the referenced standards, Class I.

2.3 MORTAR AND GROUT

A. Mortar: Mortar shall be Type S Portland Cement Lime bay proportion with a minimum 28-day 1800 psi. The color of mortar shall match adjacent CMU color as selected by engineer from manufacturer's full range of colors.

B. Grout: Grout shall have a minimum 28-day compressive strength of 3500 psi. Proportions shall be one (1) part Portland Cement, two to three (2-3) parts sand, and not more than one (1) part pea gravel. Grout shall have a slump of 9-inches plus or minus 1-inch. Transit-mixed grout may be used and shall be continually rotated at idle speed from the time the water is added until the grout is discharged.

2.4 MISCELLANEOUS MATERIALS

A. Portland Cement shall be Type I or II, low alkali, conforming to UBC Standard No. 26-1 (ASTM C 150). Masonry cements or plastic cements will not be permitted.

B. Hydrated lime shall be Type N conforming to UBC Standard 24-18.

C. Mortar aggregates shall conform to UBC Standard No. 24-21 (ASTM C 144). Grout aggregate shall conform to UBC Standard No. 24-23 (ASTM C 404).

D. Water for mixing into mortar or grout shall be clear, potable water.

E. Admixtures other than coloring for use in mortar and grout shall not be used unless approved by the engineer. Coloring admixture for mortar shall be pure mineral oxide pigments delivered in sealed packages providing accurate measured amounts for uniform mix proportioning and color shall be approved by the Engineer.

PART 3 - EXECUTION

3.1 COLD WEATHER CONSTRUCTION

A. All masonry work shall be performed only under weather conditions and in conformance with UBC Section 2404(c) and subject to the approval of the Engineer.

3.2 PREPARATION OF FOUNDATION

A. Prior to laying the first course of masonry, the concrete foundation surface shall be clean and free of latence, loose aggregate, grease and curing materials. This surface preparation shall be accomplished by sandblasting or high pressure washing. The surface shall be rough to provide a good bond between foundation concrete, mortar and grout.

B. The foundation shall be sufficiently level such that the bed joint thickness is not less than 1/4-inch nor more than 5/8-inch. The foundation face shall be sufficiently true to line so that the masonry face projects no more than 1/4-inch.

3.3 MATERIAL HANDLING, STORAGE AND PREPARATION

A. Cement, lime and other calcareous materials delivered to the site shall be properly stored and protected from the weather in unbroken bags, barrels or other approved containers which are plainly marked and labeled with the manufacturers' names and brands. Materials shall be stored and handled in a manner which will prevent the intrusion of foreign materials and damage by water or dampness.

B. Masonry units shall be handled with care to avoid chipping and breakage and shall be protected from contact with the earth and exposure to the weather and shall be kept dry and clean until used. Materials stored on newly constructed floors shall be stacked in such a manner that the uniformly-distributed loading does not exceed 30 psf.

C. Reinforcing steel and all embedded items shall be stored off the ground and shall be protected from mud, oil, concrete, mortar, grout and weather conditions that will cause excessive rusting.

3.4 PLACING MASONRY UNITS

A. Masonry units shall be placed in the pattern and per the details called for on the Drawings. All work shall be plumb, level and true to line with all corners and angles square unless otherwise indicated on the Drawings.

B. All masonry cutting shall be by machine.

C. Vertical and horizontal mortar joints shall be 3/8-inch and tooled to a concave pattern.

D. The Contractor shall set or embed all required anchors, bolts, reglets, sleeves, conduits and other items as called for in the Drawings. All adjoining work including door jams and corners shall be protected from damage or disturbance during the masonry work. All sills, ledges and offsets shall be protected from droppings of mortar.

3.5 REINFORCING STEEL

A. Reinforcement bar details shall conform to UBC Section 2409(e) and shall be placed as shown on the Drawings. All dowels shall be in proper location prior to start of the work. Securing reinforcing bars in their proper position shall be strictly adhered to.

B. Horizontal joint reinforcement shall conform to UBC Section 2407(h) and (f) and shall be placed as shown on the Drawings.

3.6 GROUTING

A. Grouting operations and conditions shall conform to UBC Standard Section 2404. Only low lift grouting to a maximum height of 5-feet will be permitted during any twenty-four (24) hour period.

B. Grout shall be placed in a continuous pour, shall be consolidated by puddling or mechanical vibrating during placing and shall be reconsolidated after excess moisture has been absorbed, but before plasticity has been lost.

3.7 POINTING AND CLEANING

A. At the completion of the work all holes or defective mortar joints in exposed masonry shall be pointed. Defective joints shall be cut out and repointed.

B. Exposed masonry shall be protected against staining from wall grouting or other sources and excess mortar shall be cleaned off the surfaces as the work progresses.

C. At the completion of the work, all exposed masonry shall be cleaned using a dilute acid solution.

D. All waste and surplus masonry materials shall be removed from the job and all stains or dirt from this operation affecting adjacent surfaces shall be removed by an approved cleaning method.

E. All masonry walls shall be sealed per the requirements of Section 09 98 00, entitled "Protective Coatings", herein.

END OF SECTION

DIVISION 5 – METALS

SECTION 05 80 13 - MISCELLANEOUS METALWORK

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish, fabricate and install miscellaneous metalwork and appurtenances, complete and in accordance with the requirements of the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. All work specified herein shall conform to or exceed the requirements of the Building Code and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section.

B. Products and their delivery, handling and installation shall be in accordance with the following trade standards, codes or specifications.

C. Commercial Standards:

Aluminum Assn. AA-M32	C22A41
AISC	Specifications and Commentary
AISI	Specifications and Commentary
ASTM A 36/A36M	Specification for Structural Steel
ASTM A 48	Specification for Gray Iron Castings
ASTM A 53	Specification for Pipe, Steel, Black and Hot-Dipped Zinc-Coated, Welded and Seamless
ASTM A 123	Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strip
ASTM A 153	Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	Specification for Carbon Steel Externally Threaded Standard Fasteners
ASTM A 563	Specification for Carbon and Alloy Steel Nuts
ASTM A 575	Specifications for Steel Bars, Carbon, Merchant Quality, M-Grades

ANSI/AWS D1.1	Structural Welding Code - Steel
NFPA 101	Life Safety Code
NAAMM	Metal Stairs Manual

1.3 CONTRACTOR SUBMITTALS

A. Shop Drawings: Shop drawings of all miscellaneous metalwork shall be submitted to the Engineer for review in accordance with Section 01 33 00 entitled, "Submittal Procedures".

B. Welders Qualifications: Welders shall submit certified qualifications for the type of welding being performed.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Standard: All structural steel shapes, plates, bars and their products shall conform to the requirements of ASTM A 36.

B. Corrosion Protection: Unless otherwise shown, miscellaneous metalwork of fabricated steel, which will be used in a corrosive environment and/or will be submerged in water/wastewater shall be coated in accordance with Section 09 98 00 entitled, "Protective Coatings", and shall not be galvanized prior to coating. All other miscellaneous steel metalwork shall be hot-dip galvanized after fabrication as specified herein.

C. Stainless Steel: Stainless steel metalwork shall by of Type 316 stainless steel.

2.2 STEEL PIPE HANDRAILS

A. Steel pipe handrails which may be partially or wholly submerged or which are located inside a hydraulic structure shall be entirely of Type 316 stainless steel. All other steel pipe handrails shall be standard 1-1/2-inch black steel pipe made up by welding and hot-dip galvanized after fabrication.

2.3 METAL GRATING AND FLOOR HATCHES

A. General: Metal grating and floor hatches shall be of the design, sizes and types shown. Aluminum in contact with other metal or concrete shall have the contact surface shop-painted per System 10 specified under Section 09 98 00 entitled, "Protective Coatings".

B. Metal Grating: Metal grating shall be of aluminum or stainless steel as shown. No single piece of grating shall weigh more than 80-lbs. unless specifically detailed otherwise. Aluminum shall be 6061T6 Alloy Bearing Bars and 6063T5 Alloy Cross Bars. Stainless steel shall be Type 316. All grating shall be completely banded. Grating shall be rated at 150 lb/sq. ft.

C. Floor Hatches: Floor hatches shall be of steel or aluminum as shown. Hatches shall be double-swing and shall be furnished with two (2) stay bars designed to hold the cover in an open position and provide a railing around the opening. The hatch shall be designed to provide storage for the stay bars when the hatch is closed. The hatch shall have four (4) flush handles and a gutter or moat-type edge drain complete with drain connection. Steel hatches shall be hot-dip galvanized after fabrication.

2.4 SEAT ANGLES AND SUPPORTS

A. Seat angles for grating shall be aluminum or stainless steel. All support angles buried, submerged or below top of hydraulic structures shall be stainless steel.

2.5 BOLTS AND ANCHORS

A. Galvanized Bolts: Except where otherwise shown or specified, all bolts, anchor bolts and nuts shall be steel, galvanized after fabrication as specified herein. Threads on galvanized bolts and nuts shall be formed with suitable taps and dies such that they retain their normal clearance after hot-dip galvanizing.

B. Steel for Bolts: Except as otherwise specified herein, steel for bolts, anchor bolts and cap screws shall be in accordance with the requirements of ASTM A 307 Grade B, or threaded parts of ASTM A 36 and shall meet the following additional requirements:

1. The nut material shall be free-cutting steel.

2. The nuts shall be capable of developing the full strength of the bolts. Threads shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads. All bolts and cap screws shall have hexagon heads and nuts shall be Heavy Hexagon Series.

3. The length of all bolts shall be such that after joints are made up, each bolt shall extend through the entire nut, but in no case more than 1/2-inch beyond the nut.

C. Stainless Steel Bolts: Unless otherwise shown, all bolts, anchor bolts, washers and nuts which are buried, submerged or below the top of the wall inside any hydraulic structure shall be of Type 316 stainless steel.

D. Unless otherwise shown, expanding-type anchors shall be steel expansion type. Lead caulking anchors will not be permitted. Size shall be as shown. Expansion type anchors which are to be embedded in grout may be steel. Non-embedded buried, submerged or below top of hydraulic structure anchors shall be entirely stainless steel.

2.6 POWER-DRIVEN PINS

A. Power-driven pins shall not be used unless specifically approved by the Engineer.

PART 3 - EXECUTION

3.1 FABRICATION AND INSTALLATION REQUIREMENTS

A. Fabrication and Erection: Except as otherwise shown, the fabrication and erection of structural steel shall conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction".

B. Aluminum Railings: Aluminum railing is specified in Section 05521.

C. Steel Railings: Field welding of steel pipe handrail joints will be permitted only if approved by the Engineer.

3.2 WELDING

A. Method: All welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards governing same.

B. Quality: In assembly and during welding, the component parts shall be adequately clamped, supported and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as specified for the AWS Code. Upon completion of welding, all weld splatter, flux, slag and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance with uniform weld contours and dimensions. All burrs, spatter and sharp corners of material shall be ground smooth prior to coating.

3.3 GALVANIZING

A. All structural steel plates, shapes, bars and fabricated assemblies required to be galvanized shall, after the steel has been thoroughly cleaned of rust and scale, be galvanized in accordance with the requirements of ASTM A 123. Any galvanized part that becomes warped during the galvanizing operation shall be straightened. Bolts, anchor bolts, nuts and similar threaded fasteners, after being properly cleaned, shall be galvanized in accordance with the requirements of ASTM A 153. Field repairs to galvanizing shall be made using "Galvinox", "Galvo-Weld", or approved equal.

END OF SECTION

DIVISION 6 – WOOD, PLASTICS, AND COMPOSITES

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall construct all rough carpentry and appurtenant work, complete and in accordance with the requirements of the Contract Documents.

B. The work shall include, but not be limited to, completion of the following principal items:

1. Wood framing, including studding, rafters, purlins and similar framing elements.
2. Wood blocking, furring, stripping, backing and nailers, as shown, specified, or otherwise required for securing the work.
3. Plywood sheathing.
4. All rough hardware appurtenant to the work of this Section, as defined in Paragraph entitled, "Rough Hardware", herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 30 00 - Cast-In-Place Concrete

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Codes: The Building Code, as referenced herein, shall be the International Building Code (IBC).

B. Commercial Standards:

AITC 104-65	Timber Construction Manual
AITC 105-65	Timber Construction Manual
AWPA C1-69	AWPA Manual of Recommended Practice, Standard For Preservative Treatment by Pressure Process--All Timber Products
UBC Std. 25-10	Structural Glued-Laminated Timber
UBC Std. 25-12	Preservative Treatment by Pressure Processes and Quality Control Standards
WCLIB	Standard Grading and Dressing Rules No. 16 of the West Coast Lumber Inspection Bureau

1.4 CONTRACTOR SUBMITTALS

A. The following shall be submitted to the Engineer for review, approval or verification in accordance with Section 01 33 00 entitled, "Contractor Submittals".

1. Manufacturer's catalogs showing rough hardware conforming to or equivalent to hardware shown.

PART 2 - PRODUCTS

2.1 UNTREATED LUMBER

A. Grading: Lumber shall be graded in accordance with the "Standard Grading and Dressing Rules No. 16", of the West Coast Lumber Inspection Bureau (WCLIB) or in accordance with "Grading Rules for Western Lumber", published by Western Wood Products Association, as specified herein.

B. Grade Marking: Each piece of lumber shall bear the official grade mark of recognized grading agencies using one of the above-mentioned grading rules. The Association standards for grading and grade marking of the lumber shall be acceptable to the Engineer.

C. Size Dressing: All lumber, except as otherwise shown or specified herein, shall be dressed to size in accordance with the standards of the association under which the lumber is graded. All lumber shall be S4S unless otherwise shown.

D. Drying: All lumber incorporated in the work, except where otherwise specified, shall be air or kiln dried to a moisture content of not more than 19 percent and not less than 1 percent.

2.2 TREATED LUMBER

A. All wood nailing blocks, sills and plates resting on or embedded in concrete or masonry within 18-inches of grade shall be pressure-treated in accordance with American Wood Preservers' Association Manual of Recommended Practice, Standard for Preservative Treatment by Pressure Process-All Timber Products, Cl. Preservative shall conform to American Wood Preservers Assn. and American Wood Preserves Bureau Standard Specifications referenced in Paragraph entitled, "References Specifications, Codes and Standards". Creosote shall not be used.

B. Wherever necessary to cut, notch, dap, drill or frame treated lumber, newly cut or bored surfaces shall be treated with two heavy coats of the same preservative used in the original treatment. The minimum penetration depth shall be 1/4-inch.

2.3 PLYWOOD AND HARDWOOD

A. Plywood: Plywood shall conform to the requirements of U. S. Product Standard PS 1 as specified herein. All plywood panels shall be marked with grade mark of the American Plywood Association. The mark shall identify the plywood as to species, glue type and grade in compliance with the applicable commercial standard. Except as otherwise specified below or shown, plywood shall be Douglas Fir, Exterior, C-D, SlS, Plywood for other specific applications shall be as follows:

1. Plywood for use in concrete forms shall conform to the requirements of Section 03 30 00 entitled, "Cast-In-Place Concrete".

2. Plywood for backup boards behind telephone equipment, electrical equipment or communication equipment shall be Douglas Fir, A-C EXT grade for interior and exterior locations.

B. Hardboard: Hardboard shall be temper-treated panels manufactured from interfelted lignocellulose fibers consolidated under heat and pressure in a hot press to produce a smooth, hard-surfaced material which is resistant to water and stains. Hardboard shall conform to the requirements of PS 58.

2.4 ROUGH HARDWARE

A. General: The term "rough hardware" shall include nails, screws, lag screws, bolts, nuts, washers, plates, metal fasteners and framing anchors; anchor bolts which are to be embedded into concrete, concrete masonry or brick masonry; and similar items employed in erection and construction of the rough carpentry work. Rough hardware shall be of standard manufacture, approved by a recognized agency for the intended applications and shall be provided with laboratory test results on capabilities when requested by the Engineer. All hardware items shall be steel unless specified or shown otherwise.

2.5 MISCELLANEOUS PRODUCTS

A. Building Paper: Building paper or felt shall be non-perforated, asphalt-saturated organic felt conforming to ASTM D 226, 15 lbs. per 100 square feet.

PART 3 - EXECUTION

3.1 GENERAL

A. Rough carpentry shall be as shown, specified and as necessary to complete work. The Contractor shall verify drawing dimensions with actual field conditions and shall inspect related work and adjacent surfaces and shall report to the Engineer all conditions which could prevent proper execution of this work.

B. All rough hardware not otherwise specified, and which is necessary for the satisfactory execution of framing, including nails, spikes, dowels, fasteners and similar incidentals shall be provided and installed by the Contractor. Rough hardware shall be coordinated, furnished, installed and imbedded as shown and as required for a complete work.

C. Framing members and assemblies shall be closely fitted, accurately set and rigidly secured to required lines, levels and arrangements shown. Framing shall be accurately and neatly cut and shall be securely nailed, spiked or otherwise fastened in place in a workmanlike manner. Timber connectors and installation thereof shall conform to applicable requirements of AITC 104 and AITC 105 of the Timber Construction Manual of the American Institute of Timber Construction.

3.2 FASTENERS AND FRAMING DEVICES

A. Nailing: Where nail spacing is not otherwise regulated by the Building Code, nails shall not be driven closer together than 1/2 their length unless driven in drilled holes, nor driven closer to the edge of a member than 1/4 of their length. When necessary to prevent splitting, holes shall be drilled slightly smaller than nail diameters. The nails shall penetrate the second or farther member not less than 1/2 the nail length. Common nails shall be used unless otherwise specified or shown.

B. Bolts and Nuts: Malleable or cut-steel washers shall be provided under bolt heads and nuts except where bearing on steel plates or other steel attachments or where flat-head countersunk bolts are shown. Bolt holes shall be drilled 1/32-inch to 1/16-inch larger diameter than the bolts they are to accommodate and shall be bored true-to-line. Members shall be clamped together, and bolts shall be driven in place and nuts drawn up tightly. Bolts shall be drawn tight again immediately prior to enclosing with finish or, if left exposed, upon completion of other work. Holes at anchor bolts embedded in concrete may be 1/16-inch larger than bolt diameter.

C. Screws: Lag and wood screws shall be screwed, not driven, into place. Holes to receive lag screws shall be bored first of the same diameter and depth as shank, then continued to depth equal to length of screw with diameter equal to the base of the screw thread. Screws shall penetrate into the farther member a distance equal to at least seven times the diameter of the screw shank. Washers shall be installed under each lag screw head bearing on wood.

D. Metal Framing Devices: Metal framing devices shall be furnished and installed where shown. Nails for the framing devices shall be as furnished or recommended by the manufacturer of the anchor device. All nails shall be driven to their full depth at all holes in anchors. Bolt and lag fasteners shall be drawn tight.

3.3 FRAMING

A. Strength Considerations: Structural wood framing member shall not be spliced between bearing points or supports. Approval shall be secured from the Engineer before cutting of any wood members that may weaken structure. Due care shall be exercised in placing framing so that structural and other important members do not require cutting for openings, pipes, vents, conduits or ducts. Bearing surfaces on which wood structural members are to rest shall be finished to give full, true and even support. Wedges or shims shall not be used to correct faulty work. Wood members which have been split or otherwise damaged to such an extent as to impair their strength shall be removed and replaced at no additional cost to the Owner.

B. Cutting and Notching: Only skilled workmen shall be used for all cutting and framing of wood members required to accommodate structural members, routing of piping, conduit, ducts and the installation of mechanical, electrical or other apparatus or equipment. Members shall not be cut, notched nor bored more than 1/4 of their depth without adequate and approved reinforcing.

C. Blocking and Backing: All blocking and backing in walls and ceilings shall be nominal 2-inch thick material of a depth as needed and shall be accurately located around light fixtures, ceiling register, grilles and other required mechanical and electrical items. The blocking shall fit snugly and shall be spiked into the supporting framing members. Wood blocking (backing) to receive sheathing, siding, metal lath and gypsum board shall be provided wherever necessary for securing the facing materials.

D. Backing for Specialties and Accessories: Backing shall be accurately located and installed for all building specialties, toilet accessories and finish hardware items as required.

E. Concrete-Imbedded Blocks: Where required and approved, nominal 2-inch thick nailing blocks (dovetail type) shall be provided in concrete to receive superimposed wood stripping, grounds and backing. Applied grounds or stripping shall be securely nailed into wood nailing blocks, using nails of approved length.

F. Furring: Furring shall be 2-inch by 3-inch wood studs spaced at 16-inches on center, laid flat to the wall. Light metal framing may be substituted at non-thermo wall conditions. Other sizes and spacing of furring or stripping shall be as shown or specified in the Contract Documents.

END OF SECTION

DIVISION 7 – THERMAL AND MOISTURE PROTECTION

SECTION 07 19 00

WATER REPELLANT

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Penetrating sealer over concrete and masonry.

1.2 **REFERENCES**

A. **ASTM Standards**:

C67 Sampling and Testing Brick, and Structural Clay Tile.

C140 Sampling and Testing Concrete Masonry Units.

C642 Specific Gravity, Absorption, and Voids in Hardened Concrete.

C672 Standard Test Method for Sealing Resistance of Concrete Surfaces Exposed to Deicing Chemicals.

B. **DOT Standards**:

NCHRP 244 Series IV Concrete Sealers for Protection of Bridge Structures, National Cooperative highway Research Program, Report 244, Dec 1981.

1.3 **SUBMITTALS**

A. Manufacturer's recommended installation procedures.

B. Performance criteria data sheet showing compliance.

PART 2 PRODUCTS

2.1 **PENETRATING COMPOUND**

A. Material: Unless indicated elsewhere, CONTRACTOR’s choice:

1. Organo-silane,
2. Organo-siloxane,
3. Silocanate,
4. Potassium silicate.
5. Styrene acrylic silane co-polymer

B. Performance Criteria:
   1. Water Absorption Reduction: 75 percent minimum, ASTM C67, ASTM C140, or ASTM C642.
   2. Scaling Resistance (weight loss): Two (2) percent maximum, ASTM C672, when subject to 500 cycles of freeze-thaw.
   3. Chloride Ion Reduction: 75 percent minimum, NCHRP 244 series IV.
   4. Moisture Vapor Permeability: 100 percent minimum, NCHRP 244 series IV.
   5. Maximum Drying Time: 1-1/2 hours.

C. Volatile Organic Compounds (VOC): Comply with local, state and federal requirements.

PART 3 EXECUTION

3.1 PREPARATION

A. Do not use water repellant on surfaces that are to receive hardeners. Refer to Section 03 35 00.

B. Cure new concrete for 28 days before sealer application.

C. Remove curing compound before applying sealer. Do not expose large aggregate.

D. Make surfaces dry and free of laitance, dirt, dust, paint, grease, oil, rust, and other contaminants.

3.2 APPLICATION

A. Apply coating continuously and uniformly. Keep surface wet for 30 to 45 minutes.

END OF SECTION

SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

A. Extent of insulation work is shown on drawings and indicated by provisions of this section.

B. Applications of insulation specified in this section include the following:

1. Rigid insulation.
2. Foundation wall insulation (supporting backfill).
3. Safing Insulation.
4. Blanket-type building insulation.
5. Roof Corner insulation.

1.3 QUALITY ASSURANCE

A. Thermal Resistivity: Where thermal resistivity properties of insulation materials are designated by R-values they represent the rate of heat flow through a homogenous material exactly 1-inch thick, measured by test method included in referenced material standard or otherwise indicated. They are expressed by the temperature difference in degrees F between the two exposed faces required to cause one BTU to flow through one square foot per hour at mean temperatures indicated.

B. Fire Performance Characteristics: Provide insulation materials which are identical to those whose fire performance characteristics, as listed for each material or assembly of which insulation is a part, have been determined by testing, per methods indicated below, by UL or other testing and inspecting agency acceptable to authorities having jurisdiction.

C. Surface Burning Characteristics: ASTM E 84.

D. Fire Resistance Ratings: ASTM E 119.

E. Combustion Characteristics: ASTM E 136.

F. Maximum Allowable Asbestos Content of Inorganic Insulations: Provide insulations composed of mineral fibers or mineral ores which contain less than 0.25 percent by weight of asbestos of nay type or mixture of types occurring naturally as impurities as determined by polarized light microscopy test per Appendix A of 40 CFR 763.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's product literature and installation instructions for each type of insulation and vapor retarder material required.

B. Certified Test Reports: With product data, submit copies of certified test reports showing compliance with specified performance values, including R-values (aged values for plastic insulations), densities, compression strengths, fire performance characteristics, perm ratings, water absorption ratings and similar properties.

1.5 DELIVERY, STORAGE AND HANDLING

A. General Protection: Protect insulation from physical damage and from becoming wet, soiled, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage and protection during installation.

B. Protection for Plastic Insulation:

1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver plastic insulating materials to project site ahead of installation time.
3. Complete installation and concealment of plastic materials as rapidly as possible in each area of work.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

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

1. Manufacturers of Extruded Polystyrene Board Insulation:

    a. Amoco Foam Products Co.
    b. Dow Chemical U.S.A.
    c. Minnesota Diversified Products, Inc.
    d. UC Industries
    e. or approved equal

2. Manufacturers of Glass Fiber Insulation:

    a. CertainTeed Corp.
    b. Owens Corning
    c. or approved equal

3. Manufacturers of Semi-Refractory Fiber Insulation:

    a. Manville Corp.
    b. United States Gypsum Co.
    c. or approved equal

2.2 INSULATING MATERIALS

A. General: Provide insulating materials which comply with requirements indicated for materials,

compliance with referenced standards, and other characteristics.

B. Preformed Units: Sizes to fit applications indicated, selected from manufacturer's standard thicknesses, widths and lengths.

C. Extruded Polystyrene Board Insulation: Rigid, cellular thermal insulation with closed-cells and integral high-density skin, formed by the expansion of polystyrene base resin in an extrusion process to comply with ASTM C 578 for Type indicated; with 5-year aged R-values of 5.4 and 5 at 40 and 75 deg. F (4.4 and 23.9 deg. C), respectively; and as follows:

1. Type IV, 1.6 lb./cu. ft. min. density, unless otherwise indicated.

D. Surface Burning Characteristics: Maximum flame spread, and smoke developed values of 5 and 165, respectively.

E. Unfaced Mineral Fiber Blanket/Batt Insulation: Thermal insulation produced by combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665 for Type I (blankets without membrane facing); and as follows:

1. Mineral Fiber Type: Fibers manufactured from glass or slag.
2. Combustion Characteristics: Passes ASTM E 136 test.
3. Surface Burning Characteristics: Maximum flame spread, and smoke developed values of 25 and 50, respectively.

F. Faced Mineral Fiber Blanket/Batt Insulation: Thermal insulation produced by combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 655 for Type III, Class A (blankets with reflective vapor-retarder membrane facing with flame spread of 25 or less); foil-scrim-kraft vapor-retarder membrane on one face, respectively; and as follows:

1. Mineral Fiber Type: Fibers manufactured from glass or slag.
2. Combustion Characteristics: Unfaced blanket/batt passes ASTM E 136 test.
3. Surface Burning Characteristics: Maximum flame spread, and smoke developed values of 25 and 50, respectively.

G. Roof Corner Joint Sealant:

1. At junction of all metal roof deck and exterior masonry walls, apply urethane foam insulation to a maximum depth of 3-inches in the corner to uniformly seal this junction air tight. Use 2 lbs. density foam.
2. Apply over foam after proper curing a coating of U.L. approved fire proofing of a tested thickness to achieve a one-hour fire protection rating.

2.3 AUXILIARY INSULATING MATERIALS

A. Mechanical Anchors: Type and size indicated or, if not indicated, as recommended by insulation manufacture for type of application and condition of substrate.

B. Mastic Sealer: Type recommended by insulation manufacturer for bonding edge joints between units and filling voids in work.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION

A. Require installer to examine substrates and conditions under which insulation work is to be performed. A satisfactory substrate is one that complies with requirements of the section in which substrate and related work is specified. Obtain Installer's written report listing conditions detrimental to performance of work in this section. Do not proceed with installation of insulation until unsatisfactory conditions have been corrected.

B. Clean substrates of substances harmful to insulations or vapor retarders, including removal of projections which might puncture vapor retarders.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's instructions for particular conditions of installation in each case. If printed instructions are not available or do not apply to project conditions, consult manufacturer's technical representative for specific recommendations before proceeding with work.

B. Extend insulation full thickness as shown over entire area to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation. Remove projections which interfere with placement.

C. Apply a single layer of insulation of required thickness, unless otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF PERIMETER AND UNDER-SLAB INSULATION

A. On vertical surfaces, set units in adhesive applied in accordance with manufacturer's instructions. Use type of adhesive recommended by manufacturer of insulation.

3.4 INSTALLATION OF GENERAL BUILDING INSULATION

A. Apply insulation units to substrate by method indicated, complying with manufacturer's recommendations. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Seal joints between closed-cell (non-breathing) insulation units by applying mastic or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with mastic or sealant.

C. Set vapor retarder faced units with vapor retarder to war side of construction, except as otherwise indicated. Do not obstruct ventilation spaces, except for firestopping.

D. Tape joints and ruptures in vapor retarder and seal each continuous area of insulation to surrounding construction to ensure air-tight installation.

E. Set reflective foil-faced units accurately with air pace in front of foil as shown. Provide not less than 0.75-inch air space where possible.

3.5 INSTALLATION OF SAFING INSULATION

A. Cut safing insulation wider than gap to be filled to ensure compression fit and seal joint between insulation and edge of wall and metal deck or other material with caulking approved by safing insulation manufacturer for this purpose. Leave no voids in completed installation.

3.6 PROTECTION

A. General: Protect installed insulation and vapor retarders from harmful weather exposures and from possible physical abuses, where possible by non-delayed installation of concealing work or, where that is not possible, by temporary covering or enclosure.

END OF SECTION

SECTION 07 41 13 - METAL ROOF PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Metal roof panels, metal flashings, accessories, fasteners, closures, and sealants.

B. Related Sections:

1. Section 07 62 00 - Sheet Metal Flashing and Trim

1.2 REFERENCES

A. General: Reference latest edition of applicable codes and standards.

B. American Society for Testing and Materials (ASTM):

1. ASTM A792/A792M-Standard Specification for Steel Sheet, 55 percent Aluminum-Zinc-Alloy-Coated by the Hot-Dip Process.

C. AISI Cold-Formed Steel Design Manual, American Iron and Steel Institute (AISI).

D. AISC Manual of Steel Construction, American Institute of Steel Construction (AISC).

E. Underwriters Laboratories, Inc. (UL).

1. UL 580-Standard Safety Tests for Uplift Resistance of Roof Assemblies.

F. Building Codes and Design Standards:

1. ASCE-7, Minimum Design Loads for Buildings and Other Structures, American Society of Civil Engineers (ASCE).
2. BOCA National Building Code, Building Officials and Code Administrators, International (BOCA).
3. Uniform Building Code (UBC), International Conference of Building Code Officials (IBCO).
4. Standard Building Code (SBC), Southern Building Code Congress International (SBCCI).
5. International Building Code (IBC), International Code Council (ICC).

1.3 SYSTEM DESCRIPTION

A. Design Requirements:

1. Provide exposed fasteners metal roof panel.
2. Provide metal panel which has been manufactured and installed to withstand specified design loads and maintains performance requirements without defects, damage, or failure.

B. Performance Requirements:

1. Design Loads: Design loads shall be as specified by building code, design standard, or as indicated on the contract drawings.
2. Deflections shall be limited L/120.

C. Performance Testing:

1. Roof panel shall be tested in accordance with UL Standard 580 and have a Class 90 rating.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's product Data.

B. Shop Drawings: Submit panel shop drawings consisting of design and erection drawings, finish specifications, and other data necessary to clearly describe design, materials, sizes, layouts, construction details, fasteners, and erection. Submit small scale layouts of panels and large-scale details of edge conditions, joints, fastener and sealant placement, flashings, penetrations and curbs, and special details. Distinction must be made between factory and field assembled work. Drawings must be approved, and field verification of all dimensions must occur prior to fabrication.

C. Samples:

1. Panel: Two (2) required, full panel width by 12-inch long.
2. Fasteners: Two (2) of each type with a statement of intended use.
3. Closures: One (1) foam closure.
4. Sealants: One (1) sample of each type, with a statement of intended use.

D. Warranties: Submit manufacturers applicable sample warranties of products.

E. Quality Assurance Submittals:

1. Certificates:
   a. A written statement from the manufacturer certifying conformance with the specified manufacturers qualifications listed in article 1.5 QUALITY ASSURANCE.
   b. A written statement from the installer certifying conformance with the specified installer qualifications listed in article 1.5 QUALITY ASSURANCE.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturers Qualifications: The manufacturer shall have had at least fifteen (15) years in metal roof and wall design and installation. The manufacturer shall have a permanent, stationary, indoor, production facility.

2. Installer Qualifications:
   a. The installer shall have had a minimum of five (5) years experience in the installation of metal roof and wall systems.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Material shall be delivered to the site in a dry and undamaged condition and unloaded per the manufacturer's instructions. The installer shall inspect materials for damage and stains upon arrival at the site.

B. Storage: Materials shall be stored out of contact with the ground in weathertight coverings to keep them dry per the manufacturer's recommendations. Storage accommodations shall provide good air circulation and protection from surface staining.

C. Handling: Exercise care in unloading, storing, and handling of panels to prevent bending, warping, twisting, or surface damage. Follow manufacturer's recommendations for material handling.

1.7 WARRANTIES

A. Manufacturer's Warranties:

1. Material Warranty: The manufacturer shall warrant that the material furnished will remain free from defects in material and workmanship for a period of one (1) year from date of shipment.
2. Metal Substrate Warranty: The manufacturer shall warrant that the metal roof panel substrate will not rupture or perforate due to corrosion within a period of twenty (20) years from date of shipment.
3. Finish Warranty: The manufacturer shall warrant against fading, chalking, peeling, cracking, checking, chipping, or erosion to base metal of the roof panel paint finish for a period of twenty (20) years from date of shipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The MBCI BattenLok HS standing seam metal roof system as manufactured by MBCI, 1155 West 2300 North, Salt Lake City, UT 84116, or approved equal

B. Requests to use alternate systems must be submitted in writing at least five (5) days prior to the bid date. Product data, samples, test reports, and required certificates shall be included for product review and approval.

C. Being listed as a pre-qualified manufacturer does not release the manufacturer from providing complete and acceptable submittal requirements.

2.2 MATERIALS

A. Metal Panels: BattenLok HS standing seam as manufactured by MBCI or approved equal.

1. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A 792M, structural quality, Grade 50, Coating Class AZ50 (Grade 340, Coating Class AZM150), prepainted by the coil-coating process per ASTM A 755/A 755M.
    a. Nominal Coating Thickness: 0.028 inch/24 gage
    b. Panel Width: 16 inches
    c. Panel Seam Height: 2-inch
    d. Joint type: Mechanically seamed

2.3 FINISHES

A. Paint Finishes: Coating systems shall have been tested in accordance with ASTM standard test methods for factory color finish.

1. Silicone Modified Polyester (SMP): Two-coat system consisting of a nominal 0.028-inch coating thickness.
2. Color: Refer to Project Drawings for Color.

B. Texture: Panel finish shall be smooth.

2.4 ACCESSORIES

A. Fasteners: Use only high-quality fasteners as recommended or approved by the manufacturer. Follow fastener manufacturer's recommendations for fastener installation.

1. Screws: Screws shall be min. #12 diameter. Self-tapping screws shall be min. #14 diameter.
    a. Exposed self-drilling and self-tapping screws shall be carbon steel with corrosion resistant coating and neoprene washer or be 300 series stainless steel with neoprene washer. All exposed fasteners shall be painted to match panel color.
2. Rivets:
    a. Trim rivets shall be min. 5/32-inch diameter, stainless steel body and stem with open end or aluminum body and stem with closed end.
    b. Rivets shall be painted to match panel color.

B. Closures

1. Pre-cut profile closure shall be cut from cross-linked, closed-cell form.

C. Sealants: Use only high-quality sealants as recommended or approved by the manufacturer. Sealants must not contain oils, asbestos, or asphalts.

1. Non-Curing Butyl: One-part, non-skinning, non-drying, synthetic butyl elastomer. Used for metal-to-metal sealing or bedding of panel and flashing seams or joints.
2. Urethane: One-part moisture curing, gun grade polyurethane sealant. Used for sealing in all exposed conditions.

2.5 FLASHING

A. All flashing shall be of the same material, gage, finish, color, and texture as the panels unless otherwise noted.

B. Flashing design shall conform to details submitted and approved by the Engineer and, if required, the panel manufacturer.

2.6 FABRICATION

A. Where possible panels shall be manufactured in continuous lengths, full length of panel runs.

PART 3 - EXECUTION

3.1 EXAMINATION

A. The installer shall inspect the building to verify that the structure is ready for metal panel installation.

1. All supports shall be in place with all bracing and connections tightened before work proceeds.
2. Field-check dimensions and check support alignment with a taut string or wire; support misalignment may cause the metal panels to appear wavy.
3. Do not proceed until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install metal panels in accordance with approved erection drawings and manufacturer's installation instructions.

B. Install metal panels so that it is weather-tight, without waves, warps, buckles, fastening stress or distortion.

C. Protect installed panels from abuse by other trades. The general contractor shall be responsible for protecting metal panels from wet cement, plaster, and paint operations.

3.3 DAMAGED MATERIAL AND CLEANING

A. Replace panels and other components of work which have been damaged beyond repair.

B. To prevent rust staining, remove immediately from finished surfaces any filings caused by drilling or cutting.

C. Wipe down each area after erection is complete for final acceptance.

END OF SECTION

SECTION 07 46 00 - SIDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Furnish and install siding, soffits and facia.

1.2 SUBMITTALS

A. Conform to Section 01 33 00 – Submittal Procedures.

B. Manufacturer's descriptive literature and recommended installation instructions.

1.3 WARRANTY

A. Aluminum Products - Lifetime, 50-year transferable, non-prorated limited warranty. Includes material and labor.

B. Steel Products - Lifetime, 50-year transferable, non-prorated limited warranty, including 50-year hail protection.

PART 2 - PRODUCTS

2.1 SIDING, SOFFIT AND FACIA

A. Steel Siding: Alcoa AS12VNT (12-INCH horizontal) finish PVC coating, or approved equal. Color to match roof.

B. Soffit: Alcoa SVG12V20 (12-inch Ventilated Groove Panel) Aluminum soffit. 15 sq. inches net free ventilation area per linear foot or approved equal. Material - Alcoa Aluminum. Exterior: Color to match roof.

C. Facia: Alcoa Aluminum Ribbed 0.019-inch gauge facia or approved equal; Color to match roof.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Before Starting Work:

1. Verify building dimensions.

2. Examine, clean and repair if necessary, adjoining work and substrate.

3. Starting work indicates acceptance of substrate and adjoining work.

B. Install According To:

1. Manufacturer's written instructions for installing steel siding.

2. "Alcoa Aluminum Soffit Installation Planner", latest edition.

C. Upon completion the Contractor shall clean all accessories, soffit and trim. Remove fingerprints, soiled areas and scape material.

D. All fasteners, trim and accessories must be designed for and compatible with the specified products. All finishes must match adjacent surfaces.

E. Fasteners must be adequate to create a weathertight envelope, plumb and square with no movement or vibration under normal wind conditions (up to 40 mph).

END OF SECTION

SECTION 07 62 00 - SHEET METAL FLASHING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Furnish labor, equipment, and materials as required to complete each type of sheet metal and flashing work as indicated on drawings and by provisions of this Section, including:

1. Provide and install new 22 ga. G.I. area divider cap with standing seams.
2. Provide and install new 22 ga. G.I. counterflashing.
3. Provide and install new 22 ga. G.I. expansion joint cap with standing seams.
4. Provide and install new 24 ga. G.I. Kynar coated coping.
5. Provide and install new 24 ga. G.I. Kynar coated perimeter edge metal.
6. Provide new 2.5 lb. minimum lead drain flashings.
7. Provide new 22 ga. G.I. and 2.5 lb. minimum lead soldered pipe flashings.
8. Provide and install new 22 ga. G.I. soldered curb caps.
9. Provide and install new miscellaneous sheet metal accessories.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Project Manual, including General and Supplementary Conditions; and General Requirements, apply to work of this Section.

1.3 REFERENCES

A. AA (Aluminum Association) - Aluminum Construction Manual: Aluminum Sheet Metal Work and Building Construction.

B. AISI (American Iron and Steel Institute) - Stainless Steel - Uses in Architecture.

C. ANSI/ASTM B32 - Solder Metal.

D. ASTM A167 - Stainless and Heat-resisting Chromium-nickel Steel Plate.

E. ASTM A525 - Steel Sheet, Zinc Coated, (Galvanized) by the Hot-Dip Process.

F. ASTM B209 - Aluminum and Aluminum Alloy Sheet and Plate.

G. ASTM B370 - Copper Sheet and Strip for Building Construction.

H. CDA (Copper Development Association) - Contemporary Copper, A Handbook of Sheet Copper Fundamentals, Design, Details and Specifications - Current Edition.

I. CDA - Copper Roofing - A Practical Handbook - Current Edition.

J. FS O-F-506 - Flux, Soldering, Paste and Liquid.

K. FS QQ-S-571 - Solder, Tin Alloy.

L. NAAMM - Metal Finishes Handbook - Current Edition.

M. NRCA - Roofing and Waterproofing Manual - Current Edition.

N. SMACNA - Architectural Sheet Metal Manual - Current Edition.

O. Uniform Building Code - Current Edition.

1.4 SYSTEM PERFORMANCE

A. Work of this section shall prevent water migration from entering building through new sheet metal flashings at built-up roofing, base flashings, walls, pipe penetrations, etc.

1.5 QUALITY ASSURANCE

A. An Engineer retained by the Owner shall provide part-time quality control. Functions of the Engineer and/or Owner's Representative include inspecting and monitoring all phases of the work of this Section to determine if materials and work conform to the Project Manual and recording the findings of each inspection.

B. The instructions of the Engineer and/or Owner's Representative regarding the execution of this work shall be immediately carried out upon issuance of a Field Order or Change Order by the Engineer. If the instructions do not conform to the requirements outlined in the Project Manual or the manufacturer's specifications, the Contractor shall notify the Engineer of any non-conformance in writing prior to performing work affected.

C. Incomplete or non-workable details shall be reported in writing to the Engineer for written clarification prior to performing work affected.

D. Contractor Qualifications: A single company specializing in applying the sheet metal flashing specified with a minimum of five years experience.

E. Contractor's Foreman Qualifications: Foreman must have a minimum of 5 years experience in work similar to nature and scope of specified sheet metal work.

F. Contractor Field Supervision: Contractor shall maintain the same full-time foreman on jobsite during all times that sheet metal or related subcontractor work is in progress - a change must be approved by the Engineer. The Owner or his representatives may, at their option, with no additional cost, require the immediate replacement of any field personnel employed by the Contractor if, in their judgement, such field personnel are or would be deleterious to the work of this project.

G. Contractor shall carefully examine jobsite and all conditions affecting work of this Section prior to bidding. Contractors bid shall reflect all anticipated conditions, materials, labor, etc., needed to complete the work of this section, including conditions not contained in the project manual but normally encountered in this type of work.

H. Work of this section shall conform to applicable sections of SMACNA - Architectural Sheet Metal Manual - Current Edition. The NRCA Roofing and Waterproofing Manual - Current

Edition; Uniform Building Code -Current Edition; primary roofing material manufacturer's current specifications. If a discrepancy should arise, the most stringent requirements shall apply.

1.6 SUBMITTALS

A. Submit shop drawings showing dimensions, layout, joining, profiles, and anchorages of all fabricated work that VARIES form that shown on the drawings.

B. Submit manufacturer's product data and installation instructions for each type of material and fastener used.

C. Any dimensions for fabrication not shown on Project Manual drawings, shall be field verified and shown on shop drawings.

D. Contractor: A single company specializing in applying the sheet metal flashing specified with a minimum of five years experience.

E. Contractor Submittals: Foreman/Applicator: Furnish the following information in writing signed by the Foreman/Applicator and Contractor: name; age; length of time with Contractor; length of time as an applicator and as a foreman; total volume of specified sheet metal installed in the past five years as an applicator and as a foreman.

1.7 SAMPLES

A. Submit material sample size, color and quantity as required by the Engineer.

1.8 REGULATORY REQUIREMENTS

A. The sheet metal flashing work shall conform to applicable city, county, state and federal codes at time of construction.

B. Contact local building authorities and fire marshal to become familiar with local laws and regulations governing this work.

1.9 PRE-JOB CONFERENCE

A. A pre-job conference will be convened at the jobsite by the Engineer at least one week prior to commencing work of this section. Those in attendance shall include the Engineer, Contractor, and other entities performing work adjoining the sheet metal work and representatives of other entities directly concerned with performance of the sheet metal work.

B. The purpose of the conference shall include reviewing Plans, drawings and project manual, submittals, status of coordinating work with related work, availability of materials, personnel and installation facilities, proposed installation schedule, requirements for inspections and testing or certifications, forecasted weather conditions, governing regulations, insurance requirements, proposed installation procedures, protection of newly installed roofing membrane and sheet metal work, and touring the jobsite. WORK ON THIS PROJECT SHALL NOT COMMENCE UNTIL ALL SUBMITTALS ARE RECEIVED AND APPROVED BY THE ENGINEER.

1.10 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver all sheet metal products dry and undamaged. Products that are wet or are damaged shall be rejected, removed from the jobsite and replaced.

B. Deliver materials in sufficient quantities to allow continuity of work.

C. Stack performed (and prefinished) material to prevent twisting, bending, or abrasion and provide ventilation.

D. Prevent contact with materials during storage which may cause discoloration, tainting, or damage.

E. Store all products in dry, well ventilated weather protected environment, clear of ground and moisture. All materials stored outside while not in use or overnight, shall be placed on pallets and completely covered with a breathable waterproof covering.

F. Do not store materials on newly installed roofing membrane, nor position installation equipment on newly installed membrane.

1.11 GENERAL PROJECT REQUIREMENTS

A. Coordinate work with other trades or entities whose work adjoins or penetrates work of this section, or whose work requires men and/or equipment to traffic over work of this section, for proper sequencing of each installation.

B. Contractor shall be responsible for the dismantling, removal, and replacement of items which are required for proper completion of the work of this section.

C. Ensure best possible weather resistance and durability of work and protection of materials and finishes.

D. Contractor shall examine conditions under which work will be performed and notify the Engineer in writing of any unsatisfactory conditions that would prevent installation of the sheet metal in accordance with the project manual or the manufacturer's specifications prior to performing work of this section.

E. Do not apply sheet metal during inclement weather or when existing or forecasted weather conditions will not permit work to be performed in accordance with the project manual.

F. Provide sufficient work force (personnel, materials and equipment) to meet the completion requirements specified in the project manual.

G. Contractor shall notify Engineer 24 hours minimum in advance of performing any work which would cover or otherwise make it difficult to inspect any portion of the work. Should any of said work be covered without proper notification having been given Engineer, contractor shall uncover that work for inspection at his own expense. Contractor shall schedule the work so that an inspector may observe and inspect a maximum part of any of the work before it is covered up. The inspector will furnish a list of items that must be completed to satisfaction of Engineer before the work is covered over. Contractor shall notify Engineer when he is ready for the inspection. If notification is not made, work installed without inspection by the Engineer may be

rejected and the Contractor shall replace the work rejected at no additional cost to the Owner.

H. All identified defects or deficiencies in the work shall be corrected by the Contractor at no additional cost to the Owner.

I. Protect the building against damage from work of this section.

J. Protect the building against damage from work of this section.

1.12 WARRANTY REQUIREMENTS

A. Manufacturer Warranty: Provide a written copy of manufacturer's 20-year warranty on metal finishes

PART 2 - PRODUCTS

A. Mill finished aluminum, thickness to match existing.

B. Commercial quality with 0.20 percent copper, ASTM A 525 except ASTM A 527 for lock-forming, G90 hot-dip galvanized.

C. 0.0359-inch thick (20 gauge) metal.

D. 0.0299-inch thick (22 gauge) metal.

E. 0.0239-inch thick (24 gauge) metal.

F. 0.0239-inch thick (24 gauge) Kynar coated metal or equal.

G. 2-1/2 lb. minimum lead sheet flashings: at drains and at specified pipe penetrations.

H. Solder: For use with steel, lead or copper, provide 50-509 tin/lead solder (ASTM B32), with rosin flux.

I. Fasteners: Screws with ¼-inch shank of similar metal as flashing/sheet metal or, other compatible non-corrosive metal as recommended by sheet manufacturer. Match finish of exposed heads with material being fastened. Use 5/8-inch neoprene washers with all exposed screws. NO NAILS OR RIVETS SHALL BE USED - RIVETS MAY BE USED IWHT ALUMINUM METAL.

J. Masonry Fasteners: Corrosion resistant, equal to Tapcon threaded or Zumac expanding sleeve anchors, minimum 3/16-inch diameter, length to penetrate masonry a minimum of 1-inch.

K. Caulking: Equal to Sikaflex-1A sealant.

L. Metal Accessories: Provide sheet metal clips, straps, anchoring devices and similar accessory units as required for installation of work, matching or compatible with material being installed, non-corrosive, size and gauge required for performance.

PART 3 - EXECUTION

3.1 GENERAL FABRICATION

A. Verify that all roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, cant strips and reglets in place, and nailing strips located.

B. Verify membrane termination and base flashings are in place, sealed, and secure.

C. Field measure site conditions prior to fabricating work to insure proper fit. Install starter, edge strp8is, and cleats before starting installation.

D. Shop fabricate work to greatest extent possible. Fabricate for waterproof and weather-resistant performance; with expansion provisions for running work, sufficient to permanently prevent leakage into the building, damage or deterioration of the work.

E. Fit all sheet metal work tight in place. Form work to it substrates. Make corners square, surfaces true and straight in planes, without excessive oil-canning, buckling and tool marks, true to line and levels indicated, with exposed edges folded to form hems. Comply with material manufacturer instructions and recommendations for forming material.

F. Secure all sheet metal work in place using continuous 20 ga. G.I. hold-down clips and concealed fasteners. Use exposed fasteners only in locations where clips are not feasible, or where approved by Engineer.

G. Solder metal joints (except standing seams0 watertight for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water.

H. Provide for separation of metal from non-compatible metal or corrosive substrates by coating concealed surfaces at locations of contact with elastomeric coating or other permanent separation as approved by Engineer.

I. Clean exposed metal surfaces, removing substances which might cause corrosion of metal or deterioration of finishes.

J. All laps in fabricated work shall be a minimum of 2-inch.

K. Installer shall advise Engineer or Owner's Representative of required procedures for surveillance and protection of flashings and sheet metal work during construction, to ensure that work will be without damage or deterioration, other than natural weathering at time of substantial completion.

L. Beginning of installation means acceptance of existing conditions.

M. New Area Divider Cap: Provide and install a new 22 ga. G.I. area divider cap as shown on drawings. Cap shall be fastened at 12-inch o.c. using ¼-inch shank corrosion resistant screws with 5/8-inch neoprene washer. Standing seams shall be ¾-inch high with a one-inch wide internal hold down cleat.

N. New Counterflashing Along Walls: Provide and install new 22-gauge G.I. surface mounted counterflashings as shown on drawings. Counterflashing shall be fastened every twelve (12)

inches o.c. Install a continuous bead of sealant between the wall and the counterflashing, and a continuous canted bead of sealant along the top of the counterflashing.

O. New Counterflashing Around Curbs: Provide and install new 22 ga. G.I. counterflashings as shown on drawings. Counterflashing shall be fastened every six (6) inches o.c. Install a continuous bead of sealant between the wall and the counterflashing, and a continuous canted bead of sealant along the top of the counterflashing.

P. New Expansion Joint Cap: Provide and install a new 22-gauge G.I. expansion joint cap as shown on drawings. Cap hold-down shall be fastened at 12-inches o.c. using corrosion resistant nails. Counterflashing shall be fastened at 12-inches o.c. using ¼-inch shank corrosion resistant screws with 5/8-inch neoprene washer. Standing seams shall be 3/4-inch-high with a one-inch wide internal hold-down cleat.

Q. New Metal Coping: Provide and install new 24 ga. G.I. Kynar coated standing seam metal coping as shown on drawings. Coping hold-down shall be fastened at 12" o.c. using corrosion resistant nails. Standing seams shall be ¾-inch high with a one-inch wide internal hold-down cleat.

R. New Perimeter Edge Metal: All perimeter edge metal shall be fabricated from a continuous piece of mill finished aluminum, thickness to match existing. Installation of perimeter edge metal shall be in conformance with SMACNA Figure 2-5A, page 2.8, and SMACNA Figure 2-6B, page 2.10 with modifications as shown on drawings. Perimeter metal shall be fastened at 6-inch o.c. using corrosion resistant masonry fasteners or ¼-inch shank corrosion resistant screws with 5/8-inch neoprene washer. Hold-down clip shall be continuous, fastened with corrosion resistant nails every twelve inches o.c.

S. New Flashings at Drain Penetrations:

1. Provide new 36 x 36 inches 2-1/2 lb. lead sheet drain flashings.

T. New Flashings at Pipe Penetrations:

1. Fabricate new soldered 2-1/2 lb. lead and 22 ga. G.I. flashings.

U. New Curb Caps: Provide and install a new 22-gauge G.I. soldered curb caps as shown on drawings. Cap shall be fastened at 6-inches o.c. using corrosion resistant fasteners or ¼-inch shank corrosion resistant screws with 5/8-inch neoprene washer.

V. Miscellaneous Sheet Metal Accessories: Provide and install new miscellaneous sheet metal accessories as required for each application.

END OF SECTION

SECTION 07 92 11 - SEALANTS, CAULKING AND BELOW GRADE WATERPROOFING

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall perform all caulking, sealing, moisture protection and appurtenant work complete and in accordance with the requirements of the Contract Documents.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Concrete Construction Joints. Section 03 15 16

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Federal Specifications:

TT-S-00230C(2)	Sealing Compound, Elastomeric Type, Single Component, (For Caulking, Sealing and Glazing in Buildings and Other Structures).
TT-S-001543A	Sealing Compound, Silicone Rubber Base, (For Caulking, Sealing and Glazing in Building and Other Structures).

B. Commercial Standards:

ASTM D 41	Specification for Asphalt Primer Used in Roofing and Waterproofing.
ASTM D 226	Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
ASTM D 312	Specification for Asphalt Used in Roofing.
ASTM D 4551	Standard for PVC Flexible Sheeting for Concealed Water Containment Membranes.

1.4 CONTRACTOR SUBMITTALS

A. Samples: The Contractor shall submit to the Engineer for review, samples, including color samples of all the caulking and sealant materials and other moisture protection materials he proposes to use. The samples shall be clearly marked with the manufacturer's name and product identification and shall be submitted along with the manufacturer's technical data and application instructions.

B. The Contractor shall submit copies of the manufacturer's technical literature, specifications, warranty and installation instructions.

PART 2 - PRODUCTS

2.1 SEALANTS AND CAULKING MATERIALS

A. All caulking and sealing materials shall conform to the following requirements:

1. Sealant for joints in concrete is specified under Section 03 15 16, entitled "Concrete Construction Joints".

2. Sealant for general exterior and/or interior architectural use shall be 2-part polyurethane, gun grade, such as Products Research Corp "210"; Progress Unlimited "Iso-Flex 2000"; or equal. Sealant for interior use may be 1-part acrylic trypolymer sealant, such as Tremco's "Mono"; Dap One-Part Acrylic; or equal.

3. The sealants used with aluminum doors, windows, storefronts and frames shall be silicone sealant conforming to Federal Specifications TT-S-001543A (Class A) and TT-S-00230C(2) (Type II, Class A).

4. Filler material shall be resilient, closed-cell polyethylene foam and/or bond breakers of proper size for joint widths. It shall be compatible with sealant manufacturer's product.

5. Primers shall be as recommended in the manufacturer's printed instructions for caulking and sealants.

6. Cleaning and cleanup solvents shall be as recommended in the manufacturer's printed instructions for caulking and sealants.

7. All sealants, chemicals and materials that will be in contact, or may come into contact, with potable water shall be NSF/ANSI 61 certified for use with drinking water systems.

8. Curing per manufacturer’s requirements and prohibit filling tank, pipes, or other structures with drinking water until curing is complete.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. All work under this Section and all testing, where applicable, shall be performed in accordance with manufacturer's printed recommendations, specifications and installation instructions except where more stringent requirements are shown or specified herein; and, except where project conditions require extra precautions or provisions to assure performance of the waterproofing system.

B. Authorized Installers: Caulking, sealants and moisture protection shall be complete systems and installed only by installers authorized and approved by the respective manufacturers.

C. Sub-Slab Membrane: A sub-slab membrane shall be installed under all new building floor slabs with vinyl composition tile finishes and at other locations designated in the Contract Documents.

D. Showers: Showers shall be provided with a shower pan membrane waterproofing system as specified herein for moisture protection.

3.2 SEALANT FILLED JOINTS

A. The Contractor shall be responsible for providing the on-site services of the sealant manufacturer's representative prior to sealant work to inspect the joints to be sealed and to instruct the installer in the proper use of the materials. Joints and spaces to be sealed shall be clean, dry and free of dust, loose mortar and other foreign materials. Ferrous metal surfaces shall be cleaned of all rust, mill scale and other coatings by wire brush, grinding or sandblasting. Oil and grease shall be removed by cleaning in accordance with sealant manufacturer's printed recommendations. Protective coatings shall be removed from all aluminum surfaces against which caulking or sealing compound is to be placed. Bituminous or resinous materials shall be removed from surfaces to receive caulking or sealants. Where required by the manufacturer, sides of joints of porous materials shall be primed immediately prior to caulking or sealing.

B. Sealant depth in expansion joints shall be 1/2 the width of joint, but not less than 1/8-inch deep and 1/4-inch wide nor more than 1/2-inch deep and 1-inch wide. All joints shall have a rigid filler material installed to proper depth prior to application of sealant.

C. A full bead of sealant shall be applied into the joint under sufficient pressure with the nozzle drawn across sealant to completely fill the void space and to ensure complete wetting of contact area to obtain uniform adhesion. Sealants shall be tooled immediately after exposure with caulking tool or soft bristled brush moistened with solvent. The finished sealant filled joint shall be slightly concave unless detailed otherwise.

D. After application of sealant and caulking materials, adjacent materials which have been soiled shall be cleaned and left in a neat, clean, undamaged or discolored condition. On porous surfaces, excess sealant shall be removed per sealant or caulking manufacturer's printed instructions.

END OF SECTION 079200

DIVISION 8 - OPENINGS

SECTION 08 16 13 – FIBERGLASS DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fiberglass Reinforced Plastic (FRP) Doors
   2. Fiberglass Resin Transfer Molded Door Frames

1.2 RELATED SECTIONS

A. Related Sections:
   1. Section 08 71 00 – Door Hardware
   4. Section 08 80 00 – Glazing

1.3 QUALITY ASSURANCE

A. Test certification by an independent and accredited laboratory is required for the properties listed in this Quality Assurance section. Reports shall be made available upon request for each of the standards and certifications described below.

B. Reference Standards

   1. Door Properties
      a. Standard test method for steady state thermal transmission properties by means of the heat flow meter apparatus.
      b. Successfully completed 1,000,000 cycles test in accordance with:
         1. AAMA 920-03 – Specification for Operating Cycle Performance of Side-Hinged Exterior Door Systems.
         2. ANSI A250.4-2001 – Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcings.
         3. NWWDA TM-7 Test Method to Determine the Physical Endurance of Wood Doors and Associated Hardware Under Accelerated Operating Conditions.
      c. Florida Building Code
         1. SFBC PA 201 Impact Procedures for Large Missile Impact
         2. SFBC PA 202 Uniform Static Load on Building Components
         3. SFBC PA 203 Products Subjected to Cycle Wind Pressure
         4. SFBC 3603.2 Forced Entry Test
         5. ASTM E 1886 Impact and Cycling, Large Missile Impact
         6. ASTM E 1996 Specifications for Performance of Exterior Doors
         7. ASTM C 518 Heat Transfer
         8. ASTM D 1761 Mechanical Fasteners

   2. Laminate Properties

      a. Door face plate is a minimum of 0.125 inch thick fiberglass reinforced plastic molded into one continuous sheet starting with a 25 mil resin-rich gelcoat layer resin integrally molded with multiple layers of 1.5 oz. sq ft fiberglass mat and one layer of 18 oz per square yard fiberglass woven roving saturated with special resin. Door plate weight shall not be less than 0.97 lbs per square foot at a ratio of 30/70 glass resin.

      b. Laminated plate by itself evaluated in accordance with Florida Building Code TAS 201 Large Missile Impact Test as per ASTM-1996-05b, Standard Specification for Performance of Exterior

Windows, Curtain Wall, Doors and Storm Shutters Impacted by Windborne Debris in Hurricanes. The missile (a 2 x 4 with a weight of 9 lbs shot from a cannon at a velocity of 50 ft/sec) did not penetrate the door face plate.

1. ASTM D 638 Tensile Strength Properties of Plastic
2. ASTM D 790 Flexural Strength Properties of Plastic
3. ASTM D 2583 Indention Hardness of Plastics
4. ASTM D 256 Izod Pendulum Impact Resistance
5. ASTM D 792 Density/Specific Gravity Of Plastics
6. ASTM D 1761 Mechanical Properties of Fasteners
7. ASTM E 84 Surface Burning Characteristics of Materials
8. ASTM G 155 Xenon Light Exposure of Non Metallic Materials
9. ASTM D 635 Method For Rate of Burning
10. ASTM D 2843 Smoke Density
11. ASTM D 1929 Self Ignition Temperature Properties
12. SFBC PA 201 Impact Procedures for Large Missile Impact

3. Core Properties
    1. ASTM C 177 Thermal Properties of Materials
    2. ASTM D 1622 Density and Specific Gravity
    3. ASTM E 84 Surface Burning Characteristics of Materials
    4. WDMA TM-10 and TM-5 Firestop ASTM E 152 U.L 10(b)
    5. ASTM E90-04- Sound Transmission Loss
    6. ASTM E413-04- Classification for Rating Sound Insulation
    7. ASTM E1332-90- Standard Classification for Determination of Outdoor-Indoor Transmission Class
    8. ASTM E2235-04- Standard Test for Determination of Decay Rates for Use in Sound Insulation Methods

C. Qualifications

1. Manufacturer Qualifications: A company specialized in the manufacture of fiberglass reinforced plastic (FRP) doors and frames as specified herein with a minimum of 15 years documented experience and with a record of successful in-service performance for the applications as required for this project.
2. Installer Qualifications: An experienced installer who has completed fiberglass door and frame installations similar in material, design, and extent to those indicated and whose work has resulted in construction with a record of successful in-service performance.
3. Source limitations: Obtain fiberglass reinforced plastic doors and resin transfer molded fiberglass frames through one source fabricated from a single manufacturer, including fire rated fiberglass frames. This ensures complete uniformity of physical properties and consistency in the resin chemistry tailored for this application.
4. Source limitations: Hardware and accessories for all FRP doors as specified in Section 08 71 00 shall be provided and installed by the fiberglass door and frame manufacturer.
5. Source Limitations: Glass for windows in doors shall be furnished and installed by door and frame manufacturer in accordance with related section, Section 08 80 00, Glazing.

1.4 SUBMITTALS

A. Product Technical Data Including:
1. Acknowledgment that products submitted meet requirements of standards referenced.
2. Manufacturer shall provide certificate of compliance with current local and federal regulations as it applies to the manufacturing process.
3. Manufacturer’s installation instructions.
4. Schedule of doors and frames indicating the specific reference numbers used on the owner’s project documents, noting door type, frame type, size, handing and applicable hardware.
5. Details of core and edge construction. including factory construction specifications.

6. Certification of manufacturer's qualifications.

B. Submittal Drawings for Customer Approval Shall be Submitted Prior to Manufacture and Will Include the Following Information and Formatting:
   1. Summary door schedule indicating the specific reference numbers as used on owner's drawings, with columns noting door type, frame type, size, handing, accessories and hardware.
   2. A drawing depicting front and rear door elevations showing hardware with bill of material for each door.
   3. Drawing showing dimensional location of each hardware item and size of each door.
   4. Individual part drawing and specifications for each hardware item and FRP part or product.
   5. Construction and mounting detail for each frame type.

C. Samples:
   1. Provide one complete manufactured door sample which represents all aspects of the typical manufacturing process, including molded in gelcoat color and face plate construction. One edge should expose the interior of the door depicting the unique u-shaped continuous piece stile and rail, hardware reinforcement and core material.

D. Operation and Maintenance Manual
   1. Include recommended methods and frequency for maintaining optimum condition of fiberglass doors and frames under anticipated traffic and use condition.
   2. Include one set of final as built drawings with the same requirements as mentioned in Section B above.
   3. Include certificate of warranty for door and frame listing specific door registration numbers.
   4. Include hardware data sheets and hardware manufacturer's warranties.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Each door and frame shall be delivered individually crated for protection from damage in cardboard containers, clearly marked with project information, door location, specific reference number as shown on drawings, and shipping information. Each crate shall contain all fasteners necessary for installation as well as complete installation instructions.
   1. Doors shall be stored in the original container on edge, out of inclement weather for protection against the elements.
   2. Handle doors pursuant to the manufacturer's recommendations as posted on outside of crate.

1.6 WARRANTY

A. All fiberglass doors and frames have a lifetime guarantee against failure due to corrosion. Additionally, fiberglass doors and fiberglass frames are guaranteed for ten years against failure due to materials and workmanship, including warp, separation or delamination, and expansion of the core.
B. On site assistance available.

PART 2 – PRODUCTS

2.1 FRP DOORS

A. Doors shall be made of fiberglass reinforced plastic (FRP) using Class 1 premium resin with no fillers that is specifically tailored to resist chemicals and contaminants typically found in environment for which these specifications are written. Doors shall be 1 ¾ inch thick and of flush construction, having no seams or cracks. For consistency in the resin chemistry tailored for this application and to maintain the same physical properties throughout the structure, all fiberglass components including face plates, stiles and rails and frames must be fabricated by the same manufacturer. Components obtained through various outside sources for plant assembly will not be accepted.
B. Door Plates shall be 0.125-inch-thick minimum, molded in one continuous piece, starting with 25 mil gelcoat of the color specified, integrally molded with multiple layers of 1.5 ounces per square foot fiberglass mat and

one layer of 18 ounce per square yard fiberglass woven roving. Each layer shall be individually laminated with resin as mentioned above. Door plate weight shall not be less than 0.97 lbs per square foot at a ratio of 30/70 glass to resin. Plate alone to withstand Large Missile Impact per FBC TAS 201. Face plates manufactured using the pultrusion process does not allow for a smooth molded gelcoat finish, the use of woven roving for adequate plate thickness, strength and weight, or the appropriate glass to resin ratio and will not meet the quality standards of this project.

C. Stiles and Rails shall be constructed starting from the outside toward the inside, with a matrix of at least three layers of 1.5 ounce per square foot of fiberglass mat. The stile and rail shall be molded in one continuous piece to a U-shaped configuration and to the exact dimensions of the door. In this manner there will be no miter joints and disparate materials used to form the one-piece stile and rail.
D. Core material shall be Polypropylene plastic honeycomb core with a non woven polyester veil for unparalleled plate bonding, 180 PSI typical compression range unless otherwise requested.
E. Internal Reinforcement shall be #2 SPF of sufficient amount to adequately support required hardware and function of same.
F. Finish of door frame shall be identical with 25 mil resin-rich gelcoat of the specified color integrally molded in at time of manufacture resulting in a smooth gloss surface that is dense and non-porous. To achieve optimum surface characteristics, the gelcoat shall be cured within a temperature range of 120F to 170F creating an impermeable outer surface, uniform color throughout, and a permanent homogeneous bond with the resin/fiberglass substrate beneath. Only the highest quality gelcoat will be used to ensure enduring color and physical properties. Paint and/or post application of gelcoat results in poor mechanical fusion and will be deemed unacceptable for this application. The finish of the door and frame must be field repairable without compromising the integrity of the original uniform composite structure, function or physical strength.
G. Window openings, if required, shall be provided for at time of manufacture and shall be completely sealed so that the interior of the door is not exposed to the environment. Fiberglass retainers, which hold the glazing in place, shall be resin transfer molded with a profile that drains away from glazing. The window retainer must match the color and finish of the door plates with 25 mil of resin-rich gelcoat integrally molded in at time of manufacture. Mechanical fasteners shall not be used to attach retainers. Glass, as specified herein, shall be furnished and installed by door and frame manufacturer. In order to maintain uniform appearance, product longevity and the corrosion resistance this application requires, window retainers fabricated from Metal, PVC or Vinyl will not be accepted.
H. Louver openings, if required, shall be completely sealed so that the interior of the door is not exposed to the environment. Louvers are to be solid fiberglass “V” Vanes and shall match the color and finish of the door plates.
I. Transoms shall be identical to the doors in finish, construction, materials, thickness and reinforcement.

2.3 FRP FRAMES

A. Frames (rated and non-rated) shall be fiberglass and manufactured using the resin transfer method creating one solid piece (no voids) with complete uniformity in color and size. Beginning with a minimum 25 mil gelcoat layer molded in and a minimum of two layers of continuous strand fiberglass mat saturated with resin, the frame will be of one-piece construction with molded stop. All frame profiles shall have a core material of 2 psf polyurethane foam. Metal frames or pultruded fiberglass frames will not be accepted.
B. Finish of frame shall be identical to the door with 25 mil resin-rich gelcoat of the specified color integrally molded in at time of manufacture. To achieve optimum surface characteristics, the gelcoat shall be cured within a temperature range of 120F to 170F creating an impermeable outer surface, uniform color throughout, and a permanent homogeneous bond with the resin/fiberglass substrate beneath. Only the highest quality gelcoat will be used to ensure enduring color and physical properties. Paint and/or post application of gelcoat result in poor mechanical fusion and will be deemed unacceptable for this application. The finish of the door and frame must be field repairable without compromising the integrity of the original uniform composite structure, function or physical strength.
C. Jamb/Header connection shall be mitered for tight fit.
D. Internal Reinforcement shall be continuous within the structure to allow for mounting of specified hardware. Reinforcing material shall be a dense matrix of cloth glass fibers and premium resin with a minimum hinge

screw holding value of 1000 lbs per screw. All reinforcing materials shall be completely encapsulated. Documented strength of frame screw holding value after third insert must be submitted. Dissimilar materials, such as steel, will be deemed unacceptable as reinforcement for hardware attachment.

E. Mortises for hardware shall be accurately machined by CNC to hold dimensions to +/- 0.010 inch in all three axis.
F. Hinge pockets shall be accurately machined by CNC to facilitate heavy duty hinges at all hinge locations, using shims when standard weight hinges are used.

2.4 HARDWARE

A. See Section 08 71 00.

PART 3 – EXECUTION

3.1 INSTALLATION CONDITIONS

A. Verification of Conditions
   1. Verify openings are correctly prepared to receive doors and frames.
   2. Verify openings are correct size and depth in accordance with submittal drawings.
B. Installer's Examination
   1. Door installer shall examine conditions under which construction activities of this section are to be performed and submit a written report to general contractor if conditions are unacceptable.
   2. General Contractor shall submit two copies of the installer's report to the architect within 24 hours of receipt.
   3. Installer shall not proceed with installation until all unacceptable conditions have been corrected.

3.2 INSTALLATION

A. Doors shall be delivered at job site individually crated. Each crate to be clearly marked with the specific opening information for quick and easy identification.
B. All doors to be shipped completely assembled in the frame.
C. Install door opening assemblies in accordance with shop drawings and manufacturer's printed installation instructions, using installation methods and materials specified in installation instructions.
D. Site tolerances: Maintain plumb and level tolerance specified in manufacturer's printed installation instructions.
E. Fire labeled doors, frames and any associated hardware must be installed by qualified professional installers in strict accordance with manufacturer's instructions and the latest revision of NFPA 80.

3.3 ADJUSTING

A. Adjust doors in accordance with the door manufacturer's maintenance instructions to swing open and shut without binding and to remain in place at any angle without being moved by gravitational influence.
B. Adjust door hardware to operate correctly in accordance with hardware manufacturer's maintenance instruction.

3.4 CLEANING

A. Clean surfaces of door opening assemblies and exposed door hardware in accordance with respective manufacturer's maintenance instructions.

3.5 PROTECTION OF INSTALLED PRODUCTS

A. Protect door opening assemblies and door hardware from damage by subsequent construction activities until final inspection.

END OF SECTION

SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish and install all finish hardware and appurtenant work, complete and in accordance with the requirements of the Contract Documents.

B. The Contractor shall provide mounting templates as needed and install all trim, attachments and fastenings specified or required for a proper and complete installation. The work of this Section shall include all hardware that is not specified in other sections.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. All work specified herein shall conform to or exceed the requirements of the International Building Code (latest edition) and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section.

1. Hardware Institute (DHI); Recommended Procedure for Processing Hardware Schedules and Templates and Architectural Hardware Scheduling and Format.

2. Federal Specifications.

3. Manufacturer's published recommendations and Specifications.

4. Underwriters' Laboratories, Inc. (UL) requirements and approvals.

1.3 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 entitled, "Submittal Procedures."

B. The Contractor shall submit a complete detailed hardware list and a schedule along with manufacturer's literature and technical data on each item for approval. No hardware shall be delivered until the hardware schedule has been approved by the Engineer. If samples of any hardware items are requested, they shall be furnished by the hardware supplier no later than ten (10) days after said request is received.

C. The hardware schedule submitted by the Contractor shall list the manufacturer's product series numbers. The schedule shall indicate groups, type, manufacturer's name, catalog number, location and finish of each item to be provided, all in accordance with the DHI "Architectural Hardware Scheduling Sequence and Format". The schedule shall also include a complete template list showing template references and data for each item requiring preparation of metal doors and frames.

1.4 PROPRIETARY DESIGNATION

A. Manufacturer's product names, numbers and models are given herein for the purpose of indicating the requirements for the type, general construction, material and operation of the specific item.

1.5 PACKING, MARKING AND DELIVERY

A. All locks, exit devices, door closers, overhead door holders, hinges, kickplates, pulls and push plates, thresholds and other similar items shall be individually packed in separate, suitable original containers as furnished by the hardware manufacturers. Each container shall be clearly marked with item numbers, article numbers and names corresponding to those listed in the hardware schedule.

PART 2 - PRODUCTS

2.1 GENERAL

A. Finish hardware shall be coordinated with all other work requiring builder's hardware or attaching to it. Copies of schedules, templates, etc., shall be furnished in ample time to avoid fabrication and construction delays. Each item of hardware shall be identified according to approved list and schedule. All hardware shall be made to template.

B. All hardware furnished in connection with doors bearing Underwriters' Labels or where necessary to meet special requirements shall be in strict accordance with conditions established by the authority having jurisdiction and shall be subject to approval of that authority.

C. Hand of lock shall be as shown. If door hand is changed during construction the Contractor shall make necessary changes at no extra cost to the Owner.

D. Exit doors shall be openable at all times from the inside without the use of a key or any special knowledge or effort.

E. For convenience in specifying, model numbers have been taken from the catalogs of the following manufacturers:

1. Hinges: Bonner, Hager, Stomley
2. Locksets: Schlage
3. Closers: LCN
4. Stops and Trim: Glynn Johnson
5. Weatherstrip and Thresholds: Reese, Renco, Nat. Gaard

F. The Contractor shall provide the hardware supplier with approved shop drawings from those trades with which hardware must be coordinated. After checking these shop drawings, the Contractor shall promptly supply necessary template information to all concerned as may be required to facilitate the progress of the job. All procedures for template information shall be in accordance with the handbook, "Recommended Procedure for Processing Hardware Schedules and Templates".

G. Finish of all hardware shall be as shown in Hardware Schedule unless specified otherwise.

2.2 KEYING

A. All locks and cylinders shall be master keyed to the Owner's requirements as directed by the Engineer.

B. The Contractor shall furnish six (6) keys per cylinder keying combination. All keys along with four (4) master keys shall be delivered to the Owner immediately upon installation of the locking cylinders.

2.3 FASTENERS

A. The Contractor shall provide all necessary screws, bolts and other fasteners of suitable size and type to secure the hardware into position. The fasteners shall match the hardware in material and finish.

B. The hardware provided, such as expansion bolts, sex bolts, toggle bolts and other approved anchorages shall be coordinated with the job and to each setting condition.

2.4 HINGES

A. Three (3) hinges shall be provided for each door leaf up to and including 7-foot in height and an additional hinge shall be added for each 2-foot or fractions thereof of additional door height.

B. All hinges on exterior doors, except for four-fold industrial doors, shall be full mortise, 4-1/2 inches high, heavy duty, 4-ball bearings, stainless steel, non-removable pins with security studs, similar to Model BB1199, manufactured by Hager, Inc., or approved equal.

C. All hinges on interior doors shall be full mortise, 4-1/2 inches high, standard weight, 2-ball bearings, steel, non-rising removable pin with button tip and plug, similar to Model BB1279, manufactured by Hager, Inc., or approved equal.

2.5 OVERHEAD CLOSERS

A. All overhead closers shall be the product of one (1) manufacturer. Closures shall have high strength cast iron cylinder with rectangular covers, adjustable spring power and adjustable back-check, full rack and pinion action, tamper proof, non-critical regulating screws and be UL listed.

B. Closers shall be coated with a rust prohibiting primer and finish coated in the field to match doors.

C. All closers shall be provided with hold-open arm. All exterior door closers shall have a cushion type stop arm as well as the hold-open arm feature.

D. Except at exterior doors, closers shall not be mounted on the corridor or vestibule side of door.

E. Closers for outswinging exterior doors shall be top-jamb-mounted and furnished with adapter plates for doors under 7-foot 6-inches in height. If necessary, closers may be mounted on drop brackets on doors above 7-foot 6-inches in height. Closers shall be provided with sex bolts for fastening through doors, frames and transoms.

F. The Contractor and its hardware supplier shall be responsible to provide the right arm with the closers. Arms shall be parallel with the closed door whenever possible.

G. Closers shall be LCN, Corbin, Russwin, or approved equal.

2.6 LOCKSETS AND LATCHSETS

A. Provide locksets with Schlage B502-191 cam mortise type lockset or approved equal.

B. Locksets and latchsets must conform to ANSI A156.2, Series 4000, Grade 1 and be UL listed.

C. Locksets and cores to be of the same manufacturer to maintain complete lockset warranty.

C. All component parts of locksets shall be the product of one manufacturer, unless otherwise approved by the Engineer.

D. Function of locksets or latchsets shall be appropriate for doors use.

F. Permanent core face must be the same finish as the locksets finish.

2.7 KICKPLATES

A. Kickplates shall be stainless steel, 0.050-gage, beveled on three (3) sides and 10-inches high. Width shall be door size less 2-inches. Kickplates shall be Builders Brass Works 37 Series, Quality Manufacturing 48 Series, or approved equal.

2.8 DOOR STOPS

A. Door stops shall be stainless steel and shall be wall or floor bumper type as required in the hardware schedule. Wall bumper stops shall be mounted with the appropriate fastening system for the wall type. Gypsum board wall shall be provided with appropriate wood backing.

B. Door stops shall be manufactured by Trimco, Builders Brass works or approved equal.

2.9 THRESHOLDS

A. All exterior doors except roll up overhead doors and bifold doors shall receive one interlocking threshold of extruded aluminum with a maximum 5/8-inch rise. Thresholds shall be Pemko 121A with door mounted surface hook 66A or approved equal. Except that the 1-hour fire rated doors shall have a gasketed threshold.

B. Thresholds shall be installed with sealant to prevent water from seeping underneath.

2.10 WEATHERSTRIPPING

A. Weatherstripping or gasketing shall be as manufactured by Pemko Manufacturing Co., Zero Weatherstripping Co., or approved equal. All weatherstripping or gasketing shall be extruded aluminum with neoprene seal attached with stainless steel sheet metal screws.

PART 3 - EXECUTION

3.1 GENERAL

A. All required items of hardware, including cylinders for locks, and all fitting, adjusting, and securing of each item neatly and firmly in place, shall be in perfect working order. Any work less than this shall form a basis for corrective measures.

B. All finish hardware shall be fitted and dismantled before painting work and shall be reinstalled after finish painting work.

3.2 HARDWARE SCHEDULE

A. The hardware schedule is arranged for convenience of locating hardware and does not preclude in any way the requirements that all necessary hardware shall be furnished and properly installed.

Hardware not specifically called out shall be similar to that required for similar uses.

B. The catalog numbers referred to in the hardware schedule are taken from catalogs of the manufacturers listed. Contractor shall provide product listed below or approved equal.

HARDWARE: Lockset - Exterior Doors (Utility Room and Janitor's Closet)

Tags #101A, 104A, and 201A

Per Door	Component
1 each	Grade 1 Mortise Locks: Schlage L Series, Grade 1, Mechanical LV9456 with 06A Lever Trim or Approved Equal, Finish: Satin Chrome
1 each	Closer: LCN 1460 or Approved Equal
1 each	Kickplate: 10" x 32" LTDW 630 or Approved Equal

HARDWARE: Privacy - Exterior Doors (Showers and Unisex Restroom)

Tags #105A, 106A, 107A, 108A, 301A, and 302A

Per Door	Component
1 each	Grade 1 Mortise Locks: Schlage L Series, Grade 1, Mechanical L9496 with 06A Lever Trim or Approved Equal, Finish: Satin Chrome
1 each	Closer: LCN 1460 or Approved Equal
1 each	Kickplate: 10" x 32" LTDW 630 or Approved Equal

HARDWARE: Passage - Exterior Doors (Men's and Women's Restroom)

Tags #102A, 103A, 202A, and 203A

Per Door	Component
1 each	Grade 1 Mortise Locks: Schlage L Series, Grade 1, Mechanical L9010 with 06A Lever Trim or Approved Equal, Finish: Satin Chrome
1 each	Deadbolt: Schlage Double Cylinder Deadbolt or Approved Equal, Finish: Satin Chrome
1 each	Closer: LCN 1460 or Approved Equal
1 each	Kickplate: 10" x 32" LTDW 630 or Approved Equal

3.3 PROTECTIVE TAPE AND COATINGS

A. Strippable coating or removable tape protection or other approved means to prevent any damage or staining of hardware during construction shall be used. Such protective measures shall be removed prior to final cleaning for Owner's acceptance of project.

END OF SECTION

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Windows.
2. Doors.
3. Skylights.
4. Interior borrowed lites.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 by a qualified professional engineer, using the following design criteria:

1. Design Wind Pressures: As indicated on Drawings.
2. Design Snow Loads: Insert design snow load.
3. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
4. Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass to resist each of the following combinations of loads:

    a. Outward design wind pressure minus the weight of the glass. Base design on glass type factors for short-duration load.
    b. Inward design wind pressure plus the weight of the glass plus half of the design snow load. Base design on glass type factors for short-duration load.
    c. Half of the inward design wind pressure plus the weight of the glass plus the design snow load. Base design on glass type factors for long-duration load.

5. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
6. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

1.3 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

1.4 ACTION SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

D. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Preconstruction adhesion and compatibility test report.

1.6 QUALITY ASSURANCE

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F, and the fire-resistance rating in minutes.

D. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

1.7 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

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

C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

C. Windborne-Debris-Impact Resistance: Provide exterior glazing that passes basic-protection testing requirements in ASTM E 1996 for Wind Zone 1 when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than glazing indicated for use on the Project and shall be installed in same manner as glazing indicated for use on the Project.

1. Large-Missile Test: For glazing located within 30 feet of grade.

2. Small-Missile Test: For glazing located more than 30 feet above grade.
3. Large-Missile Test: For all glazing, regardless of height above grade.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
2. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS

A. Glass Specifications: Glass shall conform to Federal Specification DD-G-451D and Federal Specifications DD-G-1403B(1) (Tempered Glass). Insulating glass shall conform to SGMA 65-7-2.

B. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

C. Ultraclear Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I, complying with other requirements specified and with visible light transmission not less than 91 percent.

1. Products: Subject to compliance with requirements, provide the following:

a. ASG Industries, Inc.
b. Combustion Engineering, Inc.
c. Libby Owens Ford Co.
d. PPG Industries, Inc.; Starphire.
e. Or Equal.

D. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

E. Type A: Tinted, colored float glass shall be not less than 1/4-inch minimum thickness. The glass color shall be gray. Type A glass shall be PPG, "Solargray"; LOF, "Monolithic Gray"; or equal.

F. Type B: Tinted, colored, tempered float glass shall be heat-treated safety glass 1/4-inch minimum thickness, such as PPG, "Herculite - Solargray"; LOF, "Thermopane - Monolithic Gray"; or equal. The glass color shall be gray.

G. Type C: Clear float glass shall conform to Federal Specification DD-G-451D and shall be not less than 1/4-inch thick. Type C glass shall be PPG, "Pennvernon"; LOF, "Monolithic Annealed Glass"; or equal.

H. Type D: Clear, tempered float glass shall be heat-tempered safety glass conforming to Federal Specification DD-G-1403B(1) and shall be not less than 1/4-inch thick.

I. Type G: Tinted, colored, insulating glass shall be metal-edged units of 1-inch thickness, consisting of an outside lite of 1/4-inch thick, tinted, colored gray float glass; 1/2-inch air space; and 1/4-inch thick, clear float glass inside lite. Provide tempered glass as described above where required by code and where indicated in the drawings.

2.3 LAMINATED GLASS

A. Laminated Glass: ASTM C 1172 and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral interlayer or cast-in-place and cured-transparent-resin interlayer to comply with interlayer manufacturer's written recommendations.
2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

B. Windborne-Debris-Impact-Resistant Laminated Glass: ASTM C 1172 and complying with testing requirements in 16 CFR 1201 for Category II materials, with "Windborne-Debris-Impact Resistance" Paragraph in "Glass Products, General" Article, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with one of the following to comply with interlayer manufacturer's written recommendations:

    a. Polyvinyl butyral interlayer.
    b. Polyvinyl butyral interlayers reinforced with polyethylene terephthalate film.
    c. Ionoplast interlayer.
    d. Cast-in-place and cured-transparent-resin interlayer.
    e. Cast-in-place and cured-transparent-resin interlayer reinforced with polyethylene terephthalate film.

2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

2.4 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.

1. Sealing System: Dual seal.
2. Spacer: Manufacturer's standard spacer material and construction.

2.5 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:

1. Neoprene complying with ASTM C 864.
2. EPDM complying with ASTM C 864.
3. Silicone complying with ASTM C 1115.
4. Thermoplastic polyolefin rubber complying with ASTM C 1115.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene EPDM silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.

1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

2.6 GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Sealants used inside the weatherproofing system, shall have a VOC content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
4. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
5. Colors of Exposed Glazing Sealants: As indicated by manufacturer's designations.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

C. Glazing Sealants for Fire-Rated Glazing Products: Products that are approved by testing agencies that listed and labeled fire-resistant glazing products with which they are used for applications and fire-protection ratings indicated.

2.7 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer

rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.8 MISCELLANEOUS GLAZING MATERIALS

A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

E. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

F. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

PART 3 - EXECUTION

3.1 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.2 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Apply heel bead of elastomeric sealant.

F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.3 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.4 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.5 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION

DIVISION 9 – FINISHES

SECTION 09 30 00 - TILING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Tile

1. Color Body Porcelain
2. Glazed Porcelain
3. Quarry and Saltillo
4. Terrazzo
5. Floor and Wall Glazed
6. Wall and Counter Glazed
7. Mosaics Floor and Wall
8. Natural Stone
9. Manufactured Stone

B. Surface Preparation Products

1. Cement Backer Board
2. Self-Leveling Underlayment
3. Waterproofing Membrane
4. Crack Isolation Membrane
5. Uncoupling Membrane
6. Sound Reduction Mat Underlayment
7. Shower System - Prefabricated

C. Setting Materials: Architecturally Engineered Mortar Systems

1. Polymer Modified Thin Set Mortar
2. Polymer Modified Medium Bed Mortar
3. Rapid Setting Mortar
4. Chemical Resistant Bonding Mortar
5. Ceramic Tile Adhesive

D. Colored Tile Grouts

1. Sanded Cement Based Grout
2. Non-Sanded Cement Based Grout
3. Epoxy Grout
4. Single Component High Performance Grout

E. Tile & Stone Care and Maintenance Products

1. Penetrating Stain Protecting Sealer
2. Color Enhancing Sealer

F. Edge Protection and Transition Profiles

1. Floors
2. Walls and Countertops
3. Stair Nosing

1.2 RELATED SECTIONS

A. Section 01 33 00 – Submittal Procedures

B. Section 03 30 04 - Concrete

C. Section 10 28 13.16 – Restroom, Shower, and Utility Accessories

1.3 REFERENCES

A. ANSI A108 Series/A118 Series - American National Standards for Installation of Ceramic Tile.

B. ANSI A136.1 - American National Standard for Organic Adhesives for Installation of Ceramic Tile.

C. TCNA Handbook for Ceramic, Glass and Stone Tile Installation

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

D. Verification Samples: For each finish product specified, two samples, minimum size 6 inches square, representing actual product, color, and patterns.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products of this section with minimum ten years documented experience.

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

C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and fabrication and installation.
   1. Locate mock-ups on site in locations and size directed by Architect or Engineer.
   2. Finish areas designated by Architect or Engineer.
   3. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect or Engineer.
   4. Refinish mock-up area as required to produce acceptable work.
   5. Retain and maintain mock-ups during construction in undisturbed condition as a standard for judging completed unit of Work.
   6. Obtain Architect's acceptance of mock-ups before start of final unit of Work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements of ANSI A137.1 for labeling sealed tile packages.

B. Prevent damage or contamination to materials by water, freezing, foreign matter and other causes.

C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Environmental: Install mortar, set and grout tile when surfaces and ambient temperature is minimum 50 degrees F and maximum 90 degrees F. Consult with manufacturer for specific requirements.

C. Do not install mortar, set or grout tile exterior when inclement weather conditions are expected within 48 hours after work is completed unless properly protected.

D. Protection: Protect adjacent work surfaces during tile work. Close rooms or spaces to traffic of all types until mortar and grout has set.

E. Safety: Observe the manufacturer's safety instructions including those pertaining to ventilation.

1.8 WARRANTY

A. Provide one (1) year warrant after the project is declared substantially complete.

1.9 EXTRA STOCK MATERIALS

A. Supply an amount equal to 3 percent of each size, color, and surface finish of tile specified.

PART 2 PRODUCTS

2.1 TILE

A. General: Provide tile that complies with ANSI A137.1 for types, compositions and other characteristics indicated. Provide tile in the locations and of the types colors and pattern indicated on the Drawings and identified in the Schedule and the end of this Section. Tile shall also be provided in accordance with the following:
   1. Factory Blending: For tile exhibiting color variations within the ranges selected under Submittal of samples, blend tile in the factory and package so tile taken from one package shows the same range of colors as those taken from other packages.

2. Mounting: For factory mounted tile, provide back or edge mounted tile assemblies as standard with the manufacturer, unless otherwise specified.
3. Factory Applied Temporary Protective Coatings: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with a continuous film of petroleum paraffin wax applied hot. Do not coat unexposed tile surfaces.

B. ColorBody Porcelain Tile:
1. Refer to project drawings, if required.

C. Glazed Porcelain Tile:
1. Refer to project drawings, if required.

D. Quarry and Saltillo Tile:
1. Refer to project drawings, if required.

E. Terrazzo Tile:
1. Refer to project drawings, if required.

F. Floor and Wall Glazed Tile:
1. Refer to project drawings, if required.

G. Wall and Counter Glazed Tile:
1. Refer to project drawings, if required.

H. Mosaics Floor and Wall Tile:
1. Refer to project drawings, if required.

I. Natural Stone:
1. Refer to project drawings, if required.

J. Manufactured Stone:
1. Refer to project drawings, if required.

2.4 TILE INSTALLATION MATERIALS

A. Anti-Fracture Membrane/Cleavage Membrane complying with ANSI A118.12: Where indicated on the Drawings, and elsewhere as required for isolating the installation from cracking due to minor substrate movement and normal structural deflections as specified in ANSI A108.17.

B. Waterproofing Membrane complying with ANSI A118.10: Where indicated on the Drawings, and elsewhere as required for waterproofing tile assembly as specified in ANSI A108.13.

C. Sound Control/Acoustical Underlayment complying with ANSI A118.13: Where indicated on the drawings, and elsewhere as required to be load bearing, shock and vibration resistant.

D. Moisture Barrier System: Where indicated on the Drawings and elsewhere as required for thin-set tile installations.

E. Self-Leveling Underlayment: Where indicated on the drawings, and elsewhere as required to provide a flat, level surface for direct receipt of tile and other floor

coverings on dry, interior installations.

F. Shower System – Prefabricated: Where indicated on the Drawings, and elsewhere as required for waterproofing tile assembly in showers. A108.01 Article 2.2 and A108.13.

G. Mortar Bed Installations: Where indicated on the Drawings, and elsewhere as required for mortar bed or brown coat as the substrate for tile work; work to conform to ANSI A108.1.

H. Cementitious Backer Units complying with ANSI A118.9. Where indicated on the Drawings, and elsewhere as required for floors and walls, interior and/or exterior, wet areas, and dry as recommended substrate for tile, fire rated wall installations, heat shield with UL listing for floors and walls; installation to comply with ANSI A108.11 and manufacturer's installation instructions.

I. Cementitious Tile Adhesives:
   1. ANSI A118.4 / A118.11: Polymer-Enhanced Mortars: Where indicated on the Drawings, and elsewhere as required for setting tile as specified by ANSI A108.5 or A108.12, Dry-Set Portland Cement Mortar or Latex Portland Cement Mortar, over substrates prepared accordingly.

J. Organic Tile Adhesives:
   1. ANSI A136.1: Where indicated on the Drawings, and elsewhere as required for setting tile as specified by ANSI 108.4, Organic Adhesives, over substrates prepared accordingly.

K. Epoxy Tile Adhesives:
   1. ANSI A118.3: Where indicated on the Drawings, and elsewhere as required for setting tile as specified by ANSI A108.6 Chemical Resistant, Water-Cleanable Tile Setting and Grouting Epoxy, over substrates prepared accordingly.

L. Edge-Protection and Transition Profiles

   1. Exposed edges of ceramic and natural stone tile are proned to chipping when left unprotected. Profiles should be selected to protect the edges and provide transitions from various surfaces. Material, Finish and Height of the Profile must be specified.

M. Tile Grout: Where indicated on the drawings, and elsewhere as required for filling the joints between tiles. Where indicated on the Drawings, and elsewhere as required for grouting tile as specified by ANSI A108.10 Installation of Grout in tile work.

N. Elastomeric Joint Caulk: Provide where indicated on the Drawings, and elsewhere as required at joints between floors and walls and at joints between tile and dissimilar materials.

O. Ceramic and Natural Stone Tile Care and Maintenance: Required for proper maintenance of the completed tile assembly.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine surfaces, which are to receive tile.

B. Do not proceed with work until defects or conditions which would adversely affect quality, execution and permanence of finished tile work are corrected.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Surface Preparation for Tile and Stone Work.

1. General:
    a. All supporting surfaces shall be structurally sound, solid, stable, level, plumb, and true to a tolerance in plane of 1/4 inch in 10 feet for walls, 1/4 inch in 10 feet for floors when specified for thin-set method. When installing large format tile (one side greater than 15 inches) the tolerance is reduced to 1/8 inch in 10 feet. ANSI A108.01 Section 2.6.2
    b. They shall be clean and free of dust, oil, grease paint, tar, wax, curing compound, primer, sealer, form release agent, laitance, loosely bonded topping, loose particles or any deleterious substance and debris which may prevent or reduce adhesion.
    c. Mechanically sand and scarify the substrate to completely remove all paint, loosely bonded topping, loose particles and construction debris.
    d. Neutralize any trace of strong acid or alkali.
    e. All substrates shall be dry. The moisture content shall not exceed 50 percent.
    f. Turn off all forced ventilation and radiant heating systems and protect work against drafts during installation and for a period of at least 72 hours after completion. Use indirect auxiliary heaters to maintain the temperatures in the area at the recommended workable level. Vent temporary heater to exterior to prevent damage to tile work from carbon dioxide build-up.
    g. Presswood, particleboard, chipboard, masonite, gypsum floor patching compounds, asbestos board, Luan and similar dimensionally unstable materials are not acceptable substrates.
    h. Before work commences examine the areas to be covered and report any flaw or adverse condition in writing to the architect and to the general contractor. Do not proceed with work until surfaces and conditions comply with the requirements indicated in ANSI A108 standard.
2. Concrete:
    a. Concrete and Masonry surfaces must comply with ANSI A108.01 Section 3.2
    b. All concrete substrates shall be at least 28 days old, completely cured and free of hydrostatic conditions, and/or moisture problems.
3. Plywood:
    a. Plywood subfloor and underlayment must comply with ANSI A108.01 Section 3.4

4. OSB Panels
    a. OSB panel is not a suitable surface for direct bonding ceramic tile. The OSB panel should be coated with Custom Building Products RedGard Waterproofing and Anti-fracture membrane prior to the installation of ceramic tile.
5. Backerboard Units Installation of Floors, Decks or Countertops:
    a. Cementitious Backerboard shall be installed per the guidelines in ANSI A108.11.
6. Wall and Ceiling Installation
    a. Wall and Ceiling surfaces must comply with ANSI A108.01 Section 2.5
7. Gypsum Board surfaces:
    a. Gypsum Board shall be installed per the guidelines of ANSI A108.01 Section 3.5.
8. Steel:
    a. Steel substrates shall be rigid, solidly fixed, dry, well sanded and free of dust, oil, grease, primer and deleterious substances, which may prevent or diminish the bond.
9. Tiling over old substrates: Old cement terrazzo, ceramic tile paver, quarry tile, vinyl and vinyl composition floor coverings other than cushion vinyl shall be sound, solidly in place, flawless, stripped or sanded, clean, free of dust, wax, grease, sealers, soap residue and other deleterious substances which may prevent or reduce the adhesion. For further details see ANSI A108.01 Article 2.6.2.

B. Condition of surface to receive tile.
1. Assure that surfaces to receive tile are stable, flat, firm, dry, clean and free of oil, waxes and curing compounds.
2. Deflection of substrate not to exceed 1/360th of the span 1/2 inch in 15 feet in accordance with ANSI A108.01-2.3. Allow for live and impact load as well as dead load weight of tile and setting bed.
3. Protect adjacent surfaces prior to beginning tile work.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Expansion joints, control joints, insulation joints, etc., must be located in compliance with TCNA EJ171 and filled with appropriate materials.
1. Joints must be carried through layers of installation materials including tile, setting bed, mortar bed and reinforcing wire. Refer to TCNA Handbook, EJ171 and ANSI AN-3.8 for details on placement, size and specifications of materials.

C. Install grout in accordance with Grout ANSI A108.10 standard and manufacturer's directions.

D. Install elastomeric tile caulk around sinks, tubs and showers and where tile meets tile or another surface. Surfaces should be clean, dry and free of contamination. Maximum joint width and depth should not exceed 1/4 inch.

F. Seal grout, stone and unglazed tile with an appropriate sealer 48 - 72 hours

after grout application.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 09 91 00 - PAINTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Finishing work of this Section, as a system, includes but is not limited to the following:

1. Preparation of all surfaces.
2. Performance and completion of painting and finishing of all required interior and exterior surfaces, including exposed Mechanical and Electrical Work in finished spaces, including flashing. For Mechanical and Electrical identification systems see those Divisions.

B. Related Work Described Elsewhere:

Section 03 30 00	Cast-in-Place Concrete
Section 05 80 13	Miscellaneous Metalwork
Section 06 10 00	Rough Carpentry
Section 08 10 00	Metal Doors and Frames

C. Work Not to be Finished:

1. Shop painting or priming of metal which is specified under other Sections, except for minimal spot touch-up of surfaces braded during installation.
2. Surfaces in concealed areas and inaccessible areas such as furred spaces, foundation spaces, utility tunnels, pipe spaces, and duct shafts, unless otherwise indicated.
3. Metal surfaces of anodized aluminum, stainless steel, chromium plate, polished copper, bronze, and similar finished materials, unless otherwise indicated.
4. Any moving parts of operating units; mechanical or electrical parts such as valve operators, linkages, sinkages, sensing devices, and motor shafts, unless otherwise indicated.
5. Any required labels or equipment identification, performance rating, brand name, or nomenclature plates.
6. Sheet metal work which has exterior insulation.
7. Items which have been factory finished or which are surfaces with plastic laminate.

D. Definitions:

1. The term "paint", as used herein, means all finish coating systems materials including primers, emulsions, epoxy, enamels, sealers, fillers, and other applied materials whether used as prime, intermediate, or finish coats other than special coatings or pool waterproofing which are specified elsewhere.

1.2 QUALITY ASSURANCE

A. Qualification 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 acceptable to the Owner. Furnish source materials to Painting Inspection Agency for testing when required by Inspection Agency representative.

B. Qualifications of Workers:

1. The firm engaged for Work under this Section shall, upon request, furnish in writing, his qualifications attesting to past satisfactory experience in painting Work of not less than the scope of this Project.
2. Only qualified journeymen shall be engaged to do the painting work under this Section. Apprentices may be employed working under qualified journeymen's directions in accordance with trade regulations.

1.3 STANDARDS

A. American Society for Testing and Materials (ASTM): D 2200-67 (1980) "Pictorial Surface Preparation Standards for Painting Steel Surfaces".

1.4 SUBMITTALS

A. Manufacturers' Data: Within 30 calendar days after award of the Contract, submit:

1. Complete materials list of all items proposed to be furnished and installed under this Section.
2. Manufacturers' specifications and other data required to demonstrate compliance with the specified requirements.
3. For information only, submit two copies of manufacturer's specifications, including analysis and application instructions for each material. Indicate by transmittal that a copy of each manufacturer's instructions has been distributed to the applicator.
4. Upon receipt of review comments, make all revisions and corrections, and resubmit if so required.

B. Samples:

1. Following the selection of colors and glosses by the Owner, submit samples for the Owner's review:

a. Provide two samples of each color and each gloss on final substrate for each material on which the finish is specified to be applied.
b. Except as otherwise directed by the Owner, samples shall be approximately 12-inch square.
c. If so, directed by the Owner, submit samples during progress of the Work of this Section in the form of actual application of the approved materials on actual surfaces to be painted.

2. Revise and resubmit each sample as required until the Owner's approval of gloss, color, and texture is achieved.

1.5 PRODUCT HANDLING

A. Delivery of Materials: Deliver all materials to the job site in original, new, and unopened containers bearing the manufacturer's name and label showing at least the following information:

1. Name or title of the material
2. Manufacturer's stock number
3. Manufacturer's name
4. Contents by volume for major constituents
5. Thinning instructions
6. Application instructions

B. Storage of Materials: Provide proper storage to prevent damage to, and deterioration of, paint materials in accordance with manufacturer's instructions.

C. Protection: Use all means necessary to protect the materials of this Section before, during, and after installation and to protect the Work and materials of all other trades.

D. Fire Hazard & Safety: Take all necessary precautionary measures to prevent fire hazards and spontaneous combustion.

E. Toxic Material:

1. Where toxic materials, and both toxic, acetic, and explosive solvents are used, take appropriate precautions, as a regular procedure, conforming to the manufacturer's recommendations therefore, and to the requirements of the applicable safety regulatory agencies.
2. In applying acid etch coating or solutions to metal, concrete, plaster, and toxic materials to copper, provide ventilation and take protective measures to conform to the requirements of the safety regulatory agencies.

F. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner at no additional cost.

1.6 JOB CONDITIONS

A. Surface Temperatures: Do not apply solvent-thinned paints when the temperature of surfaces to be painted and the surrounding air temperature are below 50 degrees F., unless otherwise permitted by the manufacturer's printed instructions as approved by the Owner.

B. Temporary Heat: Provide approved temporary heat for Interior Work to attain temperatures specified hereinabove for Work in this Section.

C. Lighting: Do not proceed with Work under this Section unless a lighting level of a minimum of 15-foot candles is provided on the surfaces to be painted or finished. This contractor to provide temporary lighting to attain lighting level specified.

D. Ventilation: Provide adequate continuous ventilation as required for the various specified materials used in the spaces scheduled but in no case for a time less than that recommended

by the paint manufacturer for drying.

1.7 PROTECTION

A. General: Adequately protect other surfaces from paint materials and damage caused by this Work. Make good any damage caused by failure to provide suitable protection at no additional cost to the Owner.

B. Drop Cloths: Provide sufficient drop cloths, shields and protective equipment to prevent spray or dripping from fouling surfaces not being painted and, in particular, surfaces within the paint storage and preparation area.

C. Removal of Flammable Rubbish: Place cotton waste cloths and material which may constitute a fire hazard in closed metal containers and daily remove from the site.

D. Removal of Hardware & Miscellaneous Items:

1. Carefully remove electrical outlet and switch plates, mechanical diffusers, escutcheons, surface hardware, fittings, fastenings, etc. prior to starting Work under this Section.
2. Carefully store, clean and replace these items upon completion of Work in each area. Use no solvent or abrasives to clean hardware that will remove the permanent finish used on these items.

1.8 REQUIREMENTS OR REGULATORY AGENCIES

A. Codes: Observe and conform to all Federal, State and Local Fire, Safety and Ecological Laws and regulations applicable to Work in this Section.

1.9 EXTRA STOCK

A. Amount: Upon completion of the Work of this Section, deliver to the Owner an extra stock equaling 1 gallon of each color, type and gloss of paint or stain used on the Work.

B. Packaging: Tightly seal each container and clearly label with the contents and location used.

PART 2 - PRODUCTS

2.1 PAINT MATERIALS - GENERAL

A. Coating and materials other than those specified: Shall be of the standard specified, or a higher quality, top line product from an approved manufacturer.

B. Primers and undercoaters: Shall be compatible with the brand of finish paint used.

C. Mixing: All paint products shall be thoroughly mixed until homogeneous. Paints that have settled to a condition that makes them difficult to mix shall be removed from the job. Skins

and other irregular particles shall be removed by straining through fine nylon. Only clean equipment and tools shall be used.

D. Thinning: All paints are ready to apply as supplied. Under certain circumstances, however, thinning may be necessary. No thinning will be approved unless the manufacturer of the paint recommends it and documents the necessity to the Owner in writing.

2.2 MIXING

A. General:

1. Furnish ready-mixed products unless otherwise specified. Follow manufacturer's directions for field-mixing of pastes and powders and for field-catalyzing components.
2. Fully grind pigments to maintain a soft paste consistency in the vehicle during storage. It is required to be dispersed readily and uniformly by paddle to a completely homogeneous mixture ready for use, to have good flowing and brushing properties, to dry or cure free of streaks or sags and to yield the desired finish specifications.
3. Store materials not in actual use in tightly covered containers.
4. Maintain containers used in storage, mixing, and application of paint in a clean condition, free from foreign materials and residue.

B. Stirring: Stir all materials before application to produce a mixture of uniform density, and as required during the application of the materials. Do not stir into the material any film which may form on the surface. Remove the film and, if necessary, strain the material before using.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection: Carefully inspect the installed Work of all other trades and verify that all such Work is complete to the point where this installation may properly commence. Verify that painting may be completed in accordance with the design drawings and with the manufacturers' recommendations as approved by the Owner.

B. Discrepancies: Notify Owner in writing prior to commencing work or after the prime coat shows defects in the substrate of any defects or problems. Except as noted, starting Work under this Section implies acceptance of surfaces.

3.2 SURFACE PREPARATION

A. General: Prepare all new and existing surfaces as indicated below or, if not specified, consult Manual for surface preparation.

1. Prepare all surfaces for painting in compliance with manufacturers recommendations.
2. Remove loose, deleterious material from all surfaces by scraping and brushing. Patch minor defects, sand rough spots, and perform surface preparation work normal to the trade before applying paint. Brush all surfaces immediately prior to applying paint.
3. On existing finished surfaces to be re-painted or re-finished, remove all loose, blistered, scaled, or crazed finish to bare base material surface. Where new work joins existing work, prepare existing surfaces extending to the nearest break in the plane. Wash surfaces with TSP and water or other solution as required, rinse, and let dry.

B. Miscellaneous Steel and Iron: Put in proper condition to receive paint. Grease, rush, scale, dirt and dust are required to be removed by other trades except as otherwise noted.

1. Surfaces shop primed by others: At field welded or abraded spots, apply a phosphoric acid etch solution. Let set as recommended by acid etch manufacturer. Rinse with potable water. When thoroughly dry, immediately apply prime coat. Clean previously primed surfaces free of any remaining oil and grease.
2. Surfaces not previously shop primed: Remove rust and scale by wire brushing, sandblasting or other method. Remove dust dirt, oil, and grease using solvent wash. Apply phosphoric acid solution. Let set as recommended by acid etch manufacturer. Rinse with potable water. When thoroughly dry, immediately apply prime coat. Any defects showing in prime surface are required to be repaired by other trades. Reprime over repaired defects.

C. Structural Steel: Prepare shop primed steel as specified above for "Miscellaneous Steel and Iron".

D. Sheetmetal: Remove surface contamination and prepare surfaces in accordance with product manufacturer's instructions for priming.

E. Non-Ferrous Metal:

1. Aluminum and copper to be painted: Remove surface contamination by steam, high pressure water, or solvent washing. apply etching type primer, or, acid etch, let dry, then immediately prime paint.
2. Anodized aluminum: No work required.

F. Mechanical and Electrical Work: Prepare metal surfaces as specified for Miscellaneous steel and iron" and "Non-ferrous metals" as applicable to type of material scheduled to be painted. Remove dirt, grease and oil from canvas and cotton insulating covering.

G. Concrete and other cementitious surfaces:

1. Remove dirt, scale, powder, laitance, parting compounds, oil and grease, by light sandblasting treatment or alternate method that has been approved by the Owner. For cast-in-place work allow at least 14 days after forms have been removed by others before starting work, unless otherwise approved by Owner.

2. Remove stains caused by corroding metals by washing with sodium metasilicate solution after thoroughly wetting with potable water. Let thoroughly dry.

H. Concrete Floors: Remove contamination, dirt, dust, and foreign matter. Apply acid etch solution. Rinse with clean water. Let thoroughly dry. After surface treatment keep all traffic off surfaces until sealed.

I. Mildew removal: Scrub with approved cleaning/bleaching solution, then rinse with potable water; let dry thoroughly prior to painting.

M. Existing Painted Ferrous Metal: Sand rough edges of bare areas to featheredge at adjacent sound paint. Remove rust and loose paint to bare metal; solvent wash, then apply prime paint.

3.3 APPLICATION

A. Workmanship: The Contractor is solely responsible for uniform colors, textures and finishes of surfaces, irrespective of materials or number of coats specified.

B. General:

1. Apply paint or other finish by methods generally accepted by the trade to achieve approved finishes, except that all metal surfaces in finished spaces are required to be finished by spray-application. The application method must not adversely affect the appearance of the job or its durability. The surrounding and adjacent areas must not in any way be affected by the application methods.
2. Use materials only in accordance with the manufacturer's recommendations and apply at recommended and/or specified dry-mil thickness. Any shortage of film thickness or coats will cause remedial action as determined by the Owner. Film thickness shall be constant over V joints, edges, corners, etc. Fatty edges and unevenness will be corrected.
3. Eliminate such defects as sags, runs, color floats, etc., which are abnormal. Unsightly permanent impressions left on the surface by the applicators must be removed without defacing the surface.
4. In multiple coat work, provide each coat of paint of slightly different color than preceding coat. Sand lightly between coats to achieve required finish.
5. Do not apply finishes on surfaces not sufficiently dry and hard.
6 Tint filler to match stain when clear finishes are specified. Work filler well into grain. Before it has set work surface perpendicularly to the grain and wipe off excess.
7. Include as many additional coats as required for the work. It is the requirements of these specifications to obtain painted finishes of uniform color and textures, free from cloudy or mottled appearance on surfaces and evident thinness of coatings on surfaces; and to this end all spot-coating and undercoating shall be done to produce such results.

C. Finish Film Thickness: Apply primer, intermediate, and finish coats to not less than wet

and dry film thicknesses and spreading rates for each of the various types specified.

D. Inspection: Each coat of paint shall be inspected and approved by the Owner before next coat of material is applied.

3.4 CLEANING, TOUCH-UP AND REFINISHING

A. Touch-up and Refinishing: A detailed final inspection of paint work shall be made. Runs, sags, misses, holidays, stains and other defects in the painted surfaces, including inadequate coverage and mil thickness shall be satisfactorily touched up, or refinished, or repainted as necessary to the satisfaction of the Owner.

B. Cleaning:

1. Carefully remove all spatterings, spots and blemishes caused by Work under this Section from surfaces throughout the Project. Remove in such a manner as not to damage surfaces. thoroughly clean paint and splatters from glass, mirrors, and other such surfaces. Take care not to scratch surfaces.
2. During the progress of the Work, keep the premises free from any unnecessary accumulation of tools, equipment, surplus materials and debris resulting from the Work under this Section. At the conclusion of the Work, leave the premises neat and clean and request final inspection from the Owner.

3.5 COLOR SCHEDULING

A. When not previously selected or scheduled:

1. Paint and finish colors will be selected by the Owner who will provide three different sets of color cards and schedules (minimum). These will identify where various colors and finishes are required to be applied.
2. For bidding purposes, and unless otherwise specified, refer to the finish schedules and adjacent surface paint, finish texture, and sheen for matching to following finishes.
    a. Access doors, registers, prime coated hardware, exposed conduit or piping and mechanical or electrical panels.
    b. Interior steel doors, their frames and trim. Match color of existing doors in building.

3.6 PAINT SCHEDULE

A. PAINTING AND FINISHING TITLES AND CODE NUMBERS: Provide work on Drawings, as scheduled below and as specified.

B GLOSS: To be selected by Owner.

C. SURFACES TO BE PAINTED:

Finish Code System

Alkyd Finish on Galvanized Metal: 1 coat rust-inhibitive primer 2 coats exterior alkyd	1 coat pretreatment primer
Latex Finish on Interior CMU: 2 coats Interior Latex	1 coat Latex Primer Sealer
Latex Finish on Gypsum Wallboard: 2 coats interior latex	1 coat latex or alkyd primer sealer
Alkyd Finish on Exposed Ferrous Metal:	1 coat alkyd rust-inhibitive primer (unless shop primed)
Alkyd Finish on Exposed Galvanized Metal:	1 coat pretreatment primer 1 coat galvanized primer 2 coats interior alkyd

CLEAR FLOOR SEALER for cast-in-place concrete at locations indicated: Seal all concrete floor surfaces with Sonneborn Sonoglaze per manufacturers recommendations.

END OF SECTION

SECTION 09 98 00 - PROTECTIVE COATINGS

PART 1 - GENERAL

1.1 DESCRIPTION

Painting and coating shall include all materials, labor tools, equipment and services required for the furnishing and application of all painting and coatings as specified herein or as indicated on the drawings. Work shall include, but not be limited to, cleaning and preparation of surfaces, paint materials, and the application of all paint and other materials.

1.2 SCOPE OF WORK

A. Equipment and materials which require painting or coating including but not limited to:

1. System 1: Primary structural members of buildings.

2. System 2: (Hot-Dip Galvanized) Stair stringers, grating embeds, platform steel, supports, secondary members of buildings.

3. System 3: (Interior and Exterior Piping) All above ground piping including pipe supports.

4. System 4: (Submerged Piping) All submerged, or partially submerged piping.

5. System 5: (Concrete) Any concrete noted on the plans where coating is called for.

6. System 6: (Exterior Wood Siding) All exterior wood siding and paneling.

1.3 QUALITY ASSURANCE

A. Codes and Standards. In addition to the requirements of these specifications, the work to be performed under this section shall comply with the following codes and regulations:

1. Steel Structure Painting Council Specifications (SSPC).

2. National Association of Corrosion Engineers Standards (NACE).

3. Applicable Standards of American National Standards Institute, Inc. (ANSI).

4. Occupational Safety and Health Act regulations (OSHA).

B. Painter's Qualifications. The Contractor shall cause the work specified under this section to be performed by or under the supervision of a qualified painter. The Contractor shall be prepared to document the painter's experience, competence and ability to comply with the requirements of these specifications and to complete the work in a timely manner. The painting and coating subcontractor shall provide three references which show successful experience with the specified coating systems.

C. Standard Products. All materials, supplies and articles provided shall be the standards products of recognized, reputable manufacturers. All paints in a particular paint system shall be the products of a single manufacturer. The Contractor shall also minimize the

number of paint suppliers. Do not use lead-base primers or final coats on any surface or metals.

The standard products of manufacturers other than those specified will be accepted when it is demonstrated to the satisfaction of the Engineer, they are equal in composition, durability, usefulness and convenience for the purpose intended.

1.4 SUBMITTALS

A. Before any paint materials are delivered to the job site, the Contractor shall submit a complete list of all materials proposed to be furnished and applied under this section.

Two identical sets of samples of actual paint colors shall be submitted for acceptance at least three (3) months prior to painting. Samples of each color and system used shall be painted on to 8-1/2 inch by 11-inch material. The material for the samples, where possible, shall be the same material as that on which the coating will be applied in the work.

For each paint, the Contractor shall furnish the paint manufacturer's specific application instructions which shall include the following:

1. Surface preparation recommendations.
2. Type of primer, if required.
3. Maximum dry and wet mil thickness per coat.
4. Minimum and maximum curing time between coats, including atmospheric conditions for each.
5. Curing time before submergence in water.
6. Thinner to be used with each paint.
7. General ventilation requirements.
8. Atmospheric conditions during which the paint shall not be applied.
9. Allowable methods of application.
10. Maximum, allowable moisture content and minimum age of plaster, concrete and wood surfaces at time of paint application.

1.5 DELIVERY AND STORAGE

All materials shall be delivered to the job site in their original, unopened containers bearing the manufacturer's name, brand, batch number, date of manufacture, and any special directions. Only the approved material shall be stored at the job site and stored only in designated areas restricted to the storage of paint materials and related equipment. All paints shall be stored in enclosed structures and shall be protected from weather and excessive heat or cold Flammable materials shall be stored to conform to state and local safety codes. Emulsion type paints shall be protected

from freezing. Materials exceeding storage life recommended by the manufacturer will be subject to rejection and, if so rejected, removed from the site.

1.6 MANUFACTURER REPRESENTATION

Require the paint manufacturer to make available a qualified technical representative to visit the job site for technical support if necessary, in order to resolve field problems attributable to or associated with the manufacturer's products furnished under this contract.

1.7 PROTECTION OF SURFACES NOT TO BE COATED

A. Protect surfaces and equipment which are not to receive coatings during surface preparation, cleaning and painting operations.

B. Remove mask, or otherwise protect hardware, lighting fixtures, switch plates, machines, surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting. Mask openings in motors and equipment to prevent abrasives, paint and other materials from entering.

C. Exercise care not to damage adjacent work during sandblasting operations. Conduct spray painting under controlled conditions. Promptly repair any damage to adjacent work or adjoining property occurring from sandblasting or spray-painting operations.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All sealants, chemicals and materials that will be in contact, or may come into contact, with potable water shall be NSF/ANSI 61 certified for use with drinking water systems.

B. Curing per manufacturer’s requirements and prohibit filling tank, pipes, or other structures with drinking water until curing is complete.

C. Use coating materials suitable for the intended use and recommended by their manufacturer for the intended service.

D. Use quality products of nationally known manufacturers having an established good reputation in the manufacturer of quality protective coatings. Use products that have a minimum of five years of similar, satisfactory field service.

E. In any coating system, use compatible coatings and products of only one manufacturer. Coatings used for touch up shall be the same as the original materials.

F. Use materials within the manufacturer's recommended shelf life.

G. Deliver the paint materials to the job site in the manufacturer's unopened containers and prepare a list of all batch numbers for the Engineer prior to the start of work.

H. Where practicable, apply each succeeding coat of paint using a different color or shade. Where a particular finish color is specified herein, it is for bidding purposes only. Finish colors shall be as selected from the manufacturer's standard color sheets by the Engineer.

I. Where alternative products are specified, selection from among the alternatives is at the Contractor's option.

J. The Contractor may submit for consideration paint materials of manufacturers other than those specified herein. Provide satisfactory documentation from the firm manufacturing the proposed material that the material meets the specified requirements and is equivalent or better than the listed materials in the following properties:

1. Quality
2. Durability
3. Resistance to abrasion and physical damage
4. Life expectancy
5. Ability to recoat in future
6. Solids content by volume
7. Dry film thickness per coat
8. Compatibility with other coatings
9. Suitability for the intended service
10. Resistance to chemical attack
11. Temperature limitations in service and during application
12. Type and quality of recommended undercoats and topcoats
13. Ease of application
14. Ease of repairing damaged areas
15. Stability of colors

Provide tests and analyses of the proposed substitute materials required by the Engineer. If the proposed substitution requires changes in the contract work, the Contractor hall bear shall such costs involved and the costs of allied trades affected by the substitution.

2.2 ALUMINUM METAL INSTALLATION

Where aluminum surfaces come in contact with concrete or with metals not compatible with aluminum (aluminum and galvanized surfaces considered compatible), the aluminum surfaces shall be prevented from coming into direct contact with such parts: (1) by painting the dissimilar materials with a prime coat of zinc-chromate primer or other suitable primer, followed by 1 or 2 coats of aluminum metal and masonry paint or other suitable protective coating, excluding those containing lead pigmentation, or (2) by painting the dissimilar material with a coating of heavy-

bodied bituminous paint. or (3) by placing a good quality caulking material between the aluminum and the dissimilar material.

2.3 SYSTEM 1 – EPOXY COATING OF FERROUS METAL

A. Areas of Application. All interior primary structural members that are not hot-dip galvanized, shall receive this protective coating. Existing primary clarifier mechanisms. Underside of the new digester lid and all ferrous metal on the inside of the digester including but not limited to pipes, side sheets, supports, and mixers.

B. Coating

1. Prime Coat: BarRust 233H Epoxy or Devoe BarRust 235 or equal – 6 mils
   Finish Coat: Devthane 379 Aliphatic Urethane semi-gloss or equal – 3 mils
   Preparation shall be according to manufacturer's recommendations.

2.4 SYSTEM 2 – HOT-DIP GALVANIZING

A. Area of Application: may include but is not limited to stair stringers, grating embeds, fasteners, support members, and interior structural members not epoxy coated per System 1

B. Fabricator Preparation

1. The Fabricator shall consult with the hot dip galvanizer to ensure that materials, fabrication, and prep work will prevent potential problems during the galvanizing process.

2. The Fabricator shall remove all welding slag, splatter, anti-splatter compounds and burrs prior to delivery for galvanizing. Avoid unsuitable marking paints. Consult with the galvanizer about removal of grease, oil paint and other deleterious material prior to fabrication. Remove by blast cleaning or other methods surface contaminants and coatings, which would not be removable by the normal chemical cleaning process in the galvanizing operation.

C. Hot-Dip Galvanizing

1. Pre-clean steelwork in accordance with accepted methods to produce an acceptable surface for quality hot dip galvanizing.

2. Galvanize steel members, fabrications, and assemblies after fabrication by the hot dip process in accordance with ASTM A123. Galvanize bolts, nuts and washers and iron and steel hardware components in accordance with ASTM A153.

3. Safeguard products against steel embrittlement in conformance with ASTM A143.

4. Handle all articles to be galvanized in such a manner as to avoid any mechanical damage and to minimize distortion.

5. Coating Weight: conform with paragraph 5.1 of ASTM A123, Table 1 of A767, or Table 1 of ASTM A153, as appropriate.

6. Surface Finish: Continuous, adherent, as smooth and evenly distributed as possible and free from any defect detrimental to the stated end use of the coated article.

7. Adhesion: Withstand normal handling consistent with the nature and thickness of the coating and normal use of the article.

D. Testing

1. Inspection and testing of hot dip galvanized coatings shall include visual examination and tests in accordance with ASTM A123, A767 or A153 as applicable to determine the thickness of the zinc coating on the metal surface.

2. Furnish Notarized Certificate of Compliance with ASTM Standards and Specifications herein listed. The Certificate must be signed by the galvanizer and contain a detailed description of the material processed. The Certificate shall include information as to the ASTM standard used for the coating.

E. Repair of Damaged Coating

1. The maximum area to be repaired is defined in accordance with ASTM A123 Section 4.6 current edition.

   a. The maximum area to be repaired in the field shall be determined in advance by mutual agreement between parties.

2. Repair areas damaged by welding, flame cutting or during handling, transport or erection by one of the approved methods in accordance with ASTM A780 whenever damage exceeds 3/16-inch in width. Minimum thickness requirements for the repair are those described in ASTM A123 section 4.6 current edition.

2.5 SYSTEM 3 – ABOVE GROUND PIPING

A. Area of application: All non-buried and non-heat traced piping, including pipe supports.

B. Surface Preparation.

1. Follow manufactures recommendations for surface preparation for each different piping material. Piping materials may consist of PVC, galvanized steel, and ductile iron.

C. Coating

1. Alkyd Primer or equal

2. First and second coats: colored Alkyd to match color system Semi-Gloss

3. Total finish thickness of 5 mils.

D. Service Colors: As required by owner.

2.6 SYSTEM 4 – SUBMERGED PIPING

A. Area of application: All submerged or partially submerged piping, including pipe supports.

B. Surface Preparation.

1. Follow manufactures recommendations for surface preparation for each different piping material. Piping materials may consist of, steel, galvanized steel, and ductile iron.

C. Coating (All coatings in contact with potable water must be NSF approved)

1. Epoxy primer or equal

2. First and second coats: colored epoxy to match color system

3. Total finish thickness of 5.0 mils.

D. Service Color and Gloss: As required by owner.

E. Approved Products:

1. Sherwin Williams Macropoxy 486 NSF
2. Devoe Coatings: Bar-Rust 233H

2.7 SYSTEM 5 – CONCRETE

A. Area of Application. Concrete that is to be coated where noted on the plans.

B. Immersion H_2S Vapor Exposure

1. System Type: Modified Polyamine Epoxy.
2. Surface Preparation: SSPC-SP 13/NACE 6. ICRI CSP 5 Abrasive blast.

a. Surface preparation techniques employing acid, organic solvents, extreme heat (flame), impact tools (scabblers) and scarification is prohibited. After degreasing as necessary and when concrete is dry, shot blast entire area to produce a surface profile between ICRI CSP 3 and ICRI CSP 5 (excluding ICRI CSP 4). Shot blasting equipment shall produce a 20-inch minimum blast path width and, in addition, each pass shall be slightly overlapped (1/4-inch – ½-inch overlap). New shot shall be added to shot blasting equipment prior to blasting. Shot blasting shall stop when the concrete's surface resembles an ICRI CSP 5 profile. If contractor produces concrete surfaces with a level of coarseness greater than an ICRI CSP 5 profile, contractor shall resurface these areas at the contractor's expense. Concrete surfaces inaccessible to shot blasting (base of walls and under secured equipment) shall be prepared using diamond disk grinding to produce an ICRI CSP 2 profile. Resulting surfaces shall appear visually clean and contain the appropriate level of surface profile. If the resulting level of cleanliness cannot be determined, adhesion testing in accordance to ASTM D 4541 shall be conducting on the dirtiest areas of concrete. Each adhesion test shall produce cohesive failures within the concrete above 200 psi with concrete chunks attached to each pull-off coupon.

b. Contractor shall ensure that blasting material and blasted material be contained within the surface preparation area. Sand, cement, sediment laden water, and other deleterious materials shall not be allowed in effluent downstream of abrasive blast work. The Contractor shall take every precaution to ensure that downstream facilities are not injured or interrupted by abrasive blasting activities.

3. Primer: Tnemec Series 218 MortarClad or equal. DFT 1/16 in.
4. Intermediate: Tnemec Series 434 Perma-Shield H_2S or equal. DFT 125.0 Mils
5. Finish Coat: Tnemec Series 435 Perma-Glaze or equal. DFT 30.0 to 40.0 mils.
6. Total DFT: 125.0 to 165.0 mils
7. Finish Color: As selected by Owner from manufacturer's standard colors

2.8 SYSTEM 6 – EXTERIOR WOOD SIDING

A. Area of Application. All exposed wood siding and paneling.

1. System Type: Exterior grade stain and sealant.
2. Surface Preparation: Per manufacturer's recommendations
3. Primer: N/A
4. Intermediate: Per Mfg's recommendations
5. Finish Coat: Per Mfg's recommendations
6. Finish Color: As selected by Owner from manufacturer's standard colors

PART 3 - EXECUTION

3.1 PREPARATION SURFACES

A. Inspect and provide substrate surfaces that are prepared in accordance with these specifications and the printed instructions and recommendations of the paint manufacturer whose product is applied.

B. Metal Surface Preparation (Ungalvanized)

1. The minimum abrasive blasting surface preparation is as specified in the coating system schedules. Where there is a conflict between these specifications and the coating manufacturer's recommendations for the intended service, provide the higher degree of cleaning.

2. Provide workmanship, materials and methods for metal surface preparation in conformance with the referenced current Steel Structures Painting Council (SSPC) specifications and this Section. Provide blast-cleaned surfaces that match the standard samples available from the National Association of Corrosion Engineers, NACE Standard TM-0 1-70.

3. Inspect surfaces to be coated and remove all oil, grease, welding fluxes and other surface contaminants by alkaline washing per Paragraph 2.05C prior to blast cleaning.

4. Grind all sharp edges round or chamfered and grind smooth all burrs and surface defects prior to blast cleaning.

5. Select the type and size of abrasive to produce a surface profile that meets the coating manufacturer's recommendation for the particular coating and service conditions.

6. Do not reuse the abrasive unless approved by the Engineer. For automated shop blasting Systems, maintain clean, oil-free abrasives.

7. Comply with the applicable federal, state, and local air pollution control regulations for blast cleaning.

8. Supply compressed air for air blast cleaning at adequate pressure from well-maintained compressors equipped with oil/moisture separators which remove at least 95 percent of the contaminants.

9. Clean surfaces of all dust and residual particles of the cleaning operation by dry air blast cleaning, vacuuming or another approved method prior to painting.

10. Vacuum clean and wipe with a tack cloth enclosed areas and other areas where dust settling is a problem.

11. If newly applied coatings are damaged or defective, remove the coating by the specified blast cleaning to meet the clean surface requirements before recoating.

12. If the specified abrasive blast cleaning will damage adjacent work, the areas to be cleaned is less than 100 square feet and the coated surface will not be submerged in service, then SSPC-SP-2, hand tool cleaning or SSPC-SP-3, power tool cleaning may be used to achieve the specified surface preparation.

13. Completely remove shop-applied coatings of unknown composition before the specified coatings are applied. Examine valves, castings, ductile or cast-iron pipe, fabricated pipe and equipment for the presence of shop applied temporary coatings. Completely remove temporary coatings by solvent cleaning before the abrasive blast cleaning work is started.

14. Alkaline clean shop primed equipment per Paragraph 2.05C in the field before finish coats are applied.

3.2 COATING APPLICATION

A. Apply coatings to steel substrates in accordance with "Paint Application Specification No.1", (S SPC-A- 1), Steel Structures Painting Council. Use experienced workers who are skilled in application of the coating materials.

B. Inspect cleaned surfaces and all coats prior to each succeeding coat. Schedule such inspection with the Engineer in advance.

C. Apply all coatings according to manufacturer's instructions, recommendations and these specifications. If directions differ, the most stringent requirements shall be followed.

D. Paint blast cleaned ferrous metal surfaces before any rusting or other deterioration of the surface occurs. Blast clean only those surfaces that can be coated in the same working day.

E. Each coat will be subject to inspection prior to application of the next coat.

F. For submerged and severe service conditions, brush apply coating material to edges, angles, weld seams, flanges, nuts and bolts, and other placed where insufficient fill thicknesses are likely to be present prior to the first coat. For other exposures use stripe painting for these areas.

G. Particular attention shall be paid to materials that will be joined so closely that proper surface preparation and paint application is not possible. Such surfaces shall be painted prior to assembly on installation.

H. Apply all finish coats, including touch-up and damage repair coats in a manner which will present a uniform texture and color-matched appearance.

I. Do not apply coatings (1) in temperature conditions outside the manufacturer's recommended range, (2) in dust, smoke-laden atmosphere, (3) damp or humid weather, (4) when the temperature is less than 5 degrees F above dew point, (5) when it is expected the air temperature will drop below 40 degrees F, or less than 5 degrees F above the dew point within 8 hours after application of coating. Measure the dew point by use of a sling psychrometer in conjunction with U.S. Dept. of Commerce Weather Bureau psychometric tables.

J. Abrasive blast and prime steel piping before installation.

K. Apply the finish coat on all work after all concrete, masonry, and equipment installation is complete and the work areas are clean and dust free.

3.3 TESTING

A. Holiday Testing. Test all coated ferrous surfaces which will be submerged in water or other liquids for pinholes in the coating using an approved holiday detector. Additionally, test any other ferrous surfaces required elsewhere in these specifications to be tested for holidays, in accordance with the provisions of this Section. Repair or recoat areas found to contain pinholes in accordance with the coating manufacturer's instructions and retest.

1. COATINGS WITH THICKNESS EXCEEDING 20 MILS. For surfaces having a total dry film coating thickness exceeding 20 mils; pulse-type holiday detector, Tinker & Rasor Model AP-W, D.E. Stearns Co., Model 14.20 or equal, adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.

2. COATINGS WITH THICKNESS OF 20 MILS OR LESS. For surfaces having a total dry film coating thickness of 20 mils or less: Tinker & Rasor Model Ml non-destructive type holiday detector, K-D Bird Dog, or equal, operating at less than 75 volts. For thickness between 10 and 20 mils, a non-sudsing type wetting agent, Kodak Photo-Flo, or equal, shall be added to the water prior to wetting the detector sponge.

B. Testing dry film thickness. On ferrous metals, coating thickness shall be measured with a magnetic type dry film thickness gauge such as Mikrotest Model FM, Elcometer Model 11 l/lEZ, or equal. Each coat shall be checked for the correct thickness. No measurement will be made until at least 8 hours after application of the coating.

C. Contractor shall supply the testing equipment along with proper calibration devices.

3.4 CLEANUP

Upon completion of all painting, the Contractor shall remove all surplus materials, protective coverings and accumulated rubbish and thoroughly clean all surfaces and repair any overspray or other paint-related damage.

END OF SECTION

DIVISION 10 – SPECIALTIES

SECTION 10 21 13.17 – PHENOLIC-CORE TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Phenolic Toilet Compartment work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.

B. Sightless (Privacy Option) Phenolic toilet compartments.

C. Phenolic Urinal screens.

D. Hardware and structural accessories.

1.2 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry

B. Section 10 28 13.16 – Restroom, Shower and Utility Accessories

1.3 REFERENCE STANDARDS

A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

B. Field Measurements: Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.5 SUBMITTALS

A. See Section 01 33 00 – Submittal Procedures, for submittal procedures.

B. Product Data: Provide data on panel construction, hardware, and accessories.

C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.

D. Samples: Submit two samples of partition panels, 12 x 12 inch in size illustrating panel finish, color, and sheen.

E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.6 DELIVERY, STORAGE AND PROTECTION

A. Deliver materials in manufacturer's original packaging to protect from damage.

B. Store materials in manufacturer's original packaging in accordance with manufacturer's instructions. Store materials indoors, protected from the elements and construction hazards.

C. Handle materials in a manner that will protect the finished product.

1.7 WARRANTY

A. This Contractor shall guarantee his work for a period of One (1) year from date of Substantial Completion.

B. Provide manufacturer's Twenty-Five (25) year written limited warranty on its Panels, Pilasters and Doors, against chipping, breakage, corrosion, delamination and defects in workmanship; to be replaced without charge excluding labor.

C. Provide manufacturer's Ten (10) year written limited warranty on all Cast Stainless Steel Hardware, Hinges and Mounting Brackets, as well as on all full high aluminum mounting brackets, against defects in material and workmanship. All other hardware will be provided with a manufacturer's One (1) year written limited warranty, against all defects in material and workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer:
   1. Columbia Partitions: www.psisc.com
      a. Product - "Phenolic Partitions Series 58000".

B. Other Approved Manufacturers:
   1. Bradley Corporation: www.bradleycorp.com.
   2. Bobrick Washroom Equipment, Inc: www.bobrick.com.
   3. Metpar Corporation: www.metpar.com.
   4. Accurate Partitions Corp: www.accuratepartitions.com.
   5. General Partitions: www.generalpartitions.com.
   6. Global Steel Products Corp: www.globalpartitions.com.
   7. Or Equal

2.2 INSTALLATION TYPE

A. Toilet Compartments: Overhead-braced, floor supported.

B. Urinal Screens: Wall hung, floor to ceiling supported.

2.3 MATERIALS

A. Material shall be Solid Phenolic with a High-Pressure Melamine matte finish surface made as an integral part of the core material. Laminated surfaces are not acceptable.
   1. Surface and edges shall be non-porous and shall not support fungus or bacteria. Provide material which has been selected for uniform color, surface flatness and smoothness.
   2. Exposed surfaces which exhibit discolorations, pitting, seam marks, roller marks, stains, telegraphing of core material, or other imperfections on finished units are not acceptable. Defects such as chipping along edges and corners are unacceptable.
   3. Solid Phenolic shall meet or exceed all requirements for Class B Flame Spread Rating and Smoke Developed calculated according to ASTM E84, and shall carry a Class B Fire Rating Certification. Class B Fire Rating Certification shall be in the name of the Toilet Partition Manufacturer and shall be less than six (6) months old.

B. Material Thicknesses:
   1. Doors - Minimum 0.75-inch Finished Thickness
   2. Divider Panels - Minimum 0.50-inch Finished Thickness
   3. Pilasters - Minimum 0.75-inch (Finished Thickness

C. Colors: To be selected by Architect or Engineer, approved by Owner, from Melamine Manufacturer's full range of colors, including premium.

2.4 HARDWARE

A. Continuous Hinge: Continuous Hinge (57.5 inches) shall be made of Type 304, 14 gage Stainless Steel and shall have a Polished Satin Finish. Hinge shall be 3 inches wide and shall have cam knuckles for gravity type self-closing action. Pivot pin shall be 0.250 inch in diameter, and shall be made of Type 304 Stainless Steel.
   1. Pivot pin shall be 0.250 inch in diameter, and shall be made of Type 304 Stainless Steel.
      a. Pivot pin shall be non-removable
   2. Hinges shall provide emergency access by lifting the door. Inswinging Hinges shall be preset to hold Door open at 15 degrees and Outswinging Hinges shall be preset to hold Doors in the closed position when unlatched. Hinges shall be pre-drilled for mounting to door and pilaster.
   3. Mounting holes shall be at 9 inches O.C. for mounting to door and pilaster with Theft Proof Stainless Steel Torx Head with Pin Through-Bolts. Brass inserts are unacceptable.
   4. Each Hinge is to be labeled by stock number, manufacturer, and left or right hand. Furnish one Hinge per door.

B. Indicator Latch: Indicator Latch shall be Heavy Duty Type 304, Cast Stainless Steel and shall have a Polished Satin Finish. The Indicator Latch shall be surface mounted and shall require less than five (5) lbs to operate. As the Latch is operated inside of the Partition, the Indicator located on the outside of the Partition will show "Green" for Unoccupied and "Red" for Occupied. The Latch Arm serves as the Keeper and shall be fitted with a Rubber Pad to protect the finish of the Door. On Standard Doors, the Latch shall be mounted to the Pilaster and on Disabled Accessible or Outswing Doors, the Latch shall be mounted on the Door. Furnish one per door.

C. Coat Hook: Coat Hook shall be made of Heavy-Duty Type 304 Cast Stainless Steel with a Polished Satin Finish. Coat Hook and Bumper shall be 2.340 inches high, 1.230 inches wide and shall protrude out from the door 3.05 inches.
   1. The hook portion shall have a finished diameter of 0.250-inch. Coat Hooks shall be mounted to the Door with Theft Proof Stainless Steel Torx Head with Pin Through-Bolts. Stamped Stainless Steel Coat Hooks are unacceptable.
   2. The stock number shall be molded into the back of the Coat Hook and Bumper for ease in identification. Furnish one per door.

D. Pull Handle: Pull Handle shall be made of Heavy-Duty Type 304 Cast Stainless Steel with a Polished Satin Finish. Chrome Plated Zamac and Stamped Stainless Steel Door Pulls are unacceptable.
   1. Pull Handle shall protrude from the face of the door 0.940-inch and shall be 4.735 inches long. The Pull Handle shall have mounting holes drilled and tapped for 10/24 threads at 3.50-inch O.C. The Pull Handle shall be 0.655-inch wide.
   2. The stock number shall be molded into the back of the Pull Handle for ease in identification. Furnish two for each Disabled Accessible door.

E. Door Stop: Door Stop shall be Heavy Duty Type 304 Cast Stainless Steel with a Polished Satin Finish. Chrome Plated Zamac and Stamped Stainless Steel Door Stops are unacceptable.
   1. Door Stop shall have a 2.125-inch base diameter and shall protrude 1.80 inches from the wall. The bumper at the end of the Door Stop shall be 0.250-inch thick. The diameter of the shaft shall be 0.6875-inch.
   2. The stock number shall be molded into the back of the Door Stop for ease in identification. Furnish one for each Disabled Accessible or outswing door.

F. Continuous Mounting Brackets: Brackets shall be Full High, 57.5 inches, Type 304 Stainless Steel and shall have a Polished Satin Finish. Continuous Double Ear and Single Ear Brackets shall be used to mount panel/pilaster to wall. Continuous 'U' Brackets shall be used to mount panel to pilaster.
   1. Inside opening of Bracket shall be 0.50-inch for panels and 0.75-inch for pilasters. All holes in Brackets for mounting to wall and panel/pilaster shall be pre-drilled. Holes are to be spaced at 9 inches O.C. along the full length of the Bracket for a total of fourteen (14) holes for mounting to wall, and seven (7) for mounting to panel or pilaster.
   2. Panels and Pilasters shall be secured to Brackets with Theft Proof Stainless Steel Torx Head with Pin Through-Bolts. Attachments made with screws into core material are unacceptable. Brackets made of Aluminum, Chrome Plated Zamak or Single High Stamped Stainless Steel are unacceptable.

G. Overhead Bracing (Headrail): Continuous Heavy Duty Extruded 6063-T5 Aluminum Headrail with Anti-Grip profile. Headrail shall have a Satin Anodized finish and shall have integral reinforcing channel and curtain track.
   1. Provide Headrail Corner Brackets, Wall Brackets, and Headrail End Caps as required. The Headrail and Aluminum Headrail Corner Brackets shall have a minimum wall height of 2 inches. The minimum wall thickness of the Headrail and Headrail Corner Brackets shall be 0.125-inch.
   2. The Headrail Wall Brackets shall be made of Type 304, 18 gage Stainless Steel.

H. Anchorages and Fasteners: All Fasteners shall be Type 304 Stainless Steel and shall have Theft Proof Torx Heads with Pin. Stainless Steel Through-Bolts shall withstand a direct pull force in excess of 2000 lbs each. All Fasteners shall be Through-Bolted unless noted otherwise. Chrome Plated Steel, Zinc Plated Steel and Brass Fasteners are not acceptable.
   1. All Fasteners shall be Through-Bolted unless noted otherwise. Chrome Plated Steel, Zinc Plated Steel and Brass Fasteners are not acceptable.

2.5 FABRICATION

A. General: Provide Doors, Panels, Pilasters and Urinal Screens fabricated for the partition system, complete with all accessories and hardware listed above and as required for installation of a fully functional system, unless otherwise noted. Provide units with cutouts and drilled holes to receive partition-mounted hinges, accessories, and grab bars as indicated.

B. Pilasters: Each Pilaster shall have zinc plated threaded insert(s) threaded into the base of the Pilaster to receive 0.3125 x 2.5 inches ASTM A666 Type 304 Stainless Steel Jack Bolt(s) for leveling purposes. Pilaster Shoe shall be 3 inches high Type 304, 18 gage Stainless Steel and shall have an integral heel for structural connection to the floor with Stainless Steel fasteners.

C. Doors: Unless otherwise indicated, provide 24 inches wide in-swinging doors for standard Toilet Partitions and 36 inches wide out-swinging doors with a minimum 32 inches wide clear opening for Partitions indicated to be Handicapped Accessible.

D. Privacy Option Sightless Strike: The vertical edges of all Doors and Pilasters shall be rabbetted to a width and depth of 0.375 inch to provide for a sightless condition between the Door and Pilaster. Note: The Door width will be greater than the opening size. The rabbetted edge of the Door will overlay the rabbetted portion of the Pilaster to provide a sightless condition. The rabbeted portion of the Pilaster shall act as the Strike.

E. Floor Anchored Urinal Screens: Furnish Urinal Screens consisting of a pilaster and a panel of the same construction and finish as the Toilet Partitions. Furnish in accordance with the drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that room dimensions are in accordance wit Toilet Partition Shop Drawings. Inspect walls to ensure that they are plumb and suitable for the Wall Brackets.

B. Check location of entrance doors and location of plumbing fixtures. Verify that these are in accordance with Toilet Partition Shop Drawings and that there is adequate clearance between plumbing fixtures and dividing panels or screens.

C. Verify that room dimensions are in accordance with Toilet Partition Shop Drawings. Inspect

walls to ensure that they are plumb and suitable for the Wall Brackets.

1. Have any inappropriate conditions corrected before beginning installation.

3.2 INSTALLATION

A. All partitions and screens to be installed with 12-inch clearance from the floor to the bottom of the partition or screen.

B. Comply with manufacturer's written installation instructions.
   1. Install Partitions rigid, straight, plumb, and level. Provide clearances of not more than 0.50-inch between pilasters and panels, and not more than 1.0-inch between pilasters/panels and walls.
   2. No evidence of drilling, cutting and patching shall be visible in finished work.

C. Overhead-Braced Floor Supported Partitions: Secure Pilasters to floor and level, plumb, and tighten.
   1. Maintain proper Door Openings and secure continuous Overhead Brace (Headrail) to each pilaster with not less than two (2) Theft Proof Stainless Steel Torx Head with Pin Through-Bolts.
   2. Hang Doors and adjust so that tops of Doors are parallel with Overhead Brace and are the same height as the panels when doors are in closed position.

D. Screens: Attach with anchoring devices according to manufacturer's written instructions and to suit supporting structure.
   1. Set units level and plumb.
   2. Mount accessories to Partition units in accordance with accessory manufacturer's instructions.

E. Screens: Attach with anchoring devices according to manufacturer's written instructions and to suit supporting structure.
   1. Set units level and plumb.

F. Mount accessories to Partition units in accordance with accessory manufacturer's instructions.

3.3 TOLERANCES

A. Maximum Variation From True Position: ¼-inch.

B. Maximum Variation From Plumb: 1/8-inch.

3.4 ADJUSTING AND CLEARING

A. Adjust and align hardware to uniform clearance at vertical edge of doors, note exceeding 3/16-inch.

B. Hardware Adjustment: Adjust hardware according to manufacturer's written instructions for proper operation. Adjust cam on all out-swinging doors to hold doors in closed position when unlatched. Adjust cam on all in-swinging doors to hold doors in open position when unlatched.

C. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.

D. Adjust adjacent components for consistency of line or plane.

E. Provide final protection and maintain conditions that ensure Toilet Partitions and Screens are without damage or deterioration at the time of Substantial Completion.

F. Clean all exposed surfaces of Toilet Partitions and hardware

END OF SECTION

SECTION 10 28 13.16 – RESTROOM, SHOWER, AND UTILITY ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Restroom, Shower, and Utility Accessory work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.

B. Commercial restroom accessories.

C. Accessories for restrooms, showers, and utility rooms.

D. Electric hand/hair dryers.

E. Mirrors

1.2 RELATED REQUIREMENTS

A. Section 09 30 00 - Tiling

1.3 OWNER FURNISHED ITEMS (N.I.C.)

A. The following shall be supplied by the Owner and installed by the Contractor:
   1. Toilet tissue dispensers.
   2. Sanitary napkin dispensers.
   3. Sanitary napkin disposal units.
   4. Soap dispensers.
   5. Air Fresheners.
   6. Trash receptacles.

1.4 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.

C. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless-Steel Tubing for General Service 2015a (Reapproved 2019).

D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc- Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

E. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless-Steel Sheet, Strip, Plate, and Flat Bar 2015.

F. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium 2017.

G. ASTM C1036 - Standard Specification for Flat Glass 2016.

H. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement and reinforcement of restroom partitions to receive anchor attachments.

1.6 SUBMITTALS

A. See Section 01 33 00, for submittal procedures.

B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

1.7 GUARANTEE

A. The Contractor shall guarantee his work for a period of One (1) year from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer:
   1. Bradley Corporation: www.bradleycorp.com.

B. Toilet, Shower, and Bath Accessories:
   1. AJW Architectural Products: www.ajw.com.
   2. American Specialties, Inc: www.americanspecialties.com.
   3. Bobrick Washroom Equipment Inc: www.bobrick.com.
   4. American Accessories Inc: www.aaiusaonline.com.
   5. Columbia Accessories: www.psisc.com.
   6. Seachrome www.seachrome.com
   7. Or Approved Equal

C. Provide products of each category type by single manufacturer.

2.2 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
   1. Grind welded joints smooth.
   2. Fabricate units made of metal sheet of seamless sheets, with flat surfaces.

B. Keys: Provide 2 keys for each accessory to Owner; master key lockable accessories.

C. Stainless Steel Sheet: ASTM A666, Type 304.

D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.

E. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.

F. Mirror Glass: Tempered safety glass, ASTM C1048; and ASTM C1036 Type I, Class 1, Quality Q2, with silvering as required.

G. Adhesive: Two component epoxy type, waterproof.

H. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.

I. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.3 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.

B. Chrome/Nickel Plating: ASTM B456, SC 2, polished finish, unless otherwise noted.

C. Baked Enamel: Pretreat to clean condition, apply one coat primer and minimum two coats epoxy baked enamel.

D. Galvanizing for Items Other than Sheet: Comply with ASTM A123/A123M; galvanize ferrous metal and fastening devices.

E. Shop Primed Ferrous Metals: Pretreat and clean, spray apply one coat primer and bake.

F. Back paint components where contact is made with building finishes to prevent electrolysis.

2.4 RESTROOM ACCESSORIES

A. Mirrors: Stainless steel framed, 1/4-inch-thick tempered safety glass; ASTM C1048.
   1. Size: 18-inch x 30-inch
   2. Frame: 0.05-inch angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
   3. Backing: Full-mirror sized, minimum 0.03-inch galvanized steel sheet and nonabsorptive filler material.
   4. Products:
      a. 781 Series manufactured by Bradley Corporation.
      b. Or Approved Equal.

B. ADA Toilet Grab Bars: Stainless steel, textured surface, 1-1/2 inches outside diameter,

minimum 0.05-inch wall thickness, nonslip grasping surface finish, concealed flange mounting; 1-1/2 inches clearance between wall and inside of grab bar.

1. Length and configuration: As indicated on drawings.
2. Product: 812 Series manufactured by Bradley Corporation
3. Or Approved Equal.

C. Baby Changing Station: Baby changing station body shall be durable, injection-molded polypropylene. Design of unit shall be surface-mounted. Unit shall be equipped with a pneumatic cylinder for controlled opening and closing of bed. Bed shall be secured to metal mounting chassis with a concealed steel-on-steel hinge. No hinge structure shall be exposed on interior or exterior surfaces. Unit shall have mounting hardware included. Unit shall have Microban® antimicrobial embedded into plastic material on the changing surface. Unit shall comply with ADA regulations when properly installed. Bed shall have smooth concave changing area with a nylon safety strap and two hooks for bags or purses. The design is intended to be compliant with the 2010 ADA Standards for Accessible Design and the 2009 ICC A117.1, Accessible and Usable Buildings and Facilities. Unit shall conform to ASTM F 2285-04 Standard Safety Performance Specification for Diaper Changing Tables for Commercial Use, ANSI Z535.4 Product Safety Signs and Labels, EN 12221:2008, TUV Certified, ASTM G22 Antibacterial standards or local code if more stringent installation requirements are applicable for Barrier-Free accessibility. Unit shall have a built-in Liner Dispenser for use with 3-ply chemical free biodegradable bed liners, instructional graphics and safety messages in 4 languages. Unit shall be backed by manufacturer's 5-year limited warranty on materials and workmanship and include a provision for replacement caused by vandalism.

1. Length and configuration: Contoured changing surface area of 450 square inches
2. Product: KB200 Series manufactured by Koala Kare Products
3. Color: Cream or as approved by Owner
4. Or Approved Equal.

2.5 SHOWER ROOM ACCESSORIES

A. Folding Shower Seat: Wall-mounted surface; welded tubular seat frame, structural support members, hinges and mechanical fasteners of Type 304 stainless steel, L-shaped, right hand and L-shaped, left-hand seat.

1. Seat: Phenolic or polymeric composite one-piece seat or seat slats, of color as selected.
2. Size: ADA Standards compliant.
3. Products:
    a. 9569 manufactured by Bradley Corporation.
    b. Or Approved Equal.

B. ADA Shower Grab Bars: Stainless steel, 1-1/2 inches outside diameter, minimum 0.05-inch wall thickness, nonslip grasping surface finish, concealed flange mounting; 1-1/2 inches clearance between wall and inside of grab bar.

1. Length and configuration: As indicated on drawings.
2. Product: 800 Series manufactured by Bradley Corporation.
3. Or Approved Equal.

C. Towel Hook: Stainless steel, 4 7/16-inch extension from wall; rectangular-shaped bracket and backplate for concealed attachment, satin finish.
   1. Product: 9314 manufactured by Bradley Corporation.
   2. Or Approved Equal.

2.6 ELECTRIC HAND/HAIR DRYERS

A. Electric Hand Dryers: Traditional fan-in-case type, with downward fixed nozzle.
   1. Operation: Automatic, sensor-operated on and off.
   2. Mounting: Surface mounted.
   3. Cover: Plastic.
      a. Color: White.
      b. Tamper-resistant screw attachment of cover to mounting plate.

B. Basis of design:
   1. TRI-Umph High Speed Hand Dryer 20201-2
   2. TRI-Umph Hand Dryer Backplate
   3. By American Specialties www.americanspecialties.com.
   4. Or Approved Equal

2.7 UTILITY ROOM ACCESSORIES

A. Combination Utility Shelf/Mop and Broom Holder: 0.05-inch-thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06-inch steel wall brackets.
   1. Hooks: 0.06-inch stainless steel rag hooks at shelf front.
   2. Mop/broom holders: Three spring-loaded rubber cam holders at shelf front.
   3. Length: Manufacturer's standard length for number of holders/hooks indicated on Drawings.
   4. Products:
      a. Product: 9954 manufactured by Bradley Corporation.
      b. Or Approved Equal

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.

D. Verify that field measurements are as indicated on shop drawings.

3.2 PREPARATION

A. Deliver inserts and rough-in frames to site for timely installation.

B. Provide templates and rough-in measurements as required.

3.3 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
B. Install plumb and level, securely and rigidly anchored to substrate.

C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

3.4 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

DIVISION 12 - FURNISHINGS

SECTION 12 36 61.19 - QUARTZ AGGLOMERATE COUNTERTOPS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Quartz countertops.

1.2 RELATED REQUIREMENTS

A. Section 06 10 00 – Rough Carpentry

1.3 DEFINITIONS

A. Manufacturer:
   1. Manufactures quartz slabs to specified size, thickness, finish, and color.
   2. Delivers slabs to fabricator for shop fabrication of quartz countertops.

B. Fabricator:
   1. Receives quartz slabs from manufacturer.
   2. Shop fabricates quartz countertops to required dimensions and specified edge profiles for installation by installer.

1.4 REFERENCE STANDARDS

A. Architectural Woodwork Institute / Architectural Woodwork Manufacturers Association of Canada / Woodwork Institute (www.awinet.org / www.awmac.com / www.woodworkinstitute.com/asserrata.com):
   1. AWI/AWMAC/WI Architectural Woodwork Standards.

B. ASTM International (ASTM) (www.astm.org):
   1. ASTM C 97/C 97M – Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone.
   2. ASTM C 170/C 170M – Standard Test Method for Compressive Strength of Dimension Stone.
   3. ASTM C 880/C 880M – Standard Test Method for Flexural Strength of Dimension Stone.
   4. ASTM C 1026 – Standard Test Method for Measuring the Resistance of Ceramic and Glass Tile to Freeze-Thaw Cycling.
   5. ASTM C 1243 – Standard Test Method for Relative Resistance to Deep Abrasive Wear of Unglazed Ceramic Tile by Rotating Disc.
   6. ASTM D 1709 – Standard Test Methods for Impact Resistance of Plastic Film by the Free- Falling Dart Method.
   7. ASTM D 6329 – Standard Guide for Developing Methodology for Evaluating the Ability of Indoor Materials to Support Microbial Growth Using Static Environmental Chambers.

C. International Living Future Institute (ILFI) (www.living-future.org):
   1. Living Building Challenge Criteria – LBC Compliant.

D. International Organization for Standardization (ISO) (www.iso.org):
   1. ISO 4586-2 – High-pressure decorative laminates - Sheets made from thermosetting resins Part 2: Determination of properties.
   2. ISO 9001 – Quality management systems – Requirements.
   3. ISO 14001 – Environmental management systems – Requirements with guidance for use.

E. NSF International (NSF) (www.nsf.org):
   1. NSF/ANSI 51 – Food Equipment Materials.

F. UL (www.ul.com):
   1. UL 2818 – GREENGUARD Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings.
   2. UL/GREENGUARD Certification, Product Certified for Low Chemical Emissions, UL 2818.
   3. UL/GREENGUARD Gold Certification, Product Certified for Low Chemical Emissions, UL 2818.

1.5 PREINSTALLATION MEETINGS

A. Convene preinstallation meeting 2 weeks before start of installation of quartz countertops.

B. Require attendance of parties directly affecting Work of this Section, including Contractor, Owner or Owner's Representative, Architect or Engineer, installer, and manufacturer's representative.

C. Review the Following:
   1. Materials.
   2. Examination.
   3. Preparation.
   4. Installation.
   5. Tolerances.
   6. Adjusting.
   7. Cleaning.
   8. Protection.
   9. Coordination with other Work.

1.6 SUBMITTALS

A. Submittals: Section 01 33 00 Submittal Procedures

B. Product Data: Submit manufacturer's product data, including preparation and installation instructions.

C. Shop Drawings: Submit manufacturer's shop drawings indicating:
   1. Dimensions, tolerances, materials, components, attachments, fabrication, corners, overhangs, backsplashes, fasteners, hardware, and location of seams.
   2. Edge profiles.
   3. Locations and sizes of cutouts and holes.
   4. Locations and sizes of blocking, supports, and reinforcements to support quartz countertops.

D. Samples: Submit manufacturer's sample chips of quartz countertop material.

E. Manufacturer's Certification: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.

F. Test Reports: Submit manufacturer's test reports from testing performed by qualified, independent testing laboratories.

G. Manufacturer's Project References: Submit manufacturer's list of 10 successfully completed quartz slab projects of similar size and scope to this Project, including project name and location, name of architect, and type and quantity of quartz slabs manufactured.

H. Fabricator's Project References: Submit fabricator's list of 10 successfully completed quartz countertop projects of similar size and scope to this Project, including project name and location, name of architect, and type and quantity of quartz countertops fabricated.

I. Installer's Project References: Submit installer's list of 5 successfully completed quartz countertop projects of similar size and scope to this Project, including project name and location, name of architect, and type and quantity of quartz countertops installed.

J. Care and Maintenance Instructions: Submit manufacturer's care and maintenance instructions, including cleaning and repairing instructions.

K. Warranty Documentation: Submit manufacturer's standard warranty.

1.7 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer regularly engaged in the manufacturing of quartz slabs of similar type to that specified for a minimum of 5 years.
   2. Certified:
      a. ISO 9001.
      b. ISO 14001:2004.
   3. Use Breton Technology equipment.

B. Fabricator's Qualifications: Fabricator regularly engaged in the fabrication of quartz countertops of similar type to that specified for a minimum of 5 years.

C. Installer's Qualifications:
   1. Installer regularly engaged in installation of quartz countertops of similar type to that specified for a minimum of 5 years.
   2. Use persons trained for installation of quartz countertops.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Delivery Requirements: Deliver quartz countertops to site in accordance with manufacturer's instructions.

B. Storage and Handling Requirements:
   1. Store and handle quartz countertops in accordance with manufacturer's instructions.

2. Store quartz countertops vertically in clean, dry area indoors, raised above floor.
3. Protect quartz countertops during storage, handling, and installation from dirt, stains, scratches, cracks, and other damage.
4. Protect edges and corners from damage.
5. Do not store or transport quartz countertops flat.
6. Do not drop or drag quartz countertops.

1.9 AMBIENT CONDITIONS

A. Maintain ambient temperature of 50 to 95 degrees F (10 to 35 degrees C) for 48 hours before, during, and for minimum 7 days after installation.

1.10 WARRANTY

A. Warranty Period:
1. Commercial: 10-year limited warranty.
2. Residential: 15-year limited warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Vicostone, 11620 Goodnight Lane, Suite 100, Dallas, Texas 75229. Phone 972- 243-2325. Fax 972-243-4197. www.us.vicostone.com. info@vicostoneus.com.

B. Manufacturer: Silestone, 355 Alhambra Cirle, Suite 1000, Coral Gables, Flordia 33134. Phone 786-686-5060. www.silestoneusa.com.

C. Or Approved Equal

D. Single Source: Provide materials from single manufacturer.

2.2 QUARTZ COUNTERTOPS

A. Quartz Countertops: Vicostone, Silestone, or approved equal quartz countertops.

B. Material:
1. Quartz-based engineered stone.
   a. Body: Quartz aggregates and silica sand, maximum 93 percent.
   b. Binder: Polyester resin.
   c. Colorant: Color powder pigments.
2. Formed into flat slabs.
3. Solid and uniform throughout material thickness.
4. Nonporous.
5. Indoor use.

C. Certifications:
1. UL/GREENGUARD Certification, Product Certified for Low Chemical Emissions, UL2818.
2. UL/GREENGUARD Gold Certification, Product Certified for Low Chemical Emissions, UL

2818.
3. NSF/ANSI 51, certified for food safety.
4. Certified for use with kosher food.

D. ILFI Living Building Challenge:
1. Declaration Status: LBC Compliant.

E. Slab Dimensions: Refer to drawings.

F. Slab Thickness: 3 cm.

G. Factory Finish: High-gloss polish.

H. Color: Refer to Drawings

I. Edge Profile: 1/4-inch bevel

J. Test Results:
1. Water Absorption:
   a. ASTM C 97/C 97M: Less than or equal to 0.05 percent by weight.
   b. EN 14617-1: Less than or equal to 0.06 percent by weight.
2. Apparent Density, ASTM C 97/C 97M, EN 14617-1: 2.2 to 2.4 g/cm^3.
3. Flexural Strength, ASTM C 880/C 880M, EN 14617-2: Greater than 40 MPa.
4. Dimension Stability, EN 14617-12: Class A.
5. Electrical Stability, EN 14617-13:
   a. Volume Resistance (R_V): 0.9 x 10^{14} Ω.
   b. Volume Resistance (p_V): 4.88 x 10^{14} Ωm.
6. Impact Resistance, ASTM D 1709, EN 14617-9: Greater than or equal to 3.0 J.
7. Compressive Strength, ASTM C 170/C 170M, EN 14617-15: Greater than or equal to 155 MPa.
8. Mohs Scale of Hardness, EN 101: 6.0 to 7.0.
9. Resistance to Deep Abrasion, ASTM C 1243, EN 14617-4: Volume of chord, V, less than or equal to 195 mm^3.
10. Freeze-Thaw Resistance:
    a. ASTM C 1026: No defects after 15 freeze-thaw cycles.
    b. EN 14617-5: No defects after 25 freeze-thaw cycles.
11. Slip Resistance at Honed 400, DIN 51130: R9 to R10.
12. Microbial Resistance, ASTM D 6329: Ranking 3, resistant to mold growth.
13. Chemical Resistance to Acids, EN 14617-10: Class C4.
14. Thermal Shock Resistance, EN 14617-6: No visual defects after 20 cycles.
15. Determination of Resistance to Immersion in Boiling Water, AS 2924.2-7 (Equivalent to ISO 4586.2-7): Effect on surface (rating), 5 (no visible change).
16. Determination of Resistance to Dry Heat, AS 2924.2-8 (Equivalent to ISO 4586.2-8): Effect on surface (rating), 5 (no visible change).
17. Determination of Resistance to Staining (Procedure A), AS 2924.2-15 (Equivalent to ISO 4586.2-15): Effect on surface (rating), 5 (no visible change).

2.3 MANUFACTURING

A. Quartz Slab Manufacturing Process: Breton Technology equipment or approved equal.

2.4 FABRICATION

A. Shop Fabrication:
   1. Fabricate quartz countertops in accordance with manufacturer's instructions.
   2. Fabricate quartz countertops to greatest extent practical in shop.
   3. Fabricate and finish routed edges of components with clean, sharp returns.
   4. Fabricate cutouts, radii, and contours using templates to ensure clean, sharp edges.
   5. Fabricate smooth and uniform cutouts for sinks without saw marks.

B. Seams:
   1. Locate and fabricate seams in accordance with manufacturer's instructions.
   2. Do not locate seams through cooktop cutouts.
   3. Minimize number of seams.
   4. Fabricate seams to be inconspicuous.

2.5 ACCESSORIES

A. Seam Adhesives:
   1. Methacrylate, polyester, or epoxy.
   2. Compatible with quartz countertops.

B. Joint Sealants:
   1. 100 percent silicone, 2-part epoxy, or cement-based sealants.
   2. Joint Sealant Manufacturers: Akemi, Laticrete, Mapei, or approved by quartz slab manufacturer.
   3. Compatible with quartz countertops.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive quartz countertops.

B. Notify Architect or Engineer of conditions that would adversely affect installation or subsequent use.

C. Do not begin installation until unacceptable conditions are corrected.

3.2 PREPARATION

A. Prepare surfaces to receive quartz countertops in accordance with manufacturer's instructions.

B. Verify casework and surfaces to support quartz countertops are clean, dry, flat, plumb, level, square, stable, rigid, and capable of supporting the weight.

C. Field Measurements:
   1. Verify actual measurements and openings by field measurements before shop fabrication.
   2. Confirm recorded measurements on shop drawings.
   3. Coordinate field measurements and shop fabrication schedule with construction progress to avoid construction delays.

D. Inspect quartz countertops before installation to determine they are sound and free from defects and damage.

3.3 INSTALLATION

A. Install quartz countertops in accordance with manufacturer's instructions and AWI/AWMAC/WI Architectural Woodwork Standards.

B. Install quartz countertops at locations indicated on the Drawings.

C. Acclimate quartz countertops to room temperature for a minimum of 24 hours before installation.

D. Install quartz countertops level, plumb, and square.

E. Align adjacent pieces in same plane.

F. Securely anchor quartz countertops to casework and supports.

G. Install quartz countertops with proper support at perimeter, seams, joints, cutouts, and overhangs.

H. Install seams to be flush, tight, and inconspicuous.

I. Do not install mechanical fasteners directly into quartz countertops.

J. Install joint sealants around bottom perimeter of quartz countertops at casework and at locations indicated on the Drawings.

3.4 TOLERANCES

A. Variation from Level and Plumb: Maximum 1/8-inch in 10-feet, noncumulative.

B. Variation in Plane Between Adjacent Pieces at Seams: Maximum plus or minus 1/16-inch.

3.5 ADJUSTING

A. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Architect or Engineer.

B. Remove and replace with new materials, damaged quartz countertops that cannot be successfully repaired, as determined by Architect or Engineer.

3.6 CLEANING

A. Clean quartz countertops promptly after installation in accordance with manufacturer's instructions.

B. Do not use harsh cleaning materials or methods that could damage finish.
   1. Do not use acetone.
   2. Do not use cleaning materials that contain abrasive ingredients.

3.7 PROTECTION

A. Protect installed quartz countertops from dirt, stains, scratches, cracks, and other damage during construction.

B. Do not use installed quartz countertops as work surfaces or for storage during construction.

END OF SECTION

DIVISION 22 – PLUMBING

SECTION 22 00 50 – GENERAL PIPES AND FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 SUMMARY

A. This section is generic in that it describes material and installation required by several other sections of this specification.

B. Types of pipes and pipe fittings specified in this section include the following:

1. Steel Piping
2. Copper Piping
3. Cast-Iron Pressure Piping
4. Cast-Iron Soil Piping
5. Plastic Piping
6. Grooved Joint Piping
7. Miscellaneous Piping Materials/Products.

C. Pipes and pipe fittings furnished as part of factory - fabricated equipment, are specified as part of equipment assembly in other Division - 22 and 33 Sections.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of pipes and pipe fittings of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications:

1. Firm with at least three years history of successful experience on projects of similar nature.
2. Licensed as a firm in the contractor state of origin and in the State of Nevada.
3. Have a publicly registered bonding capacity of sufficient amount to cover this work and all other work in progress by the contractor.

4. All workmen employed on the project shall carry state licenses as journeyman or apprentice pipe fitters with additional certification for welders.

C. Welding Certification:

1. Each welder shall have passed a qualification test within the past six months.

2. The test shall be in accordance with the ASME Boiler and Pressure Vessel Code, Section IX, "Welding Qualifications", ASME Section VIII, and ANSI 313.

3. The test report shall certify that the welder is qualified to weld the material to be used at the job site.

4. The contractor shall submit three copies of each welder's qualification test report to the Project Manager for approval prior to commencing the work. No welder shall be used on the project until so certified.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, installation instructions, and dimensioned drawings for each type of pipe and pipe fitting. Submit piping schedule showing manufacturer, pipe or tube weight, fitting type, and joint type for each piping system.

B. Welding Certifications: Submit reports as required for piping work.

C. Brazing Certifications: Submit reports as required for piping work.

D. Maintenance Data: Submit maintenance data and parts lists for each type of mechanical fitting. Include this data, product data, and certifications in maintenance manual; in accordance with requirements of Division 1.

1.5 REFERENCES

A. Codes and Standards:

1. Welding: Qualify welding procedures, welders and operators in accordance with ASME B31.1, or ASME B31.9, as applicable, for shop and project site welding of piping work.

2. Brazing: Certify brazing procedures, brazers, and operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, for shop and job-site brazing of piping work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Except for concrete, corrugated metal, hub-and-spigot, clay, and similar units of pipe, provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube.

B. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate above grade and enclose with durable, waterproof wrapping.

C. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

PART 2 - PRODUCTS

2.1 GENERAL

A. Piping Materials: Provide pipe and tube of type, joint type, grade, size and weight (wall thickness or Class) indicated for each service. Where type, grade or class is not indicated, provide proper selection as determined by Installer for installation requirements, and comply with governing regulations and industry standards. Use United States (domestic) manufactured pipe only. Do not use foreign made pipe.

B. Pipe/Tube Fittings: Provide factory-fabricated fittings of type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve or equipment connection in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable. Use domestic manufactured fittings only. Do not use foreign manufactured fittings.

2.2 STEEL PIPES AND PIPE FITTINGS

A. Black Steel Pipe: Seamless or ERW, ASTM A 53.

B. Galvanized Steel Pipe: ASTM A 53.

C. Galvanized Seamless Steel Pipe: ASTM A 53.

D. Electric-Resistance-Welded Steel Pipe: ASTM A 135.

E. Electric-Fusion-Welded Steel Pipe: ASTM A 671, A 672, or A 691.

F. Cast-Iron Flanged Fittings: ANSI B16.1, including bolting.

G. Cast-Iron Threaded Fittings: ANSI B16.4.

H. Malleable-Iron Threaded Fittings: ANSI B16.3; plain or galvanized as indicated.

I. Unions: ANSI B16.39; 300 lb. ground joint malleable iron, hexagonal, selected by Installer for proper piping fabrication and service requirements, including style, end connections, and metal-to-metal seats (iron, bronze or brass); plain or galvanized as indicated.

J. Dielectric Unions: 175 psig WSP at 250oF. Equal to Walter Vallet Company V-line insulating coupling.

K. Threaded Pipe Plugs: ANSI B16.14.

L. Steel Flanges/Fittings: ANSI B16.5, including bolting and gasketing of the following material group, end connection and facing, except as otherwise indicated.

1. Material Group: Group 1.1.

2. End Connections: Buttwelding.

3. Facings: Raised-face.

4. Steel Pipe Flanges For Waterworks Service: AWWA C207.

M. Forged-Steel Socket-Welding and Threaded Fittings: ANSI B16.11, except MSS SP-79 for threaded reducer inserts; rated to match schedule of connected pipe.

N. Forged Branch-Connection Fittings: Except as otherwise indicated, provide type as determined by Installer to comply with installation requirements.

O. Pipe Nipples: Fabricated from same pipe as used for connected pipe; except do not use less than Schedule 80 pipe where length remaining unthreaded is less than 1-1/2-inch, and where pipe size is less than 1-1/2-inch, and do not thread nipples full length (no close-nipples).

2.3 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 88; Type K, L (wall thickness) as indicated for each service; hard-drawn temper, except as otherwise indicated.

B. DWV Copper Tube: ASTM B 306.

C. ACR Copper Tube: ASTM B 280.

D. Cast-Copper Solder-Joint Fittings: ANSI B16.18.

E. Wrought-Copper Solder-Joint Fittings: ANSI B16.22.

F. Cast-Copper Solder-Joint Drainage Fittings: ANSI B16.23.

G. Wrought-Copper Solder-Joint Drainage Fittings: ANSI B16.29.

H. Cast-Copper Flared Tube Fittings: ANSI B16.26.

I. Bronze Pipe Flanges/Fittings: ANSI B16.24.

J. Copper-Tube Unions: Provide standard products recommended by manufacturer for use in service indicated.

2.4 CAST-IRON SOIL PIPES AND PIPE FITTINGS:

A. Hubless Cast-Iron Soil Pipe: FS WW-P-401.

B. Cast-Iron Hub-and-Spigot Soil Pipe: ASTM A 74.

C. Hubless Cast-Iron Soil Pipe Fittings: Neoprene gasket complying with ASTM C 564 and stainless steel clamp holding band.

D. Cast-Iron Hub-and-Spigot Soil Pipe Fittings: Match soil pipe units; complying with same standards (ASTM A 74).

E. Compression Gaskets: ASTM C 564.

F. Lead/Oakum Joint Materials: Provide products complying with governing regulations for use in service indicated.

2.5 PLASTIC PIPE AND PIPE FITTINGS

A. Polyvinyl Chloride Pipe (PVC): ASTM D 1785. Schedule 80.

B. PVC Fittings:

1. Schedule 80 Socket: ASTM D 2467.

2. Schedule 80 Threaded: ASTM D 2464.

C. Polypropylene Pipe: Piping and fittings shall be manufactured to Schedule 80 iron pipe dimension, from virgin unpigmented polypropylene pipe grade material, without the addition of normal antioxidants or slip agents. The pipe shall be furnished in 10 foot lengths, cylindrical and straight, and sterile capped at time of manufacture. Pipe and fittings shall meet ASTM D2146, but without additives, and be manufactured to meet dimensional tolerances of ASTM D1785.

Fittings to have electric resistance coils.

2.6 ACID RESISTANT CAST IRON

A. Bell and spigot type, high silicon iron alloy "Duriron" or approved equal, with chemical resistant packing and caulked lead joints.

B. POLYPROPYLENE PIPE: Orion Blueline, flame retardant, Schedule 40, with Schedule 40 fittings, heat fusion welded joints. Alternate manufacturers, GSR, Enfield. Meet material standards of ASTM-D4101, joint standards of ASTM-D2657.

2.7 DUCTILE IRON PIPE AND FITTINGS POLYETHYLENE LINED AND ENCASED:

A. Ductile iron pipe materials shall conform to the requirements of ANSI/AWWA C151/A21.51.

B. Fittings for ductile iron pipe shall conform to the requirements of ANSI/AWWA C110/A21.10 for diameters 3-inch through 48-inch. Ductile iron fittings larger than 48-inch shall conform to the above referenced standard with the necessary modifications for the larger size.

C. Polyethylene lining material shall be functional polyethylene complying with ANSI/ASTM D1248, compounded without an inert filler except 3 percent carbon black to resist ultraviolet rays during above ground storage of the pipe and fittings. The polyethylene shall be chemically bonded to the interior of the pipe and fittings. The polyethylene lining shall cover the inner surfaces of the pipe and fittings from the plain or beveled spigot and through the entire gasket seat in the bell. The ling shall extended on the exterior surface of the beveled spigot end to a point past the gasket seat area at a minimum thickness of 10 mils.

D. Material for the polyethylene encasement shall conform to the requirements of ANSI/AWWA C105/A21.5.

E. All elastomer gaskets used for ductile iron pipe shall be of neoprene (CR) material.

F. All buried bolts and nuts used in the assembly of ductile iron pipe and fittings shall be Cor-Ten steel bolts as manufactured by NSS Industries, or approved equal.

G. The pipe and fittings shall be of the diameter shown and shall be of pressure Class 350, except that where mechanical couplings are used and the pipe is grooved, the ductile iron pipe shall be of special thickness Class 53.

H. Ductile iron pipe and fittings shall be furnished with mechanical joints, push-on joints, flanged joints and restrained joints as required.

1. Mechanical and push-on joints shall conform to ANSI/AWWA C111/A21.11.

2. Flanged joints shall conform to ANSI/AWWA C115/A21.15.

3. Restrained joints shall be "Lok-Ring" Restrained Joint by American Ductile Iron Pipe, "TR FLEX" Restrained Joint by U.S. Pipe, "Mechanical Lock Joint" by Pacific States Cast Iron Pipe Company, or equal.

I. Polyethylene Lining:

1. All surface areas which will be exposed to liquids and gases shall be cleaned so as to remove all deleterious materials. After cleaning, the lining compound shall be applied to all surface areas so as to obtain a uniform and smooth integral lining.

2. The lining in the barrel area shall have a nominal thickness of 40 mils. and minimum thickness of 35 mils. However, the lining in the bell area may taper from a 35-mil minimum thickness at the edge of the barrel area to 10 mil minimum thickness at the edge of the gasket socket. The 10 mil. minimum lining shall also continue form inside the barrel area, around the spigot end of the pipe and along the outside of the next pipe to a point past the total gasket engagement of the next pipe section. This is a minimum requirement. The thickness of linings shall be determined by using a dry file thickness magnetic gauge.

3. Lining Material must pass the following immersion tests (35 mil. minimum dry film thickness) without disintegration, blistering of cracking:

Test	Temperature	Duration
75 percent H2S04	70 deg. F	45 days
10 percent H2S04	140 deg. F	45 days
10 percent H2S04	70 deg. F	45 days
30 percent H2S04	140 deg. F	45 days
25 percent H2S04	70 deg. F	45 days
5 percent H2S04	140 deg. F	45 days
5 percent H2S04	70 deg. F	45 days

4. Each piece of pipe shall be tested and shall have an absence of holidays when tested by a suitable holiday detector. In all cases the barrel area of the pipe shall be tested using a

dry conductive probe. A wet sponge test shall be used in the bell interior and exterior of the spigot.

5. The pipe manufacturer shall issue a certification that states that the pipe and lining meet the following standards and specifications:

   a. All ductile iron pipe and fittings have a polyethylene interior lining of 40 mils. in the barrel area, 10 mils. minimum in the bell area and 10 mils. minimum on the exterior of the spigot end.

   b. Each piece of pipe and each fitting have been checked for holidays utilizing a suitable testing voltage with a dry conductive probe in the barrel area and a suitable testing voltage with a wet sponge in both the bell area and the exterior of the spigot end, and not holidays were found. Holiday testing shall conform to ASTM G62-87 and NACE Standards RP-02-74 and RP0188-90 (latest revisions).

J. Exterior Coating of Pipe:

1. The exterior surfaces of ductile iron pipe which will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and then give a shop coat of rust-inhibitive primer conforming to the requirements of Division 09 98 00 entitled, “Protective Coatings". This exposed piping shall not be coated with the bituminous coating by the manufacturer prior to delivery

2. Buried ductile iron pipe shall be polyethylene encased per System C-9, see Division 09800.

2.8 GROOVED PIPING PRODUCTS (Only where acceptable.)

A. General: As Installer's option, mechanical grooved pipe couplings and fittings may be used for piping systems having operating conditions not exceeding 230oF (110oC), excluding steam piping and any other service not recommended by manufacturer, in lieu of welded, flanged, or threaded methods, and may also be used as unions, seismic joints, flexible connections, expansion joints, expansion compensators, or vibration reducers.

B. Coupling Housings Description: Grooved mechanical type, which engages grooved or shouldered pipe ends, encasing an elastomeric gasket which bridges pipe ends to create seal. Cast in two or more parts, secure together during assembly with nuts and bolts. Permit degree of contraction and expansion as specified in manufacturer's latest published literature. (Victaulic style 77 or approved equal) For rigid joints (Victaulic "Zero Flex" style 07 or approved equal).

1. Coupling Housings: Malleable iron conforming to ASTM A 47.

2. Coupling Housings: Ductile iron conforming to ASTM A 536.

3. Standard: Enamel coated; options hot dip galvanized.

C. Gaskets: Mechanical grooved coupling design, pressure responsive so that internal pressure serves to increase seal's tightness, constructed of elastomers having properties as designated by ASTM D 2000.

1. Water Services: EDPM Grade E, with green color code identification.

2. Other Services: As recommended by Manufacturer.

D. Bolts and Nuts: Heat-treated carbon steel, ASTM A 183, minimum tensile 110,000 psi.

1. Exposed Locations: Tamper resistant nuts.

E. Branch Stub-Ins: Upper housing with full locating collar for rigid positioning engaging machine-cut hole in pipe, encasing elastomeric gasket conforming to pipe outside diameter around hole, and lower housing with positioning lugs, secured together during assembly with nuts and bolts.

F. Fittings: Grooved or shouldered end design to accept grooved mechanical couplings.

1. Malleable Iron: ASTM A 47.

2. Ductile Iron: ASTM A 536.

3. Fabricated Steel: ASTM A 53, Type F for 3/4-inch to 1-1/2-inch; Type E or S, Grade B for 2-inch to 20-inch.

4. Steel: ASTM A 234.

G. Flanges: Conform to Class 125 cast iron and Class 150 steel bolt hole alignment.

1. Malleable Iron: ASTM A 47.

2. Ductile Iron: ASTM A 536.

H. Specialties:

1. Inline strainers.

2. Suction diffusers.

I. Grooves: Conform to the following:

1. Standard Steel: Square cut.

2. Lightweight Steel: Roll grooved.

3. Ductile Iron: Radius cut grooved, AWWA C606.

J. Manufacturer: Subject to compliance with requirements, provide grooved piping products of one of the following:

1. ITT Grinnell Corp.

2. Stockham Valves & Fittings, Inc.

3. Victaulic Co. of America.

4. Gustin-Bacon

5. Grippin.

6. Or Approved Equal.

2.9 MANUFACTURERS

A. Manufacturer uniformity: conform with the requirements specified in Basic Mechanical Requirements, under "Product Options."

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering piping materials and specialties which may be incorporated in the work include, but are not limited to, the following:

1. Pipe Escutcheons:

    a. Chicago Specialty Mfg. Co.
    b. Sanitary-Dash Mfg. Co.
    c. Grinnell
    d. Or Approved Equal.

2. Dielectric Waterway Fittings:

    a. Epco Sales, Inc.
    b. Victaulic Company of America
    c. Or Approved Equal.

3. Dielectric Unions:

    a. Eclipse, Inc.
    b. Perfection Corp.
    c. Watts Regulator Co.
    d. Or Approved Equal.

4. Strainers:

    a. Armstrong Machine Works.
    b. Hoffman Specialty ITT; Fluid Handling Div.
    c. Spirax Sarco.
    d. Victaulic Co. of America. (low pressure applications only)
    e. Watts Regulator Co.
    f. Or Approved Equal.

5. Expansion Joints:

    a. Flexonics Div.; UOP, Inc.
    b. Hyspan Precision Products, Inc.
    c. Keflex, Inc.
    d. Metraflex Co.
    e. Vibration Mountings and Controls, Inc.

f. Or Approved Equal.

6. Flexible Connectors:

a. Flexonics Div.; UOP, Inc.
b. Hyspan Precision Products, Inc.
c. Keflex, Inc.
d. Metraflex Co.
e. Vibration Mountings and Controls, Inc.
f. Or Approved Equal.

2.10 PIPING SPECIALTIES

A. Escutcheons: Chrome-plated, stamped steel, hinged, split-ring escutcheon, with set screw. Inside diameter shall closely fit pipe outside diameter, or outside of pipe insulation where pipe is insulated. Outside diameter shall completely cover the opening in floors, walls, or ceilings.

B. Unions: Malleable-iron, Class 150 for low pressure service and class 250 for high pressure service; hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.

C. Dielectric Unions: Provide dielectric unions with appropriate end connections for the pipe materials in which installed (screwed, soldered, or flanged), which effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion.

D. Dielectric Waterway Fittings: electroplated steel or brass nipple, with an inert and non-corrosive, thermoplastic lining.

E. Y-Type Strainers: Provide strainers full line size of connecting piping, with ends matching piping system materials. Screens shall be Type 304 stainless steel, with 3/64-inch perforations at 233 per square inch.

1. Provide strainers with 125 psi working pressure rating for low pressure applications, and 250 psi pressure rating for high pressure application.

2. Threaded Ends, 2-inch and Smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with pipe plug.

3. Threaded Ends, 2-1/2-inch and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.

4. Flanged Ends, 2-1/2-inch and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.

5. Grooved Ends, 2-1/2-inch and Larger: Tee pattern, ductile-iron or malleable-iron body and access end cap, access coupling with EPDM gasket.

2.11 EXPANSION JOINTS

A. Rubber Expansion Joints: Construct of duck and butyl rubber with full-faced integral flanges, internally reinforced with steel retaining rings. Provide steel retaining rings over entire surface of flanges, drilled to match flange bolt holes, and provide external control rods.

B. Expansion Joints for Grooved Piping: Provide expansion joints constructed of cut grooved short pipe nipples and couplings, designed by manufacturer to suit intended service. Select couplings and gasket materials to match balance of piping system.

2.12 FLEXIBLE CONNECTORS

A. Braided Flexible Pump Connector: Stainless steel annular corrugated metal surrounded with a woven braid of high tensile stainless steel flange connection. Minimum 125 psi pressure rating, similar to Keflex KSSPC or approved equal.

B. Flexible Connector: Stainless steel annular, close pitch hose with stainless steel braid. Flanged or threaded connection, Minimum 125 psi pressure rating, similar to Keflex KFCS or approved equal.

2.13 SLEEVES

A. Sheet-Metal Sleeves: 10 gauge, galvanized sheet metal, round tube closed with welded longitudinal joint.

B. Steel Sleeves: Schedule 40 galvanized, welded steel pipe, ASTM A53, Grade A.

2.14 MECHANICAL SLEEVE SEALS

A. Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.15 MISCELLANEOUS PIPING MATERIALS/PRODUCTS

A. Welding Materials: Except as otherwise indicated, provide welding materials as determined by Installer to comply with installation requirements.

Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.

B. Soldering Materials: Except as otherwise indicated, provide soldering materials as determined by Installer to comply with installation requirements. Use no lead bearing solders in domestic water applications.

Tin-Antimony Solder: ASTM B 32, Grade 95TA.

Silver-Lead Solder: ASTM B 32, Grade 96TS.

C. Brazing Materials: Except as otherwise indicated, provide brazing materials as determined by Installer to comply with installation requirements.

Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials.

D. Gaskets For Flanged Joints: ANSI B16.21; full-faced for cast-iron flanges; raised-face for steel flanges, unless otherwise indicated.

E. Piping Connectors For Dissimilar Non-Pressure Pipe: Elastomeric annular ring insert, or elastomeric flexible coupling secured at each end with stainless steel clamps, sized for exact fit to pipe ends and subject to approval by plumbing code.

MANUFACTURER: Subject to compliance with requirements, provide piping connectors of the following:

1. Fernco, Inc.
2. Mission.
3. Or Approved Equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently- leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings, but with adequate and accessible union, flanges, etc., for disassembly and maintenance/replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16-inch misalignment tolerance. Do not cold spring. Store filler weld materials in accordance with codes.

Comply with ANSI B31 Code for Pressure Piping.

B. Locate piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, columns and other clearance to 1/2-inch where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1-inch clearance outside insulation. Wherever possible in finished and occupied spaces, conceal piping from view, by locating in column enclosures, in hollow wall construction or above suspended ceilings; do not encase horizontal runs in solid partitions, except as indicated. Provide high point vents, low point drains with valves and extension to drain for all piping.

C. All piping in press room, mechanical rooms, fan rooms, etc., shall be exposed. Do not conceal or imbed piping in walls, floors or other structures.

D. Make changes in direction or size with manufactured fittings. Anchor and support piping for free expansion and movement without damage to piping, equipment or to building.

E. Piping shall be arranged to maintain head room and keep passageways clear.

F. Provide unions at connections to equipment and elsewhere as required to facilitate maintenance.

G. Run full pipe size through shutoff valves, gas cocks, balancing valves, etc. Change pipe size within three pipe size diameters of final connection to equipment, coils, etc.

H. All piping shall be erected to insure proper draining. Air piping shall pitch down in the direction of flow a minimum of 1-inch per 40 feet. Domestic water and utility water shall slope down a minimum of 1-inch per 40 feet towards the drain (low point). Refrigerant suction line shall slope a minimum of 1-inch per 10 feet towards compressor. Soil, waste, vent, and roof drain lines shall slope in accordance with requirements of Uniform Plumbing Code.

I. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4-inch ball valve, and short 3/4-inch threaded nipple and cap.

J. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6-inch shall be steel; pipe sleeves 6-inch and larger shall be sheet metal.

K. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, or floors, the fire rated integrity shall be maintained.

L. Use fittings for all changes in direction and all branch connections.

M. Install strainers on the supply side of each control valve, pressure reducing or regulating valve, solenoid valve, and elsewhere as indicated.

N. Install unions adjacent to each valve, and at the final connection to each piece of equipment and plumbing fixture having 2-inch and smaller connections, and elsewhere as indicated.

O. Install Flanges in piping 2-1/2-inch and larger, where indicated, adjacent to each valve, and at the final connection to each piece of equipment.

P. Install dielectric unions to connect piping materials of dissimilar metals in dry piping systems (gas, compressed air).

Q. Install dielectric fittings to connect piping materials of dissimilar metals in wet piping systems (water). Insulating fittings are not required between bronze valves and steel pipe or between copper coil headers and steel pipe.

R. Electrical Equipment Spaces: Do not run piping in or through, electrical room, transformer vaults and other electrical or electronic equipment spaces and enclosures or above electrical gear unless authorized and directed. Install drip pan under piping that must be run through electrical spaces.

3.2 EXPANSION AND CONTRACTION

A. Make all necessary provisions for expansion and contraction of piping.

B. Use grooved joint couplings, expansion compensator, offsets or loops as required to prevent undue strain.

C. At piping connection to heat exchangers provide expansion (joint) as shown on drawings.

3.3 FLEXIBLE CONNECTORS

A. At pumps, engines and at all rotating or vibrating pieces of equipment, provide and install flexible connectors to accommodate alignment and vibration.

B. At pumps provide and install a series of three grooved joint couplings or braided flexible pump connectors.

C. At engines provide and install flexible connector.

D. Install owner furnished flex connectors for digester gas and natural gas.

3.4 PROTECTIVE COATINGS

A. All underground steel pipes shall be wrapped with Scotchwrap No. 50 tape to give not less than two complete layers on the underground piping system, or piping shall have "X-tru Coat", factory applied plastic protective covering, or pipe shall be coated and wrapped with coal tar enamel and Kraft paper, all with coated and taped joints.

3.5 PIPING SYSTEM JOINTS

A. General: Provide joints of type indicated in each piping system.

B. Threaded: Thread pipe in accordance with ANSI B2.1; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.

C. Brazed: Braze copper tube-and-fitting joints where indicated, in accordance with ASME B31.

D. Soldered: Solder copper tube-and-fitting joints where indicated, in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.

E. Welded:

1. Weld pipe joints in accordance with ASME Code for Pressure Piping, B31.

2. Weld pipe joints in accordance with recognized industry practice and as follows:

3. Weld pipe joints only when ambient temperature is above 0oF (-18oC) where possible, with minimum pipe preheat to 50oF.

4. Bevel pipe ends at a 37.5o angle where possible, smooth rough cuts, and clean to remove slag, metal particles and dirt.

5. Use pipe clamps or tack-weld joints with 1-inch long welds; 4 welds for pipe sizes to 10-inch, 8 welds for pipe sizes 12-inch to 20-inch.

6. Build up welds with stringer-bead pass, followed by hot pass, followed by cover or filler pass. Eliminate valleys at center and edges of each weld. Weld by procedures which will ensure elimination of unsound or unfused metal, cracks, oxidation, blow-holes and non-metallic inclusions.

7. Do not weld-out piping system imperfections by tack-welding procedures; refabricate to comply with requirements.

8. At Installer's option, install forged branch-connection fittings wherever branch pipe is indicated; or install regular "T" fitting.

9. At Installer's option, install forged branch-connection fittings wherever branch pipe of size smaller than main pipe is indicated; or install regular "T" fitting.

F. Flanged Joints: Match flanges within piping system, and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.

G. Lead Joints: Tightly pack joint with joint packing material. Do not permit packing to enter bore of finished joint. Clean joint after packing. Fill remaining joint space with one pouring of lead to indicated minimum depth measured from face of bell. After lead has cooled, calk joint tightly by use of hammer and caulking iron.

H. Hubless Cast-Iron Joints: Comply with coupling manufacturer's installation instructions.

I. Plastic Pipe/Tube Joints: Comply with manufacturer's instructions and recommendations, and with applicable industry standards:

1. Heat Joining of Thermoplastic Pipe: ASTM D 2657.

2. Making Solvent-Cemented Joints: ASTM D 2235, and ASTM F 402.

J. Grooved Pipe Joints: Comply with fitting manufacturer's instructions for making grooves in pipe ends. Remove burrs and ream pipe ends. Assemble joints in accordance with manufacturer's instructions.

3.6 INSTALLATION OF DUCTILE IRON PIPE

A. All pipe, fittings, etc., shall be carefully handled and protected against damage, impact shocks and free fall. All pipe handling equipment shall be acceptable to the Engineer. Pipe shall not be placed directly on rough ground, but shall be supported in a matter which will protect the pipe against injury whenever stored at the trench site. All pipe damaged prior to Substantial Completion shall be repaired or replaced by the Contractor.

B. If the contractor makes a field cut of polyethylene lined pipe, he shall comply with the recommendations of the pipe manufacturer in applying an approved field coating to the pipe end and in allowing proper drying time before pipe assembly. In all cases, as a minimum, a 10 mil. coating shall be applied to the pipe end and shall overlap the polyethylene ling by 2-inches and extend around the end of the pipe and along the outside of the pipe a minimum of 10-inches and shall also be allowed to dry before pipe assembly. In addition, the overlapped surface of the polyethylene lining shall be roughed up to produce a 3 to 5 mil. profile over the entire surface to secure proper adhesion of the field coating.

C. Repair of the damaged sections of the polyethylene lining shall be in accordance with the lining manufacturer's recommendations or as specified above so that the repaired area is equal to the undamaged lined area in all respects. All damaged lined areas and holidays shall be repaired immediately.

D. The Contractor shall inspect each pipe and fitting prior to installation to ensure that there are no damaged portions of the pipe. No pipe shall be installed where the lining or coating show defects that may be harmful as determined by the Engineer. such damaged lining or coating shall be repaired, or a new undamaged pipe shall be furnished and installed.

E. The pipe shall be installed in accordance with ANSI/AWWA C600. Before placement of the pipe in the trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance which may have collected thereon and shall be kept clean at all times thereafter. For this purpose, the openings of all pipes and fittings in the trench shall be closed during any interruption to the work. As pipe laying progresses, the contractor shall keep the pipe interior free of all debris. The contractor shall completely clean the interior of the pipe of all sand, dirt, rocks and any other debris following completion of pipe laying prior to testing and disinfecting the completed pipeline.

F. Pipe shall be laid directly on the imported bedding material. No blocking will be permitted and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent joint loading at the bells or couplings. Excavation shall be made as needed outside the normal trench section at field joints to permit adequate access to the joints for field connection operations and for application of coating on field joints.

G. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the Engineer may change the alignment and/or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters or by the use of additional fittings. However, in no case shall the deflection in the joint exceed the maximum deflection recommended by the pipe manufacturer.

H. The openings of all pipe and specials where the pipe and specials have been polyethylene lined in the shop shall be protected with suitable bulkheads to prevent unauthorized access by persons, animals, water or any undesirable substance. At all times, means shall be provided to prevent the pipe from floating.

I. Immediately before jointing pipe, the bell end of the pie shall be thoroughly cleaned and a clean rubber gasket lubricated with an approved vegetable-based lubricant shall be placed in the bell groove. The spigot end of the pipe shall be carefully cleaned and lubricated with a vegetable-based lubricant. The spigot end of the pipe section shall then be inserted into the bell of the previously laid joint and telescoped into its proper position. Tilting of the pipe to insert the spigot into the bell will not be permitted.

J. Buried ductile iron pipe shall be polyethylene encased in accordance with the requirements of ANSI/AWWA C105/A21.5.

3.7 CLEANING, FLUSHING, INSPECTING

A. General: Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings (if any). Flush out piping systems with clean water

before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.

1. Inspect pressure piping in accordance with procedures of ASME B31.

B. Disinfect water mains and water service piping in accordance with AWWA C601.

3.8 PIPING TESTS

A. General: Provide temporary equipment for testing, including pump and gages. Test piping system before insulation is installed wherever feasible, and remove control devices before testing. Test each natural section of each piping system independently but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with water or air and pressurize for indicated pressure and time.

1. Required test period is 2 hours.

2. Test long runs of Schedule 40 pipe at 150 psi, except where fittings are lower Class or pressure rating.

3. Test each piping system at 150 percent of operating pressure indicated, but not less than 25 psi test pressure.

4. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 5 percent of test pressure.

B. Notifications: At least 10 days prior to commencement of required testing, notice shall be submitted for review. Tests shall be made prior to painting insulating or covering of any joints and shall be in accordance with ANSI Code for Pressure Piping.

C. Inspections: Services of an authorized ASME inspector shall be furnished, not an employee of Contractor, to visually inspect piping while under hydrostatic pressure. Copies of inspection shall be submitted for review. At option of contract, welds not hydrostatically tested may be x-ray tested.

D. Repair piping systems sections which fail required piping test, by disassembly and re-installation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.

E. Drain test water from piping systems after testing and repair work has been completed.

F. Test pressure piping in accordance with ANSI B31.

G. Test waste, drain and vent systems in accordance with local plumbing code and these specifications. Repair failed sections by disassembly and reinstallation.

H. If test procedures in other sections differ from the above, comply with more stringent requirements.

END OF SECTION

SECTION 221410 - PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Water Piping.

B. Soil, Waste and Vent Piping.

C. Storm Water Piping.

D. Testing.

1.2 RELATED REQUIREMENTS

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Section 230500 - Basic Mechanical Requirements.

1.3 RELATED SECTIONS

A. Section 230529 - Basic Mechanical Materials and Methods.

B. Section 230540 - Mechanical Sound and Vibration Control.

C. Section 230548 - Mechanical Seismic Control.

D. Section 230700 - Mechanical Insulation.

E. Section 221411 - Disinfecting Water Supply System.

F. Section 221430 - Plumbing Specialties.

G. Section 224440 – Plumbing Fixtures.

H. Section 224450 – Plumbing Equipment.

1.4 SUBMITTALS

A. Submit Product Data for the following items under provisions of the General Conditions of the Contract:

1. Water Piping, Fittings, and Joints.

PART 2 - PRODUCTS

2.1 WATER PIPE, TUBE, FITTINGS AND JOINTS

A. Exterior Buried:

1. Copper Tube, Fittings, and Joint Material:

a. Copper tube ASTM B88 Type K shall be brazed to wrought or cast fittings using AWS class BCuP brazing filler metal.
b. Wrought copper and bronze solder joint fittings shall conform to ANSI B16.22.
c. Cast bronze solder joint fittings shall conform to ANSI B16.18.

2. Cast Iron Pipe Fittings and Joints:

a. Gray cast iron pipe, centrifugally cast, 18/40 physicals, cement lined, mechanical joint, thickness class 23 minimum. 300 psi minimum working pressure "laying condition A" as designated by USA Standard A21.1 and 8 foot bury.
b. Mechanical joints and fittings shall be furnished with set screw retaining glands and shall conform to ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11.
c. Mechanical joint fittings shall be Ductile Iron, 350 psi working pressure up to 24" size.

3. Ductile Iron Pipe Fittings and Joints:

a. Class 150, ductile iron pipe centrifugally cast, thickness class 2, cement lined, mechanical joint, 350 psi minimum working pressure "laying condition A" as designated by USA Standard A21.51 and 8 foot bury.
b. Mechanical joints and fittings shall be furnished with set screw retaining glands and shall conform to ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11.

B. Interior Buried:

1. Provide type K annealed (soft) copper water tube conforming to ASTM B-88 with 95% tin 5% antimony solder joints using wrought fittings. No joints below grade. Provide continuous tube for all buried tubing using tube bends in lieu of fittings. Exterior tube may be coupled where requirements are in excess of standard mill lengths by using wrought pressure couplings with stops and silver solder brazed Joints. Lengths coupled in this manner, where necessary and acceptable to the Engineer, will meet the intent of the no fitting requirement of this Specification. Interior buried tube shall meet the same criteria and requirements.

C. Interior Tube Supported by Hangers and Clamps:

1. Provide ASTM B88 Type L hard drawn copper tube for all water distribution piping inside building/structure, with wrought copper fittings and couplers up to 6", cast brass or bronze fittings and couplers for sizes 6" and larger. Joints shall be 95-5 Class SnSb solder or Victaulic CTS roll-grooved couplers and fittings for 3” and larger tube.

2.2 SOIL DRAIN WASTE, VENT AND STORM PIPE FITTINGS AND JOINTS

A. General:

1. Cast iron pipe centrifugally cast service weight (SV) soil pipe with cast iron drainage fittings conforming to ASTM A 74. Joint materials and systems may be hub and spigot with neoprene gaskets and lubricant conforming to ASA-021 and ASTM C-564 SV pattern. Gaskets shall be equal to U.S. Pipe Company Veri-tite conforming to ASTM-C564 and pipe and fittings be certified in writing to the Engineer that the following criteria has been met, thru testing by a recognized independent testing laboratory. Cast iron hubless pipe and fittings conforming to ASTM A 888, CISPI 301. Hubless couplings shall conform to ASTM C 1277 for standard and ASTM C 1540 for heavy duty or CISPI 310. Pipe and fittings shall be marked with the collective trademark of the cast iron soil pipe institute or receive prior approval of the engineer.

   Criteria: Sizes 2" thru 6" shall withstand 15 psig hydrostatic pressure for 10 minutes with unrestrained joints, and no leakage, and using restrained joints must be able to withstand 25 psig air pressure and 40 psig hydrostatic pressure with no leakage. Offset joints shall withstand 1056 pounds of horizontal force without joint separation or detectable leakage.

2. a. Polyvinylchloride (PVC) sewer pipe and fittings shall conform to DR-35, ASTM D3034, bell and spigot type with reinforced rubber ring gasket integral with bell joint, minimum pipe stiffness at 5% deflection

is 46, material to meet ASTM D1784, D2444 and joint tightness in accordance with ASTM D3212.

b. Solvent cement to be low volatile organic compound (VOC) to meet South Coast Air Quality Management District (SCAQMD) Rule #1168. Product: IPS Weld-On #2700 or equal.

B. Buried Pipe:

1. Provide SV hub and spigot cast iron pipe and fittings to 5'-0" beyond building excavation line, continue past this point with SV cast iron or XS vitrified clay to termination points with hub and spigot joints. At Contractor's option and where approved by local jurisdiction, No-Hub standard weight cast iron pipe with either M-G couplings or heavy-duty stainless steel shielded couplings may be used in lieu of hub and spigot with Ty-Seal neoprene gaskets. The heavy-duty shielded couplings shall comply with ASTM C1540, with ASTM C564 neoprene gaskets, minimum 0.008" stainless steel shields with transverse corrugations across longitudinal corrugations, standard 304 stainless steel clamps and 305 stainless steel screws. Entire assembly shall be suitable for direct burial, be corrosion resistant, and accommodate pipe deflection.

C. Interior Pipe Supported By Hangers and Clamps:

1. Provide hubless cast iron pipe using hubless cast iron soil pipe couplings certified to withstand a minimum of 50 psi internal pressure. Where stack pressures may theoretically exceed 50 psi, use clamp all or heavy-duty couplings with restrained joints horizontal and vertical up to 80 psig. For pressures above 80 psi, use Schedule 40 ASTM A-120 galvanized steel pipe with threaded cast iron drainage fittings. Roll grooved schedule 40 pipe with Victaulic Style 77M galvanized couplers may be used on horizontal and vertical stacks and mains. Use Teflon tape or compound for all threaded joint make-up.
2. Sump pump discharge from the pump to the point the waste stream flows continuously via gravity shall be Schedule 40 galvanized steel pipe with NPT threaded joints and fittings.
3. Copper Waste, Vent and Soil Pipe and Fittings shall be prohibited on this project.

2.3 PLASTIC DRAIN, WASTE AND VENT PIPING

A. Plastic drain, waste and vent piping may be installed when in compliance with jurisdictional codes and this specification.

B. Plastic DWV may be either P.V.C. or A.B.S. as required by code and utilizing drainage pattern fittings.

C. P.V.C. (polyvinylchloride) pipe and fittings shall conform to ASTM D2665 with a flame spread rating of 25 or less and shall consist of Schedule 40 DWV pattern.

D. A.B.S. (acrylonitrile - butadiene - styrene) pipe and fittings shall conform to ASTM D2661, CS 270-65, Schedule 40 DWV pattern.

E. All plastic DWV piping shall bear the seal of the National Sanitation Foundation (N.S.F.). None will be accepted without this seal.

2.4 SOLVENTS FOR PLASTIC PIPING

A. Solvents for plastic piping joints shall be certified to meet SCAQMD Rule #1168/316A. This includes but is not limited to PVC, CPVC, and ABS piping, all grades and sizes.

B. Solvent cement to be low volatile organic compound (VOC) to meet South Coast Air Quality Management District (SCAQMD) Rule #1168. Product: IPS Weld-On #2700 or equal.

C. Product: IPS Weld-On #2700 or equal.

PART 3 - EXECUTION

3.1 WATER TUBE, FITTINGS AND JOINTS

A. General:

1. All copper tube and fittings shall be reamed and buffed prior to soldering or brazing.
2. The use of lead solder of any class, for joint make-up or back-up for finishing is prohibited.
3. Refer and conform to the Copper Development Association instructions for proper preparation and actual installation practice for all soldered and brazed joints.
4. Support water tube in accordance with Section 230529.
5. Pull tee (T-drill) fittings are forbidden.

3.2 SOIL, DRAIN, WASTE, VENT AND STORM PIPE FITTINGS AND JOINTS

A. General:

1. Provide bedding, restraints and hangers as appropriate and in accordance with manufacturers recommendations based upon type of pipe, fittings, joints, and bury depth using final finished grading as the basis.
2. Piping shall be run true, plumb, and straight, with all restraints and hangers adjusted to carry their proportional load and locked to prevent pipe "wag" misalignment, movement or shear.
3. Provide anchors for piping risers on every floor using riser clamps, wall brackets, knee brackets, and foot blocks for all vertical piping over 20 feet straight height.
4. Furnish and install all soil, waste and vent piping for the complete sanitary system in accordance with jurisdictional code requirements.

5. All soil and waste piping shall be run at the following minimum slope unless otherwise indicated on drawings.

Slope of Horizontal Drainage Pipe	
Size (In.)	Min. Slope (In./Ft.)
2-1/2 or less	1/4
3 to 6	1/8
8 or larger	1/16

6. Bushings in soil waste or vent piping shall be prohibited. Tapped spigots or tees shall be used when changing from cast iron pipe to steel waste or vent piping, and for appropriate cleanout plugs.
7. Vertical Piping: All vertical soil and vent stacks shall be supported with riser clamps at each floor slab. When soil stacks over two stories in height terminate at the bottom on slab fill or native soil, provide stack base elbows set on 24" x 24" x 8" thick minimum poured reinforced concrete pads set directly on undisturbed native soil or fill compacted to same density as undisturbed earth.
8. Horizontal Piping (suspended):

    a. Supports - Horizontal piping shall be supported at sufficiently close intervals to keep it in alignment and prevent sagging.
    b. Cast iron soil pipe - Where joints occur, suspended cast iron soil pipe shall be supported at not more than five (5) foot intervals; except that pipe exceeding five (5) feet in length, may be supported at not more than ten (10) foot intervals. Supports shall be adequate to maintain alignment and prevent sagging and shall be placed within eighteen (18) inches of the hub or joint. Hubless or compression gasket joints must be supported at least at every other joint except that when the developed length between supports exceeds four (4) feet, they shall be provided at each joint. Supports shall also be provided at each horizontal branch connection. Supports shall be placed on or immediately adjacent to the coupling. Suspended lines shall be suitably braced to prevent horizontal movement.
    c. Threaded pipe - Threaded pipe (IPS), shall be supported in accordance with Section 230529.
    d. Rigid support sway bracing shall be provided at changes in direction greater than 45 degrees for pipe sizes 4 inches and larger.
    e. For pipe sizes greater than 4 inches, axial restraints shall be provided for drain pipes at all changes in direction and at all changes in diameter greater than two pipe sizes.

9. The waste connections between fixtures and their respective collection and venting systems shall consist of galvanized steel nipples and cast iron drainage fittings.

10. All interior waste, soil, and vent piping up to 1-1/2" shall consist of galvanized steel with cast iron drainage fittings, all piping 1-1/2" and over shall consist of S.V. cast iron soil pipe and fittings.
11. All pipe and fittings shall have affixed thereon the CISPI grade mark of identification.
12. All vents shall be installed through the roof of at least the minimum size as required by jurisdictional code and shall be cast iron.
13. All vents protruding through the roof shall be not less than 2" size and extended to not less than 12 inches above the finished roof. Vents through built-up roofing shall be flashed with 24" x 24" x 4 lb. sheet lead. The flashing shall extend to top of vent and the edges turned down into a cast iron vent pipe. Single ply rubberized roofing systems shall be flashed around vent with top edge of roofing clamped to vent pipe and sealed with compatible sealant.
14. All vents shall be located in accordance with jurisdictional code and in no case less than two (2) feet from roof edge or parapet, or wall line of an "on the roof structure". Vent terminations shall not occur within twenty-five (25) feet of any outside air intake.
15. Provide all expansion joints, braces, earthquake restraints as required by the contract documents (Section 230548) and jurisdictional authority.

3.3 PROHIBITED PIPE ROUTING

A. Plumbing piping, regardless of contents (water, sewer, vent, etc.) shall not be routed through or above the following locations:

1. Electrical panel rooms
2. Electrical switch gear rooms
3. Electrical transformer rooms
4. Elevator shafts
5. Elevator equipment rooms
6. Data Centers
7. File Server Rooms / MDF / IDF

B. Should there be a conflict with the plans and the above paragraph, notify the Engineer immediately for corrective action prior to starting work.

3.4 PLASTIC DRAIN WASTE AND VENT PIPING

A. Plastic piping shall be installed with caution towards expansion and contraction characteristics. The piping shall be free to flex and move without bindings. The pipe shall be securely anchored at the roof to prevent movement at the roof penetrations.

B. Roof penetrations shall be made with self-sealing neoprene boots with integral lead or copper flashing pans.

C. Provide solvent weld joints.

D. Solvent cement to be low volatile organic compound (VOC) to meet South Coast Air Quality Management District (SCAQMD) Rule #1168. Product: IPS Weld-On #2700 or equal.

E. Support vertical soil, waste, drainage stacks and vents from building structure with padded riser clamps.

3.5 TESTING

A. Schedule of Testing:

Service	Allowable Test Methods H_2O	CA	N_2	V	Minimum Test Pressure (psig)	Minimum Test Period (minutes)	Allowable Pressure Variance (psig)
1. Potable Water Pipe Valves & Fittings	X	X			125 100	60 60	-0- +1/2
2. Sanitary, Storm and Vent System:							
*Stack Height:							
0-23 FT.	X				10	30	-0-
24-34 FT.	X				15	30	-0-
35-46 FT.	X				20	20	-0-
47-57 FT.	X				25	20	-0-
58-69 FT.	X				30	10	-0-
70-80 FT.	X				35	10	-0-
81-92 FT.	X				40	10	-0-
93-103 FT.	X				45	10	-0-
Over 104 FT.	X				50	10	-0-

B. Testing connections for hydrostatic tests shall be made at the base of the system, CA, N2 and vacuum testing can be made from connections anywhere in the system tested.

C. In the event that tests fail, use a standard soap and brush inspection using "Trouble Bubble" Liquid high density soap as manufactured by Jersey Meter Co., Patterson N.J. Formula ST-1. After source of failure is discovered, correct and retest system. Repeat procedure until system sustains required testing successfully.

D. Testing contractor shall give at least 16 working hours notice to the General Contractor/Construction Manager so that arrangements for witnessing tests can be made.

The General Contractor/Construction Manager shall witness and SIGN the required test form.

E. All joints, valves, fittings and piping accessory items shall be exposed to view during tests whether pipe is above or below ground. "Closed in" or "Buried" piping shall be re-exposed during testing.

F. Proper restraining of piping and test plugs shall be accomplished prior to test.

END OF SECTION 221410

SECTION 221411 - DISINFECTING WATER SUPPLY SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Disinfection of Domestic Water Supply System.

1.2 RELATED WORK

A. Requirements: Provide Disinfecting Water Supply System in accordance with the Contract Documents.

B. Section 230500 - Basic Mechanical Requirements.

C. Section 221410 - Plumbing Piping.

1.3 DEFINITIONS

A. Disinfectant residual means the quantity of disinfectant in treated water.

B. pH factor means the measure of alkalinity and acidity in water.

C. ppm means parts per million.

1.4 CONTRACTOR'S QUALIFICATIONS

A. Water Treatment Contractor: At least three years experience performing work specified herein.

B. Bacteriological Laboratory: Certified by Serving Water Board or District and be in compliance with the State and U.S. Safe Drinking Water Act.

1.5 REGULATORY AGENCY REQUIREMENTS

A. Comply with requirements of Local and State Regulations.

1.6 SUBMITTALS

A. Submit for review and acceptance the following items under provisions of the General Conditions of the Contract:

1. Water treatment contractor's evidence of experience.
2. Bacteriological laboratory's evidence of certification.

B. Submit printed data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

1. Disinfection Report:

a. Include the following:

Date issued.

Project name and location.

Treatment Contractor's name, address, and phone number.

Type and form of disinfectant used.

Time and date of disinfectant injection start.

Time and date of disinfectant injection completion.

Test locations.

Initial and 24 hour disinfectant residuals in ppm for each outlet tested.

Time and date of flushing start.

Time and date of flushing completion.

Disinfectant residual after flushing in ppm for each outlet tested.

2. Bacteriological Report:

a. Include the following:

Date issued.

Project name and location.

Laboratory's name, certification number, address and phone number.

Time and date of water sample collection.

Name of person collecting samples.

Test locations.

Time and date of laboratory test start.

Coliform bacteria test results for each Outlet tested. Certification that water conforms or fails to conform to bacterial standards of State and Federal Safe Drinking Water Act.

Bacteriologist's signature.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Protect against damage and discoloration.

B. Maintain caution labels on hazardous materials.

C. Maintain storage room dry and with temperatures as uniform as possible between 60 deg. F and 80 deg. F.

D. Do not store Caustic Soda directly on floor colder than 55 deg.F.

1.8 PROTECTING WORK OF OTHER TRADES

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

B. Protect against damage and discoloration caused by work of this Section.

PART 2 - PRODUCTS

2.1 DISINFECTANT

A. Free chlorine; liquid, powder, tablet, or gas.

2.2 ALKALI

A. Caustic Soda or Soda Ash.

2.3 ACID

A. Hydrochloric type.

PART 3 - EXECUTION

3.1 EXISTING CONDITIONS

A. Prior to starting work, verify that Domestic Water System is completed, flushed and clean.

B. Prior to starting work, notify Construction Manager/General Contractor of any defects requiring correction.

C. Do not start work until conditions are satisfactory.

3.2 PREPARATION OF WATER FOR TREATMENT

A. Verify pH factor of water to be treated.

B. If pH factor is less than 7.4, introduce sufficient alkali during disinfectant injection to produce 7.4 to 7.6 pH level.

C. If pH factor is greater than 7.6, introduce sufficient acid during disinfectant injection to lower pH to 7.4 to 7.6 level.

3.3 SYSTEM TREATMENT

A. Inject disinfectant throughout system to obtain 50 to 80 ppm residual.

B. Starting at outlet closest to water sources, bleed water from each outlet until water produces odor of disinfectant. Repeat process at each outlet throughout system.

C. Test for disinfectant residual at each of the following locations:

1. Ends of piping runs.
2. Remote outlets. (Ends of each multiple fixture branch line)
3. Tanks and domestic water heaters.
4. At least 15% of outlets on each floor as directed by Architect/Engineer.

D. Maintain disinfectant in system for 24 hours.

E. If resultant disinfectant residual test is less than 25 ppm, repeat System Treatment.

3.4 FLUSHING

A. Flush disinfectant from entire system; permit no more than residual rate of supplied incoming water.

3.5 BACTERIOLOGICAL TEST

A. Instruct Bacteriological Laboratory to take water samples no sooner than 24 hours after flushing system.

B. Take water samples at each of the following locations:

1. Where water enters system.
2. Ends of piping runs.
3. Remote outlets.
4. Tanks.
5. At least 10% of outlets on each floor other than those used for testing disinfectant residual, where directed by Architect/Engineer, but in no case less than 2 outlets per floor.

C. Analyze Water Samples in accordance with Standard Methods for the examination of Water & Waste Water, published by American Water Works Assoc., 6666 W. Quincy Ave., Denver, CO 80235.

D. If Bacteriological Test proves water quality to be unacceptable, repeat System Treatment.

3.6 PRODUCT CLEANING & REPAIRING

A. Including work of other trades, clean, repair and touch-up, or replace when directed, products which have been soiled, discolored, or damaged by work of this Section.

B. Remove debris from Project Site upon work completion or sooner, if directed.

END OF SECTION 221411

SECTION 221430 - PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Drains and drainage products.
B. Cleanouts.
C. Sillcocks, yard hydrants, hose bibbs and hose stations.
D. Pressure gauges, thermometers, and test plugs.
E. Shock arrestors.
F. Backflow preventers.
G. Pressure and temperature relief valves.
H. Trap chargers and accessories.

1.2 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

A. Furnish electrical outlets installed in Washer Wall Box for Division 26 power wiring installation.

1.3 RELATED WORK

A. Requirements: Provide Plumbing Specialties in accordance with the Contract Documents.

B. Section 230500 - Basic Mechanical Requirements.

C. Section 230529 - Basic Mechanical Materials and Methods.

1.4 SUBMITTALS

A. Submit Product Data for the following items under provisions of the General Conditions of the Contract:

1. Floor Drains (FD)
2. Floor Sinks (FS)
3. Sillcocks (SC), Ground Hydrants (GH) and Yard Hydrants (YH)
4. Hose bibbs (HB) and Hose Stations (HV)
5. Pressure gauges (PG)
6. Thermometers (T)
7. Shock Arrestors (SA)
8. Backflow Preventer (BP)
9. Trap Primers (TP)

B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

1. Backflow Preventer (BP)

1.5 WARRANTIES

A. Provide original copies of all warranties for specific equipment where specified and in accordance with Section 230500.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Where acceptable manufacturers are listed, these manufacturers must submit products that are in fact equivalent in all respects of materials, design, function, and appearance to the manufacturer listed as the base manufacturer in the specification body or drawing schedules. Deviations of any type will not be acceptable.

B. Where other acceptable manufacturers are not listed, only the base manufacturer will be accepted.

C. All items of like nomenclature shall be supplied by one manufacturer only.

2.2 FLOOR DRAINS (FD)

A. Acceptable manufacturers: Wade series 1100, JR Smith series 2005, Josam series 30000, Zurn series Z-415, Watts FD-100 series, MIFAB series F-1100.

B. Schedule: See Drawings

1. Provide flashing clamp device for drains in areas with waterproof membrane and all drains above slab-on-grade.

2.3 FLOOR DRAINS, HEAVY DUTY

A. Acceptable manufacturers: Wade series 1240, JR Smith series 2330, Josam series 31200, Zurn series Z-512, Watts FD-340 series, MIFAB series F-1340C.

B. Schedule: See Drawings

1 Provide flashing clamp device for drains in areas with waterproof membrane and all drains above slab-on-grade.

2.4 FLOOR SINKS (FS)

A. Acceptable manufacturers: Wade series 9110/9140, JR Smith series 3100/3150, Josam series 49000/49040, Zurn series Z-1900/Z-1910, Watts FD-860 series, MIFAB series FS-1520/FS-1730.

B. Schedule: See Drawings

1. Provide full grate unless otherwise noted, provide 1/2 or 3/4 grate where indicated on Drawings.
2. Provide flashing clamp device for drains in areas with waterproof membrane and all drains above slab-on-grade.
3. Indirect waste for kitchen, laundry, etc.
4. Indirect waste and floor drainage for mechanical equipment rooms.
5. Indirect waste for icemakers, sterilizers, etc.

2.5 EXPANSION JOINTS

A. Acceptable manufacturers: Wade series 3900, JR Smith series 1710, Josam series 26200, Zurn series Z-190, Watts RD-900 series, Metraflex, MIFAB series R-1900, Hyspan.

B. Schedule:

Plan Code	EJ
Material	Cast Iron
Sleeve	Bronze/Brass
Gasket	Neoprene or Graphite
Size	2”-10”

2.6 FLOOR CLEANOUTS

A. Acceptable manufacturers: Wade series 6000, JR Smith series 4020/4100/4200, Josam series 56000, Zurn series Z-1400, Watts CO-200-R/200-RX/200-US series, MIFAB series C1100-R/C1100-XR/C1100-UR.

B. Cast iron adjustable body, ABS plug.

1. Provide flange and flashing clamp for Cleanouts in areas with waterproof membrane and all cleanouts above slab-on-grade.

2. Provide nickel bronze top to match floor finish as indicated in the Architectural finish schedule. Provide heavy duty nickel bronze top for cleanouts in storage rooms, kitchens, and similar areas. Provide heavy duty cast iron or ductile iron top for cleanouts in equipment rooms, traffic areas, parking areas, and similar unfinished areas.

2.7 WALL CLEANOUTS

A. Acceptable manufacturers: Wade series 8560 with 8480R, JR Smith series 4530, Josam series 58790, Zurn series 1446, Watts CO-460-RD series, MIFAB series C-1460.

B. Cast iron clean out tee, ABS plug, stainless steel cover with screw.

2.8 GRADE CLEANOUTS

A. Acceptable manufacturers: Wade series 8300 MF with 6000 spigot outlet, JR Smith series 4250, Josam series 58850, Zurn series Z-1474 with Z-1449, Watts CO-300 series, MIFAB series C-1300.

B. Heavy duty cast iron clean out housing, heavy duty cast iron or ductile iron cover, cast iron ferrule, ABS plug, vandal proof security screws.

1. Provide piping system identification cast into cover; "SAN" for sanitary waste cleanouts, "STORM" for storm drainage cleanouts.

2.9 VENT CAPS

A. Acceptable manufacturers: JR Smith series 1748, Josam series 26700, Zurn series Z-193, Watts RD-680 series, MIFAB series R-1930.

B. Cast iron body and dome, vandal proof screws.

2.10 SAFE PANS AND DRAIN FLASHINGS

A. Provide one of following systems:

1. #24 B&S gauge (0.021") minimum sheet copper with l5 lb. asphaltic felt sub pan (underliner).
2. 0.040" non-plasticized chlorinated polyethylene sheet with 30 lb. felt underliner.
3. 3 ply 15 mil polyvinylchloride sheet with 30 lb. felt underliner.

2.11 WATER HEATER SAFETY PAN (WHSP)

A. Provide Shamrock Industries Inc. or equivalent gray polyethylene pan 2" larger than heater on all sides and minimum 1-1/2” deep with side or bottom drain fitting on electric water heaters installed above ceilings, under counters or on wood flooring.

B. Provide Ruud Mfg. Co. "Heater Pan", Canplas or equivalent spun aluminum pan 2” larger than heater on all sides and minimum 1-1/2” deep with side or bottom drain fitting on gas fired water heaters installed on combustible foundations with 3/4" thick fire proof liner between pan and combustible construction.

2.12 SILLCOCK, EXPOSED, NON-FREEZE

A. Acceptable manufacturers: Woodford series 65, JR Smith series 5609, Josam series 71050, Zurn series Z-1310, Wade series 8600, Watts HY-420 series.

B. Schedule: See Drawings

2.13 HOSE BIBBS

A. Acceptable manufacturers: As listed in schedule.

B. Schedule: See Drawings

1. Toilet rooms, Janitor's mop station, etc.

2.14 STATIONARY PRESSURE GAUGES

A. Acceptable manufacturers: Trerice 600C Series, Weksler Regal Series, Weiss Instruments.

B. Schedule:

Type	4-1/2” Dial
Bourbon Tube/Socket	Stainless Steel Tube 316 Stainless Steel Socket
Accuracy	ANSI B40.1 Grade 1A 1% F.S. over middle half of range
Case	Cast Aluminum
Window	Clear Glass
Snubber	Yes
Coil Syphon	For Steam Service
Gauge Cock	Yes
Set Hand	No
Silicone Filled	No
Weatherproof	No

C. Range: Select gauges for the following standard ranges unless otherwise indicated on drawings, or as required for special systems.

1. Domestic Water 0 to +160 psi

2.15 STATIONARY THERMOMETERS

A. Acceptable manufacturers: Trerice Industrial Series, Ametek Industrial Series, Weiss Instruments, Miljoco, Weksler.

B. Schedule:

Type	Adjustable angle
Case	9" cast aluminum
Window	Clear acrylic
Tube	Lens front, magnifying
Stem	Aluminum, insertable
Separable Socket	Brass
Fill Type	Spirit: Blue colored, organic

C. Range: Select thermometers, for the following standard ranges unless otherwise indicated on Drawings, or as required for special systems.

1. Domestic cold water 0 to 100 °F
2. Domestic hot water 30 to 240 °F

2.16 TEMPERATURE AND PRESSURE TEST PLUGS (T&PTP)

A. Manufacturer: Trerice, Fairfax, Flow Design, Peterson Equipment, Weksler.

B. Plugs suitable for vacuum to 600 psig and temperatures of -20 deg.F to 300 deg.F with cap and extension for insulated pipe where required.

C. Provide one pressure gauge(s), gauge adapter, and two thermometers in shock-proof case.

D. Schedule:

PLAN CODE:	MAKE:	MODEL:	PRESSURE & TEMPERATURE TEST KIT
T&PTP	Trerice	D3741	Trerice D3752 (0-300 psig)

2.17 SHOCK ARRESTORS FOR WATER (SA)

A. Manufacturer: Precision Plumbing Products Co., Wade Shokstop, J.R. Smith series 5000, Josam series 75000, Zurn Z-1700, Watts SS series.

B. Schedule:

"P.D.I." SIZE	FIXTURE UNITS
A	1-11
B	12-32
C	33-60
D	61-113
E	114-154
F	155-330

2.18 REDUCED PRESSURE BACKFLOW PREVENTER

A. Acceptable manufacturers: Conbraco Series 40-200, Watts series 009 and 909, Febco series 825Y, Hersey series FRP-II.

B. Bronze body, independent spring-loaded check valves, diaphragm type differential pressure relief valve, shut-off ball valves, strainer, test cocks. Suitable for water temperature range of 33-140 °F.

C. Approved under ASSE 1013 and AWWA C511.

D. Backflow preventer test kit: Provide complete test kit including pressure gauge, test valves, high pressure hoses, adaptor fittings, mounting strap, and instructions, in a corrosion resistant carrying case.

2.19 TEMPERATURE AND PRESSURE RELIEF VALVES (T&P)

A. Acceptable Manufacturers: Kunkle, Watts, Conbraco, McDonnell and Miller.

B. Schedule:

TYPES	SIZE	MAKE	MODEL	SERVICE	MAX PRESS	ASME MAX TEMP	ASME RATING BTUH MAXIMUM
T & P	3/4"	Kunkle	137	Water Pressure Vessel	125 psig	250 F	2,230,000

Press	3/4"	Kunkle	84-45	Air	125 psig	300 F	NA
Vac	3/4"	Kunkle	80-45	Vacuum	15" Hg	300 F	NA
T & P	3/4"	Watts	40XL8	Water Heater	125 psig	210 F	777,600

2.20 TRAP CHARGERS AND ACCESSORIES (NO PLAN CODE)

A. Manufacturer: Precision Plumbing Products, Co. ("P.P.P.")

B. Pressure Activated Trap Primers:

1. Schedule:

MODEL	DISTRIBUTION UNIT	SUPPLY TUBE
P-1	1 thru 4 outlets per unit as shown on drawings.	Single

PART 3 - EXECUTION

3.1 DRAINS

A. Coordinate drain placement with Contractor for Division 3 - Concrete.

B. Drain, strainer, and grate finishes shall be as specified, cover all finished surfaces during construction to prevent damage.

C. Install drains with "P" pattern traps and vents as required.

D. All drain bodies shall be plugged during construction to prevent foreign objects, dirt, concrete, etc. from entering the drain and drainage piping.

E. Planter drains shall not receive domes until final landscaping is accomplished. Provide closure plugs until landscaping and dome installation is furnished.

F. Drains shall be set flush and level with finished surfaces, with grate pattern parallel or perpendicular to adjacent walls or floor patterns.

G. Flash all drains on roofs, upper floors, and floor over crawl spaces with 24"x24" minimum flashing pans. Shower pans shall be turned up in walls to a minimum of 6" above the shower receptor threshold.

H. Clean and polish all drain bowls, rims, strainers, and grates prior to final inspection.

3.2 CLEANOUTS

A. Provide cleanouts in waste, soil, and storm piping at each change in direction greater than 45°, as required by Jurisdictional Code.

B. Provide cleanouts at 50 feet on center for all interior sanitary and storm piping, and at each base of waste, soil or storm pipe stack or drop, 100 feet on center for all exterior sanitary and storm piping or as required by jurisdictional code.

C. Provide appropriate access tops for imposed construction.

D. Coordinate interior floor cleanout locations with contractor for Division 3 - Concrete.

E. Cleanouts to be provided with ABS or Delrin plugs. Lead sealed, brass, or cast iron plugs will not be acceptable unless specifically required by jurisdictional code authority.

F. Provide 24"x24" minimum flashing pans and clamp devices for all cleanouts located on upper floors or floors over crawl spaces.

G. Where cleanout arms extend horizontally and/or vertically more than 15 feet from the sewer main which they are serving, provide 2" minimum vent off the end of the arm and connect to the building vent system.

H. Clean and polish all cleanout access covers prior to final inspection.

I. Cleanout access covers shall be flush and level with finished building surfaces.

J. Install cleanout plugs on exposed or accessible piping. Plugs shall be line size up to 3" and over 8", 4" plugs for sizes 4" thru 8".

K. Provide wall cleanouts where piping is concealed in walls or non-accessible chases, use tapped cleanout tee or tapped extension to within 4" of wall face. Do not use no-hub type blind plugs for wall cleanouts.

L. Provide 12"x12"x8" thick 3000 lb. concrete pads for all grade cleanouts. Concrete shall be in accordance with Division 3 - Concrete. Tops of pads to be 1" above finish grade and cleanout access flush and level and centered in pad surface.

3.3 SANITARY VENT CAPS

A. Install where shown on drawings, vandal resistant vent caps a minimum of 14" above the roof surface.

B. Provide 24"x24"x4 lb. sheet lead flashing up 12" above roof to vent flashing collar.

C. Secure dome and entire assembly tight to pipe.

3.4 SAFE PANS AND DRAIN FLASHINGS (no plan code)

A. Provide safe pans for all shower bases, shower rooms, wet rooms and kitchen areas. Pans shall extend wall to wall and turn up at least 6" above finish floor level or receptor rims into wall construction. Pans shall be laid over non-puncturing base such as heavy asphaltic felt, fine sand that bears no silica, or other acceptable material.

B. All drains on upper floors or over crawl spaces shall be flashed with flashing extending a minimum of 12" beyond the drain top dimensions.

C. Seams to be folded and shaped as required:

1. Solder lead seams.
2. Solder sheet copper seams with 50/50 (50% tin, 50% lead) or 45/55 (45% tin, 55% lead) commercial grade solder.
3. Solvent weld PVC and un-plasticized chlorinated polyethylene seams.

3.5 WATER HEATER SAFETY PAN (WHSP)

A. Install safety pans for all electric water heaters installed above ceilings, under counters or on wood flooring. Route drain to floor sink/drain with indirect connection.

B. Install safety pans for all gas fired water heaters installed on combustible foundations or where leakage will cause damage. Route drain to floor sink/drain with indirect connection.

C. Provide structural supports, air gapped pan drains, drain extensions and pan drain connections as required.

3.6 SILLCOCKS (SC)

A. Provide sillcocks at 100 feet maximum spacing around building perimeter, and at other locations shown on Drawings.

B. Provide all sillcocks with accessible stop and drain valves in heated areas, provide access panels where required.

C. Provide flush or surface mounting, square and plumb to building walls, with supply tube pitched for complete drainout.

D. Anchor all sillcocks with anchor flange provided by manufacturer.

E. Caulk annular space between walls and sillcock and sillcock piping with non-hardening silicone base sealant.

F. Mount sillcocks at 24" above finished grade or surfacing.

G. Where mounting heights other than 24" are shown on the Drawings, the Drawings shall supercede the Specifications.

H. Vacuum breakers to be non-removable.

I. Clean all surfaces including faceplate, box, access door, cam lock and interior of box prior to final inspection.

J. Sillcocks shall not be operated by hand tools, provide 2 keys per sillcock. Units found to be marred due to hand tool operation or other causes, shall be replaced at no increase to the Contract Sum.

K. Clean and polish entire sillcock prior to final inspection.

3.7 HOSE BIBBS (HB)

A. Provide hose bibbs in each equipment room, toilet room and kitchen area equipped with floor drainage systems and where shown on drawings, maximum spacing shall accommodate 50 feet of hose to any point within the drainage area measured around obstructions and equipment, in lieu of straight line measurement. Hose bibbs in toilet rooms mounted under standard lavatory, do not install near ADA lavatory where it could impede access.

B. Anchor hose bibb within wall for rigid flush flange mounting.

C. Install bibb true and plumb with wall flange flush to surface, caulk annular space between wall and flange.

D. Mounting height to be 18" above floor in toilet rooms and immediately under furthest lavatory from entry, 60" above floor in equipment rooms or as shown on drawings.

E. Hose bibbs shall not be operated with hand tools, use only tee handle, furnish one tee handle per bibb. Units found marred due to hand tool operation or other causes will be replaced at Contractors expense.

F. Clean and polish hose bibbs prior to final inspection.

3.8 STATIONARY PRESSURE GAUGES (PG)

A. Provide gauges for steam, water, air and vacuum systems, complete with gauge cocks and snubbers, where required by Drawings.

B. Install in semi or upright position, tilted so as to be readable from floor level.

C. Clean gauge, and glass, and calibrate by test prior to final inspection.

3.9 STATIONARY THERMOMETERS (T)

A. Install thermometers where indicated on Drawings in upright position with case tilted to be readable from floor level.

B. Clean case and glass prior to final inspection.

3.10 TEMPERATURE AND PRESSURE PLUGS (T&PTP)

A. Provide plugs where periodic temperature and/or pressure indication is required as shown on drawings. Provide 1/4" MPT tapping, cap and seal for plug and extension for insulated pipe as applicable.

3.11 SHOCK ARRESTORS FOR WATER (SA)

A. Provide shock arrestors in accordance with Plumbing Drainage Institute (PDI) Standard WH-201 and as shown on drawings.

B. Provide 8"x8" minimum access panels centered on each shock arrestor that is otherwise inaccessible.

C. Shock arrestors shall be mounted as close to the line or quick closing valve as possible. Remote mounting or excessive (over 6") nipple mounting will not be acceptable.

D. Provide ball valve at each shock arrestor to allow units to be easily removed/replaced.

E. Each shock absorber piston shall be exercised at least once prior to final installation. (Physically move the piston up into chamber from throat of unit. Use wooden push rod only in the performance of this exercise.)

3.12 REDUCED PRESSURE BACKFLOW PREVENTER (BP)

A. Provide reduced pressure type backflow preventers on all connections between the domestic water system and make-up supplies to any non potable system, i.e.: Heating, Boilers, Cooling Towers, Chiller, Evaporative Coolers, and the like.

B. Anchor backflow preventer in place.

C. Clean and test assembly in place in accordance with State Health Code.

D. Provide funnels and attach to unit per manufacturers instructions, in true, level and plumb position.

E. Provide IPS to solder adaptor to funnel outlet and run type M copper tubing in an unobtrusive manner routed to an approved drain receptor.

F. Hang and anchor drain tubing so as to be rigid and stable.

G. Permanently affix drain outlet at drain receptor so as to be rigid and unmovable.

3.13 TEMPERATURE AND PRESSURE RELIEF VALVES (T & P)

A. Provide temperature and pressure relief valves, with full size drains extended and air gapped to floor drains or approved receptor. Provide relief valves on all water heaters, pressure vessels and closed piping systems.

3.14 TRAP CHARGERS AND ACCESSORIES

A. Provide trap primer valve, gooseneck connection, distribution boxes, distribution tubing, air gap or vacuum breaker, extension drains, and pattern traps with charger connections for all emergency floor drains.

B. Support and brace charger, distribution boxes, piping and connections as appropriate.

END OF SECTION 221430

SECTION 22 44 40 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Plumbing Fixtures and Trim.

B. Plumbing Fixture Accessories.

1.2 PRODUCTS INSTALLED BUT FURNISHED UNDER OTHER SECTIONS

A. Section 115313 - Laboratory Equipment: Laboratory fixtures, trim and equipment.

B. Section 114000 - Food Service Equipment: Kitchen fixtures, trim and equipment.

1.3 RELATED REQUIREMENTS

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this section and Contractor shall review and adhere to all requirements of these documents.

B. Section 230500 - Basic Mechanical Requirements.

1.4 RELATED SECTIONS

A. Section 221410 - Plumbing Piping.

B. Section 221430 - Plumbing Specialties.

C. Section 224450– Plumbing Equipment.

D. Section 224460 - Special Plumbing Equipment Systems.

E. Section 230529 - Basic Mechanical Materials and Methods.

1.5 REFERENCES

A. Comply with the applicable provisions and recommendations of the following:

1. ANSI A112.19.1 - Enameled Cast Iron Plumbing Fixtures.
2. ANSI A112.19.2 - Vitreous China Plumbing Fixtures.
3. ANSI A112.19.3 - Stainless Steel Plumbing Fixtures.

1.6 SYSTEM DESCRIPTION

A. Provide all plumbing fixtures, materials, labor, accurate rough-in setting, leveling and adjustments of all fixtures, trim and specialties.

1.7 QUALITY ASSURANCE

A. Qualification:

1. Provide fixtures trim and specialties in accordance with style, type, quality and function as established by the named manufacturer and model specified for each item.
2. Provide all installations in accordance with jurisdictional code and health authorities standards, restrictions and recommendations.
3. Provide all fixtures and trim using a single manufacturer where possible, deviation will be allowed only where specifications indicate otherwise.

1.8 SUBMITTALS

A. Submit Product Data for the following items under provisions of the General Conditions of the Contract:

1. Fixtures
2. Carriers
3. P-Traps
4. Faucets, showerheads, valves, cocks, supplies and stops.
5. Finishes, material and colors.
6. Fixture specialties

B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

1. Flush Valves and Faucets.

1.9 WARRANTIES

A. Provide original copies of all warranties and extended warranties for specific equipment where specified and in accordance with Section 230500.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Cast iron and vitreous china: Kohler - Eljer - American Standard – Crane - Zurn – Toto - Mansfield.

B. Stainless steel sink 304 18 gauge minimum: Elkay - Just - Haws - Kohler.

C. Molded Stone: Fiat - Florestone - Stern Williams - E.L. Mustee.

D. Terrazzo: Fiat - Florestone - Stern Williams - Bradley.

E. Fiberglass and Plastic: Kohler - Snyder - Owens Corning - Bradley - Aquarius - Fiat - E.L. Mustee - Fiberglass Systems - Lasco Hitech - Florestone - Sterling.

F. Dual Flush Water Closet Flush Valves: Sloan – Zurn - Mansfield.

G. Low Flow Urinals: Sloan – Zurn – Toto – Kohler - Mansfield.

H. Waterless Urinal: Falcon – Sloan – Zurn.

I. Water Mixing Valves Thermostatic, or Pressure Balanced: Leonard - Symmons - Kohler - Powers - Lawler – Bradley – Watts – Amstrong International - Delta.

J. Metering Faucets: Bradley - Symmons – Speakman - Zurn – Moen - Delta.

K. Flush Valves: Sloan Royal - Delany Flushboy – Zurn - Aquaflush – Toto – Moen (hands free) - Speakman.

1. All flush valves require ‘dirt grabber’ flush valve filter field installed. See paragraph 2.23 in this section.

L. Toilet Seats: Comfort Seats – Bemis - Church.

M. Traps, Stops, Supplies, Airgaps, Drains: Kohler - Eljer - American Standard - Bridgeport - Brasscraft - Dearborn - Sayco - Frost - Eastman - McGuire – Zurn - Delta.

N. Chair Carriers: Josam - J.R. Smith - Zurn - Wade – Mifab - Watts.

O. Faucets: Kohler - Eljer - American Standard - Bradley - Valley - Elkay - Chicago - Delta - Moen - Symmons - Speakman - T&S Brass – Zurn - Watts.

P. Sensor Faucets: Sloan – Zurn – Toto - Moen - Speakman - Bradley - T&S Brass – Delta – Chicago Faucets - Symmons.

Q. Wash Fountains & Showers: Bradley - Willoughby - Intersan.

2.2 WATER CLOSETS

A. See Plans

2.3 LAVATORIES

B. See Plans

2.4 URINALS

A. Wall Hung, Carrier Mounted, Valve Operated Siphon Jet: See Plans

B. Wall Hung, Carrier Mounted, Valve Operated Blow Out (shield type): See Plans

C. Floor Set, Recessed, Stall Type, Valve Operated Washout: See Plans

2.5 SERVICE SINKS

A. Enameled Cast Iron: See Plans

2.6 SHOWERS

A. Individual Concealed Pressure Balancing Valve and Head. (Stall provided under Architectural Divisions of the Work.) See Plans

2.7 LAVATORY THERMOSTATIC MIXING VALVES

A. Adjustable high temperature limit stop (factory set for 110°F), thermostatic type, inlet checkstops. Provide recessed locking stainless steel cabinet where indicated.

B. Provide valves of sizes and capacities scheduled on Drawings.

C. Models:

1. Exposed: Leonard 210-SB, Symmons Series 5.
2. S.S. Cabinet: Leonard TA-254-STSTL, Symmons Series 5B., Bradley.

2.8 FIXTURE SUPPLIES & STOPS

A. Schedule:

Sink & Lavatory Supplies: (1/4 turn chrome ball valve, stainless steel braided tube, 1/2” x 3/8”)
(L.K. Stops, 12" Riser, 1/2 x 3/8)

Make:	Brass Craft	Bridgeport	Frost	Dearborn	Watts
Model:	SCR 1912	1694 LK	7824-2LK	2712 KCW	BV8940LK

DF & Lavatory Supplies:		(W.H. Stops, 12" Riser, 1/2" x 3/8")			
Make:	Brass Craft	Bridgeport	Frost	Dearborn	Watts
Model:	CR 1912	1694	7824-2	2712 SCW	BV8940LK
Bidet & Sink Supplies:		(L.K. Stop, 20" Riser, 1/2" x 1/2")			
Make:	Brass Craft	Bridgeport	Frost	Dearborn	Watts
Model:	SCR 3920	1666 or 1786	8135-2/8218-2	None	BV8940LK
Bidet & Sink Supplies:		(W.H. Stop, 20" Riser, 1/2" x 1/2")			
Make:	Brass Craft	Bridgeport	Frost	Dearborn	Watts
Model:	CR 3920A	1695 MOD	7816-2	None	BV8940LK
Water Closet Tank Supplies:		(L.K.) Stop. 12" Riser, 1/2 x 3/8)			
Make:	Brass Craft	Bridgeport	Frost	Dearborn	Watts
Model:	SCR 1912 DL	1770 LK	7925-2LK	3112 KCW	BV8940LK
Water Closet Tank Supplies:		(W.H. Stop, 12" Riser, 1/2 x 3/8)			
Make:	Brass Craft	Bridgeport	Frost	Dearborn	Watts
Model:	CR 1912 DL	1170	7925-2	3112 SCW	BV8940LK

PART 3 - EXECUTION

3.1 INSPECTION

A. Examination: Examine the contract documents and provide all necessary attachments, accessories, support equipment and materials as necessary to fit allocated spaces.

3.2 PREPARATION

A. Field Measurements: Verify all dimensions and installation requirements so that work can be accurately fitted to other construction and in accordance with the intent of the contract documents. Be responsible for accuracy of measurements and adequate space requirements for the precise fitting and assembly of finished work.

3.3 INSTALLATION/APPLICATION/PERFORMANCE/ERECTION

A. Water Closets:

1. Wall Mounted

a. Closet carriers are to be rigidly anchored to the floor structure in accordance with manufactures installation instructions.
b. Wall mounted water closets will be rigidly supported with brass mounting studs on a concealed metal carrier. Transmitting fixture

weight loads to the fixture pipe connection or wall framing will not be acceptable.

c. Water closets and trim shall be set level and plumb.

d. Spacing of water closets shall be in accordance with contract documents and jurisdictional codes.

e. Flush valve serving water closets located within the handicap stalls shall be installed with the flush handle to the “open side” of the toilet stall (opposite of the grab bar side).

2. Floor Mounted

a. Floor mounted water closet flanges are to be solidly anchored to the floor with lag screws, or bolts and expanders as appropriate for floor construction.

b. Water closet bowls are to be rigidly anchored to the floor flanges.

c. Provide fixture bolt caps to match fixture color for all exposed fixture bolts and nuts.

d. Water closets and trim shall be set level and plumb. Insert copper shims under base of bowl if required to level unit.

e. Spacing of water closets shall be in accordance with contract documents and jurisdictional codes.

f. Flush valve serving water closets located within the handicap stalls shall be installed with the flush handle to the “open side” of the toilet stall (opposite of the grab bar side).

3. Water Closet Supplies

a. Supplies shall be roughed with "L" copper tube nipple through wall cut to exact length and finished with escutcheon, matching fixture trim finish.

4. Water Closet Seats

a. Secure seats to water closets and adjust self-sustaining check hinge to hold the seat at any raised position. Removable bumpers shall match seat color and be secured.

B. Lavatories:

1. Wall and Counter Mounted

a. Wall mounted lavatory carriers are to be rigidly anchored to the floor structure in accordance with manufacturers installation instructions.

b. Carriers are to be furnished with a metal mounting plate and bearing plate or concealed arm carriers.

c. Wall mounted lavatories are to be supported by concealed metal carriers. Transmitting fixture weight loads to the fixture pipe connection is not acceptable.

d. Wood or metal mounting plates anchored to the wall framing or studs will not be acceptable.

e. Carriers are to become part of the structure and the lavatories shall not exert any weight or stress on the interior wall.
f. Lavatories and trim shall be set level and plumb.
g. Provide each lavatory with mixing valve down to anti-scalding threshold.
h. Spacing of lavatories shall be in accordance with contract documents and jurisdictional codes.

C. Urinals:

1. Wall Mounted

a. Wall mounted urinal carriers are to be rigidly anchored to the floor structure in accordance with manufacturer's installation instructions.
b. Wall mounted urinals are to be supported by concealed metal carriers. Transmitting fixture weight loads to the fixture pipe connection will not be acceptable.
c. Wood or metal mounting plates anchored to the wall framing or studs are not acceptable.
d. Carriers are to become part of the structure and the urinals shall not exert any weight or stress on the interior wall.
e. Urinals and trim shall be set level and plumb.
f. Spacing of urinals shall be in accordance with contract documents and jurisdictional codes.
g. Install urinals in accordance with manufacturers installation instructions.

D. Service Sink:

1. Install service sink in accordance with manufacturers installation instructions.
2. Terrazzo service sinks shall be set on a minimum of 1/4" of silica free sand bedding shimmed with copper shims.
3. Wall mounted service sink trap standards are to be rigidly anchored to the floor structure in accordance with manufacturers installation instructions.
4. Install mop hangers over service sinks, on wall adjacent and perpendicular to faucet mounting, so mops drain into sink.
5. Install hose brackets and attach hoses to service sink faucets.
6. Service sinks and trim shall be set level and plumb.

E. Showers:

1. Stall Showers

a. Waste outlets for shower compartment receptors shall be a minimum of 3 inches in diameter with a removable strainer.
b. All shower stalls except those having metal enameled receptors, shall have a lead or copper shower pan or the equivalent thereof as determined in Section 221430.

c. The shower drain grate area shall be not less then 1-1/2 times the free area of the waste pipe.

F. Pressure Balance Type Shower Valves:

1. Adjust limit stop control to 110 degrees F maximum temperature. Failure to adjust this control properly may result in serious scalding.

G. Fixture Supplies and Stops:

1. Provide fixture supplies and stops on every individual fixture or appliance.
2. Stops shall be compression by compression types with flexible straight copper tube risers, loose key or wheel handles stops. Provide one key per fixture for all loose key (L.K.) stops.
3. All components, stops, risers, inlet pipe and escutcheon shall be chrome plated brass, polished stainless steel, or special finish as specified for fixture trim.
4. Supplies and stops shall be anchored rigidly behind walls, eliminating push or pull movement.

H. Escutcheon Plates:

1. Provide cast brass chrome plated single piece escutcheons for all penetrations of piping thru walls, floors, or ceilings in finished and unfinished areas.

I. Faucets and Flushometers:

1. Faucets and flushometers shall be anchored rigidly behind walls, eliminating any push or pull movement.

J. Caulking:

1. All wall and floor mounted fixtures shall be caulked with a non-hardening white or fixture color match for colored fixtures adhesive elastomeric sealant compound providing a watertight seal at the joint with the walls or floor.

3.4 ELECTRICAL COORDINATION

A. Coordination of electrical service for all electric water coolers, garbage disposal units and whirlpool tubs will be the responsibility of the Division 23 Contractor in accordance with Section 230529.

3.5 FIXTURE CONNECTIONS

A. Provide supply and waste connections for fixtures in accordance with the following table of minimum sizes or larger to accommodate horizontal fixture branches, as required by jurisdictional codes, or drawings.

Fixture Description:	Hot Water:	Cold Water:	Waste:	Vent:
Water Closet (WC)				
Flush Valve:	NA	1”	4”	2”
Water Closet (WC)				
Tank Operated:	NA	½”	4”	2”
Lavatory (L):	½”	½”	1-1/4”	1-1/4”
Urinal (U):				
Flush Valve:	NA	¾”	2”	1-1/2”
Service Sinks (SS):	½”	½”	3”	1-1/2”
Sink (S):	½”	½”	1-1/2”	1-1/2”
Drinking Fountain (DF):	NA	½”	1-1/4”	1-1/4”
Electric Water Cooler (EWC):	NA	½”	1-1/4”	1-1/4”
Shower (SH):	½”	½”	3”	1-1/2”
Wash Fountains (WF):	½”	½”	2”	1-1/2”
Laundry Tray (LT):	½”	½”	1-1/2”	1-1/2”

3.6 FAUCET OPERATING ROTATION

A. Standard 2 handle faucets shall rotate as follows:

1. Hot Water clockwise to "on", counterclockwise to "off".
2. Cold Water counterclockwise to "on", clockwise to "off".

B. Wrist blade handle faucets:

1. Initial setting at "off" (rest) position shall have handles parallel to the fixture apron or counter front.
2. Hot Water; Counterclockwise to full on (1/4 turn), clockwise to "off".
3. Cold Water; clockwise to full on (1/4 turn), counterclockwise to "off".

3.7 ADJUSTMENT AND CLEANING

A. Adjustment: Adjust all flush valves, faucets, metering devices, shower heads, gas, air and vacuum cocks, and bubblers for proper flow and action after flushing operations are accomplished.

B. Cleaning: Clean all fixtures, trim, accessories and attachments including strainers, traps, aerators, and valves.

END OF SECTION 22 44 40

SECTION 224450 - PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Water Heaters and Accessories

1.2 RELATED WORK

A. Requirements: Provide Plumbing Equipment in accordance with the Contract Documents.

B. Section 230500 - Basic Mechanical Requirements.

C. Section 230529 - Basic Mechanical Materials and Methods.

D. Section 230540 - Mechanical Sound and Vibration Control.

E. Section 230548 - Mechanical Seismic Control.

F. Section 221410 - Plumbing Piping.

G. Section 221430 - Plumbing Specialties.

H. Section 231123- Natural Gas Systems.

I. Section 235100 - Breechings, Chimneys, Stacks and Flues.

1.3 SUBMITTALS

A. Submit product specification data for the following items under provision of The General Conditions of the Contract:

1. Water Heaters, Accessories and Controls.

B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

1. Water Heaters and Accessories.

1.4 WARRANTIES

A. Provide original warranties for specific equipment of term specified and in accordance with Section 230500.

PART 2 - PRODUCTS

2.1 PRODUCT ACCEPTANCE

A. Acceptable Manufacturers are listed for each product, and manufacturers shall submit products that are in fact equivalent in all respects of material, design, function, size, and appearance to the manufacturer specified. Deviations of any type will not be acceptable.

B. Where acceptable manufacturers are not listed, only the manufacturer specified will be accepted.

C. All equipment of like use and nomenclature shall be supplied by one manufacturer only.

2.2 INSTANTANEOUS POINT OF USE ELECTRIC WATER HEATERS

A. Acceptable Manufacturers: Eemax, International Technology Sales Corp. (trade name ITS), Chronomite Industries, Bradford White, Rinnai, Noritz, Takagi, Bosch, Stiebel Eltron.

B. Warranty: 1 year full non-prorated for entire unit, including the element.

C. Standard: UL 499 for electric, tankless water heating appliances.

D. Construction: Copper piping or tubing complying with NSF 61, with ASME B 1.20.1 pipe thread connections, rated to 150 PSIG, flow control fitting, electric resistance heating element, high-temperature limit cutoff, and housed in an aluminum or steel jacket with enamel or plastic finish.

E. Provide power cord; plug, mounting brackets, stops, and connection as required. Be responsible to coordinate with appropriate power supply receptacle provided by Division 26 Contractor.

2.3 DOMESTIC HOT WATER CIRCULATING PUMPS

A. Acceptable Manufacturers:

1. Taco
2. Bell and Gossett
3. Grundfos
4. Armstrong
5. Patterson

B. Provide in-line type circulating pumps, all bronze construction, <cast iron> <bronze> face bracket, cast bronze one piece enclosed type impeller hydraulically and dynamically

balanced, alloy steel shaft with cupro-nickel shaft sleeve, carbon/ceramic mechanical shaft seal, non-metallic noiseless coupler, resilient mounted dry proof motor with sleeve bearings and over load protection, pump bearing and seal assembly shall be replaceable cartridge design, one cartridge and seal to fit all pumps supplied, provide two extra cartridges and seals, oil level dip sticks (one for each pump), and oil drain plug, 125 psig @ 240 deg. F rating.

C. Provide one contactor per pump to allow the 230900 controls system to start/stop each pump.

D. Schedule: See Schedule on Drawings.

2.4 INSTANTANEOUS, GAS WATER HEATERS

A. Description: Comply with ANSI Z21.10.3/CSA 4.3, except storage is not required.

1. Manufacturers:

   a. NORITZ America Corporation
   b. Paloma Industries, Inc.
   c. Takagi Industrial Co., USA, Inc.
   d. Rheem
   e. Rinnai
   f. Bosch
   g. PVI
   h. A.O. Smith

2. Construction: Copper piping or tubing complying with NSF 61 barrier materials for potable water, without storage capacity.

   a. Tappings: ASME B1.20.1 pipe thread.
   b. Pressure Rating: 150 psig.
   c. Heat Exchanger: Copper tubing.
   d. Insulation: Comply with ASHRAE/IESNA 90.1-2004.
   e. Burner: For use with tankless water heaters and for natural gas fuel.
   f. Automatic Ignition: Manufacturer’s proprietary system for automatic, gas ignition.
   g. Temperature Control: Adjustable thermostat.
   h. Jacket: Metal with enameled finish or plastic.

3. Support: Bracket for all mounting.
4. Capacity and Characteristics: Reference Schedule.
5. Solar Hot Water Support: Models with limits on inlet water temperature or otherwise not recommended for solar water booster heating are not acceptable. Verify acceptability with the manufacturer for the specific model selected.

PART 3 - EXECUTION

3.1 INSTANTANEOUS POINT OF USE ELECTRIC WATER HEATERS

A. Attach firmly to structure, provide union connections and install per manufacturers, U.L., and jurisdictional authorities' requirements and recommendations.

B. Units shall be level, plumb and square.

C. Provide unit isolation valves and unions.

D. Provide factory trained technician for startup of all units.

E. Coordinate electrical power requirements with Division 26 Contractor in accordance with Section 230529 - Basic Mechanical Materials and Methods.

3.2 DOMESTIC HOT WATER CIRCULATING PUMPS

A. Coordinate contactor for pump and electrical power requirements with Division 26 Contractor in accordance with Section 230529 - Basic Mechanical Materials and Methods.

B. Set pump level, plumb and square where indicated on contract documents on vertical pipe leg extended to and supported by floor, provide floor plate and capped leg at floor.

C. Provide drain valve on pump support leg at 18" above floor.

D. Anchor vertical pump leg pipe to prevent movement and vibration.

END OF SECTION 224450

DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 05 00 - BASIC MECHANICAL REQUIREMENTS

SECTION 230500 - BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Basic requirements common to the work in general of Division 21/22/23 and other Divisions and Sections of the Specification where referenced.

B. Provide, unless specified otherwise, all labor, materials and equipment necessary for completely finished and operational mechanical systems described and specified under Division 21/22 and other Sections of this Division 23.

C. Provide all minor incidental items such as offsets, fittings, and accessories required as part of the work even though not specified or indicated.

D. Inspection: Inspect work preceding or interfacing with work of Division 21/22/23 and report any known or observed defects that affect the Work to the Construction Manager/General Contractor. Do not proceed with the work until defects are corrected.

E. Existing Utilities: Are indicated as accurately as possible on the Drawings. Close openings and repair damage in acceptable manner to utilities encountered. This Contractor shall be responsible for field surveying all aspects of existing conditions prior to bid date. Change orders will not be issued for a failure to review existing conditions which affect Division 21/22/23 work.

1.2 RELATED WORK

A. Requirements: Provide Basic Requirements in accordance with the Contract Documents.

1.3 UTILITIES, EXTENSIONS, CONNECTIONS AND FEES FOR WATER AND SEWER

A. Provide all building services extensions and connections to off-site and on-site utilities.

B. Sewer connection charges, typically based on fixture units, that in principle allow the right to obtain the sewer services from the utility will be arranged and paid for by the by owner.

C. Water system development fees, typically based on meter size, that in principle allow the right to obtain the water services from the utility will be arranged and paid for by the Owner.

D. Sewer tap fees as they are known to the trade and are the charges for actual materials and labor for tapping, inspection and recording of the tap shall be arranged and paid for by the Owner.

E. Water tap fees as they are known to the trade and are the charges for actual materials and labor for tapping, inspection and recording of the tap shall be arranged and paid for by the Owner.

F. In the event that the serving utility company installs their own taps, service, meters, etc., all costs imposed by this action shall be paid for by the Division 23 Contractor. Extensions from termination points to connection with building services and systems will be the responsibility of the Division 23 Contractor.

G. Be responsible for all pads, vaults, manholes, manhole covers, meter enclosures, valves, services boxes, and the like, all in conformance with requirements of the serving utility company.

H. In the event that the water service to the building is a combination domestic and fire protection service, the responsibility of said "combination service" to the point of domestic connection shall be that of a licensed Fire Protection Contractor, including tap, valves, excavation, backfill, compaction and meters, if any. After point of domestic connection, responsibility for separate fire and domestic services is with appropriate trades including all labor and materials as herein before mentioned.

1. Contractor shall coordinate with other trades all interface piping and types of connections to be provided for interface.
2. Provide fire hydrant, auxiliary gate valve, tapping sleeve and valve or tee, service boxes, and anchor or swivel couplings, thrust blocks, deadmen, rods, and the like, all in conformance with the requirements of serving utility company.

1.4 REFERENCES

A. General:

1. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
2. The date of the standard is that in effect at the date of the Contract Documents, except when a specific date is specified.
3. When required by individual Specification sections, obtain copy of standard. Maintain copy at job site during work until substantial completion.

B. Schedule of Referenced Organizations: The following is a list of the acronyms of organizations referenced in these Specifications:

ADC Air Diffusion Council
1000 E. Woodfield Rd.
Schaumburg, IL 60173
www.flexibleduct.org

AGA	American Gas Association 400 No. Capitol St. N.W. Washington, DC 20001 www.aga.org
AMCA	Air Movement and Control Association 30 West University Drive Arlington Heights, IL 60004 www.amca.org
ANSI	American National Standards Institute 1819 L Street N.W. Washington, DC 20036 www.ansi.org
ARI	Air Conditioning and Refrigeration Institute 4301 No. Fairfax Drive. Arlington, VA 22203 www.ari.org
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers 1791 Tullie Circle, N.E. Atlanta, GA 30329 www.ashrae.org
ASME	American Society of Mechanical Engineers Three Park Avenue New York, NY 10016 www.asme.org
ASPE	American Society of Plumbing Engineers 8614 W. Catalpa Ave. Chicago, IL 60656 www.aspe.org
ASSE	American Society of Sanitary Engineering 901 Canterbury Westlake, OH 44145 www.asse-plumbing.org
ASTM	American Society for Testing and Materials 100 Barr Harbor Dr. West Conshohoeken, PA 19428 www.astm.org

AWS	American Welding Society 550 N.W. LeJeune Rd. Miami, FL 33126 www.aws.org
AWWA	American Water Works Association 6666 West Quincy Avenue Denver, CO 80235 www.awwa.org
CDA	Copper Development Association 260 Madison Avenue New York, NY 10016 www.copper.org
CISPI	Cast Iron Soil Pipe Institute 5959 Shallow Ford Rd., Suite 419 Chattanooga, TN 37421 www.cispi.org
CS	Commercial Standard of NBS (U.S. Dept. of Commerce, National Institute of Standards and Technology) Government Printing Office Washington, D.C. 20402
CTI	Cooling Technology Institute 530 Wells Fargo Drive Houston, TX 77090 www.cti.org
ICC	International Code Council 5203 Leesburg Pike, Suite 600 Falls Church, VA 22041 www.intlcode.org
IAPMO	International Association of Plumbing and Mechanical Officials 20001 E. Walnut Drive South Walnut, CA 91789 www.iapmo.org
NEBB	National Environmental Balancing Bureau 8575 Grovemont Circle Gaithersburg, MD 20877 www.nebb.org
NEC	National Electric Code (of NFPA)

NEMA	National Electric Manufacturer's Association 1300 N. 17th Street Rosslyn, VA 22209 www.nema.org
NFPA	National Fire Protection Association One Batterymarch Park P.O. Box 9101 Quincey, MA 02269 www.nfpa.org
NSF	NSF International 789 No. Dixboro Rd. Ann Arbor, MI 48113 www.nsf.gov
OSHA	Occupational Safety Health Administration (U.S. Dept. of Labor) Government Printing Office Washington, D.C. 20402 www.osha.gov
PDI	Plumbing and Drainage Institute 45 Brystal Drive South Easton, MA 02375 www.pdionline.org
SMACNA	Sheet Metal and Air Conditioning Contractor's National Association 4201 Lafayette Center Drive Chantilly, VA 20151 www.smacna.org
UL	Underwriters Laboratories, Inc. 333 Pfingston Rd. Northbrook, IL 60062 www.ul.com

1.5 DEFINITIONS

A. Specification Language Explanation: These Specifications are of abbreviated, simplified or streamlined type and include incomplete sentences. Omissions of words of phrases such as "the Contractor shall", "in conformity therewith", "shall be", "as noted on the drawings", "a", "the", are intentional. Supply when "NOTE" occurs on Drawings. Supply words "shall be" or "shall" by inference when colon is used with sentences or phrases. Supply words "on the Drawings" by inference when "as indicated" is used with sentences or phrases. Singular words will be interpreted as plural and plural words will

be interpreted as singular where applicable and where full context of the Contract Documents so indicates.

B. Furnish: Except as otherwise defined in greater detail, term "furnish" is used to mean supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

C. Install: Except as otherwise defined in greater detail, term "install" is used to describe operations at Project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations, as applicable in each instance.

D. Provide: Except as otherwise defined in greater detail, term "provide" means furnish and install, complete and ready for intended use, as applicable in each instance.

E. Indicated: The term "Indicated" is a cross-reference to graphics, notes or schedules on Drawings, to other paragraphs or schedules in the Specifications, and to similar means of recording requirements in contract documents. Where terms such as "shown", "noted", "scheduled", and "specified" are used in lieu of "indicated", it is for purpose of helping reader locate cross-reference, and no limitation of location is intended except as specifically noted.

F. General Contractor: The term "General Contractor" used in Division 23 and elsewhere in the Contract Documents means the party with whom the Owner has executed the Owner-Contractor Agreement.

G. Approved Equal: Except as otherwise defined in greater detail, term "approved equal" means that any materials, equipment, work procedures and techniques shall be either addressed on the drawing, specifications or addendum by manufacturer or by detailed material description. When brand names are referenced it implies that only the manufacturers listed are approved. All approved material, equipment, work procedures, and techniques will be noted in the specifications, drawings, or by addendum prior to bid date. Items not approved in this manner will not be considered.

1.6 QUALITY ASSURANCE

A. Quality Control:

1. Materials and apparatus required for the work to be new and of first-class quality; to be furnished, delivered, erected, connected and finished in every detail; and to be so selected and arranged so as to fit properly into the building spaces. Where no specific kind or quality of material is given, a first-class standard article shall be furnished.
2. Furnish the services of an experienced superintendent, who will be constantly in charge of the installation of the work, together with all skilled workmen, fitters, metal workers, certified welders, plumbers, millwrights, sprinkler fitters, drain layers, helpers, and labor required to unload, transfer, erect, connect, adjust, start, operate and test for each system.

3. Unless otherwise specifically indicated, equipment and materials to be installed in accordance with the recommendations of the manufacturer. This includes the performance of tests as recommended by the manufacturer.

B. Proof of Performance:

1. Division 23 Contractor shall provide proof of performance certification of all Mechanical Equipment and Systems to demonstrate that all Mechanical Equipment and Systems are operating to the intent of the design. This proof of performance shall include, but shall not be limited to, actual demonstration of all temperature/pressure control loops, operation of all heating/cooling equipment and other required tests upon request by the Engineer or Owner. A signed certificate from the piping, sheet metal, control, and balancing subcontractors stating that they have personally checked the operation of all equipment and control loops and that everything under their subcontract is operating as specified. These certificates shall be furnished to the 230593 Contractor for inclusion in the Operation and Maintenance Manual.

1.7 REGULATORY REQUIREMENTS

A. Execute work per Underwriters, Public Utility, Local and State Codes, Ordinances and applicable regulations. Obtain and pay for required permits, inspections, and certificates. Notify Architect of items not meeting said requirements.

B. Comply with editions of all applicable codes, ordinances and regulations in effect at the time of bid opening including but not necessarily limited to the following:

International Mechanical Code
International Plumbing Code
International Fuel Gas Code
International Energy Conservation Code
State Department of Health Requirements
State Energy Code
National Fire Protection Association Standards
International Fire Code
International Building Code
National Electrical Code NFPA-70
State Boiler Code
Jurisdictional County Health Department
Jurisdictional City Wastewater Management Division or District
Jurisdictional City Water Department
Jurisdictional Water Conservation Standards

C. If discrepancies occur between the Contract Documents and any applicable codes, ordinances, acts, or standards, the most stringent requirements shall apply.

D. Where hourly fire ratings are indicated or required, provide components and assemblies meeting requirements of the IBC, and listed by Underwriters Laboratories, Inc.

1.8 SUBMITTALS

A. Submit Samples, Shop Drawings and Product Data as required by various Sections of Division 23 in accordance with The General Conditions of the Contract. The Contractor agrees that these Submittals processed by the Engineer are not Change Orders; that the purpose of these Submittals by the Contractor is to demonstrate to the Engineer that the Contractor understands the design concept, that he demonstrates his understanding by indicating which equipment and material he intends to furnish and install and by detailing the fabrication and installation methods he intends to use. Contractor further agrees that if deviations, discrepancies, or conflicts between these Submittals and the Contract Documents in the form of design drawings and specifications are discovered either prior to or after these Submittals are processed by the Engineer, the Design Drawings and Specifications shall control and shall be followed.

B. The submittals shall be submitted in a single package with all mechanical equipment for the project enclosed. The submittals shall be enclosed in a stiff back, 3-ring binder. All mechanical equipment shall be separated with tabbed index cards with an indexed legend provided in the front of the binder. In the event submittals are submitted in electronic format, the submittal shall be in the form of a single PDF file in which all equipment has been electronically bookmarked and all bookmarks have been identified using the equipment tags used on the drawings. Individual PDF files for separate pieces of equipment or specification sections will not be accepted.

C. Test Reports: Submit certified test reports as required by various Sections of Division 23 showing compliance in accordance with General Conditions of the Contract. Signed copies shall be included in the Operation and Maintenance Manual.

D. Operating Instructions and Maintenance Data: Prepare and submit printed operating instructions and maintenance data in accordance with Operating and Maintenance Data paragraph in this Section.

E. Submittals will be reviewed and marked as follows:

1. No Exceptions Taken: No action required.
2. Make Corrections Noted: Correct the submittals per notes by engineer and submit new copies of submittal to contractor for project records. Do not resubmit to engineer.
3. Rejected: Equipment as submitted does not meet requirements of contract documents. Revise and/or clarify per comments and resubmit to engineer.
4. Submittal Not Requested: Submittal not required per specification. Submittal returned with no review.

F. Note that the submittal review process does not relieve Contractor of responsibility for ensuring that submitted items satisfy all requirements of the Contract Documents.

G. Site Condition and Coordination:

1. Before any ductwork is fabricated or equipment installed and before running and/or fabricating any lines of piping or ductwork, the Contractor shall provide Architect and Engineer ¼" scale drawings of all mechanical rooms and main access walkways coordinated with all trades with submitted equipment and verify all other areas to assure himself that they can be run and installed as contemplated in cooperation with Contractors of other Divisions of the Work and the physical constraints of the Structural and Architectural Work and maintain access walkways are clear for maintenance.

1.9 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Substitutions and Prior Approvals: Substitutions and prior approvals will be acceptable only when the proposed substitute has been submitted to the Engineer and approved through an addendum or change order. Request for prior approval shall be submitted a minimum of 10 calendar days prior to bid.

B. Some materials and equipment are specified by manufacturer and catalog numbers. The manufacturer and catalog numbers are used to establish a degree of quality and style for such equipment and material.

C. NOTE: When alternate or substitute materials and equipment are used Division 23 Contractor shall be responsible for engineering/redesign costs, space requirements, configurations, performance, changes in bases, supports, structural members and openings in structure, electrical changes and other apparatus and trades that may be affected by their use. Notification of General Contractor and other affected subcontractors shall be the responsibility of the Division 23 Contractor.

1.10 PROJECT RECORD DOCUMENTS

A. General: Comply with Division 1.

B. Job Site Documents: Maintain at the job site, one record copy of the following:

1. Drawings
2. Specifications
3. Addenda
4. Reviewed Product Submittals and Shop Drawings
5. Field Test Records

Do not use record documents for construction purposes. Maintain documents in clean, dry legible condition, apart from documents used for construction.

C. Record Information: Label each document "Record Document". Mark information with red ink. Keep each record current. Do not permanently conceal any work until required information is recorded.

D. Record following information on Drawings:

1. Horizontal and vertical location of underground utilities to be dimensioned from column lines.
2. Dimensioned location of internal utilities and appurtenances concealed in construction.
3. Field changes of dimension and detail.
4. Changes by change order or field order.
5. Details not on original contract drawings.
6. Manufacturer, trade name, catalog number and supplier of each product and item of equipment actually installed shall be indicated on equipment schedules.

E. Record the following information on Specifications:

1. Changes by change order or field order.
2. Other matters not originally specified.

F. Shop Drawings: Maintain shop drawings as record documents recording changes made after review as specified for drawings above.

G. Submittal: At completion of project, deliver record documents to Owner's representative and transmit a copy of signed receipt from Owner to the Engineer.

1.11 OPERATING AND MAINTENANCE DATA

A. The "Operating and Maintenance Manual" (O & M) is a bound compilation of descriptive drawings and data which identify equipment installed at the project site and detail the procedures and parts required to maintain and repair the equipment. Copies of final reviewed submittals shall be included for all equipment items.

B. Five sets of bound manuals will be required for this project. These are to be submitted for approval to the Project Manager. Five electronic versions of the manuals are also required, as described in Paragraph I below.

C. Organization of the manuals shall follow the recommendations in ASHRAE Guideline current edition.

D. Enclose the material in rigid 3-ring or metal post binders and submit to the Project Manager at the completion of the project. Binders shall be Buckram or metal post binders or prior approved equal with block lettering. Simple binders with slide-in cover sheets are not acceptable. Sheet size shall be 8-1/2" x 11" with expandable metal capacity as required for the project. The number of binders forming one O & M Manual shall be based on a maximum limit of 4 inches. The following information shall appear on the front cover and backbone:
1. "Operation and Maintenance Manual"
2. Project Name (and volume number if more than one volume)
3. Project number
4. Building name, number, and street address
5. Architect's name
7. Engineer's name
8. General Contractor's name

9. Mechanical Contractor's name

* Items "6" through "9" need not be printed on the backbone.

E. Pages are to be standard 8-1/2" x 11" sheets, or 11" x 17" folded to fit the 8-1/2" x 11" sizes.

F. The manual shall include the following:

1. Alphabetical list of all system components including the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year's operation.
2. Operating instructions for complete system, including emergency procedures for fire or failure of major equipment and procedures for normal starting/operating/shutdown and long-term shutdown
3. Maintenance instructions, including valves, valve tag and other identified equipment lists, proper lubricants and lubricating instructions for each piece of equipment and necessary cleaning/replacing/adjusting schedules.
4. All test reports and proof of performance certificates.
5. Manufacturer's data and instruction sheets for each piece of equipment, marked to indicate the plan symbol, model, number, and options installed for each item of equipment furnished and installed on the project. These data sheet shall be accompanied by reviewed submittals that had no exceptions taken to them. Provide original printed material in each book, faxes are NOT acceptable. The serial numbers of each item of equipment installed are to be listed with the model numbers and plan symbols.

    a. Installation instructions.
    b. Drawings and specifications (final shop drawings).
    c. Complete parts lists, and a source of supply for each piece of equipment, marked with model, size, and plan symbol.
    d. A copy of the reviewed submittals for each piece of equipment, with any/all corrections identified during the submittal process made to the final submittal documents.
    e. Performance curves and capacity data, marked with model number, size, and plan code.
    f. Complete “as-builts” wiring and temperature control diagrams. (Shop drawings are not acceptable).
    g. Lubrication and other preventative maintenance data.
    h. Equipment warranties.
    i. The final balance report.

6. Design Intent Document furnished by Engineer.
7. Include a Table of Contents and tabbed index dividers.

G. In addition to the maintenance manual, and keyed to it, the equipment shall be identified and tagged as specified on drawings. Insert a copy of the Equipment List or Equipment Schedules in manual.

1. Identify all starters, disconnect switches, and manually operated controls, except integral equipment switches. Label with permanently applied, legible markers corresponding to operating instructions in the "Maintenance Manual".
2. Tag all valves per requirements in Section 230529.
3. Provide a typed tag list or schedule laminated or mounted under plexiglass in the equipment room stating valve ID number, location, service or function of each tagged item, and normal valve position. Insert a copy of tag list in each "Maintenance Manual". Also provide one copy of the list in a plastic closure as manufactured by Seton Name Plant Company, New Haven, Conn; or approved equal. The plastic closure shall include two holes punched at the top, with a brass or nickel grommet in each hole, and an 8” long length of nickel plated bead chain run through the holes, allowing the list to be hung from a wall peg.
4. Provide a reduced scale drawing of each floor indicating the location of each manual and automatic valve in every HVAC and plumbing piping system and include valve position number and normal valve position (normally open/normally closed) as per Specification Section 230529. Mount all drawings under plexiglass or laminate and mount on equipment room wall.

H. Division 230593 Contractor shall be responsible for scheduling instructional meetings for maintenance personnel on the proper operation and maintenance of all mechanical systems, using the maintenance manual as a guide. These meetings must be scheduled through the Architect, Construction Manager/General Contractor and far enough in advance so that all necessary personnel can be adequately notified.

1. Submit training certificate to Owner’s Representatives at end of training and have certificate signed to indicate adequate training has been received.

I. Operating and Maintenance Data documents must be provided in digital format as follows:

1. Provide O&Ms in an intuitive format on a CD-ROM or DVD. Electronic manual preparation shall be under the direction of an individual or organization that has demonstrated expertise in the preparation of a comprehensive and complete electronic operation and maintenance manual. Qualifications shall be submitted for approval. One source of procurement used on past projects is Emanuals by Scanitall in Sandy, UT (tel. 801-619-2082). This is the responsibility of the Division 21/22/23 contractor.
2. A single CD or DVD to be authored with the latest edition of Adobe Acrobat, and be in a “non-protected” network accessible format.
3. All information on the CD-ROM or DVD shall be printable on 8.5”x11” or 11”x17”plain paper.
4. Capture images using OCR technology such that the user can key word search for information.
5. Provide a hypertext alphabetical index of all equipment and building products. All hypertext shall be blue in color.
6. Provide 3 copies of the O&M CD-ROM or DVD.

1.12 DELIVERY, STORAGE AND HANDLING

A. General: Deliver and store materials and equipment in manufacturer's unopened containers fully identified with manufacturer's name, trade name, type, class, grade, size and color.

B. Protection: Store materials and equipment off the ground and under cover, protected from damage. Maintain caution labels on hazardous materials.

C. Large Items: Make arrangements with other contractors on the job for introduction into the building of equipment too large to pass through finished openings.

D. Handling of Materials: Materials shall be handled, sorted and distributed using appropriate handling methods to protect all materials from damage. Dented, rusted, corroded or otherwise damaged materials shall be removed from the project site. Lined ductwork on which the liner becomes wet shall be removed from the project site. Determination of materials deemed unusable or inappropriate for installation shall be made by the Architect/Engineer.

1.13 PROJECT CONDITIONS

A. Accessibility:

1. Division 23 Contractor shall be responsible for the sufficiency of the size of shafts and chases and the adequate clearance in double partitions and hung ceilings for proper installation of his work. He shall cooperate with Contractors of other Divisions of the Work whose work is in the same space and shall advise the Construction Manager/General Contractor of his requirements. Such spaces and clearances shall, however, be kept to the minimum size required.
2. Division 23 Contractor shall locate all equipment which must be serviced, operated, or maintained in fully accessible positions. Equipment shall include (but not be limited to) valves, shock arrestors, traps, cleanouts, motors, controllers, switchgear, filters, VAV boxes, control valves, balancing valves, and drain points. If required for better accessibility, furnish access doors for this purpose. Minor deviations from Drawings may be allowed to provide for better accessibility. Any changes shall be approved by the Architect/Construction Manager/General Contractor prior to making the change.
3. Division 23 Contractor shall provide the Construction Manager/General Contractor with the exact locations of access doors for each concealed valve, damper, or other device requiring service. Locations of these doors shall be submitted in sufficient time to be installed in the normal course of work.

B. Fabrication:

1. Before any ductwork is fabricated and before running and/or fabricating any lines of piping or ductwork, the Contractor shall assure himself that they can be run as contemplated in cooperation with Contractors of other Divisions of the Work and the physical constraints of the Structural and Architectural Work.

C. Freeze Protection:

1. Do not run lines in outside walls, or locations where freezing may occur. Piping next to outside walls shall be in furred spaces with insulation between the piping and the outside wall. Insulation of piping shall not be considered freeze protection. Buried pipe shall be installed minimum 6" below frost depth, unless noted otherwise in the documents.

D. Scaffolding, Rigging and Hoisting:

1. Provide all scaffolding, rigging, hoisting and services necessary for erection and delivery into the premises of any equipment and apparatus furnished; remove same from premises when no longer required.

E. If Contractor during the course of work observes or suspects the existence of asbestos in the structure or building, Contractor shall promptly notify Owner and Architect/Engineer. Owner shall consult with Architect/Engineer regarding removal or encapsulation of the asbestos material and Contractor shall not perform any work pertinent to the asbestos material prior to receipt of special instructions from Owner through the Architect/Engineer.

1.14 COORDINATION

A. General: Coordinate and order the progress of mechanical work to conform to the progress of the work of the other trades. Complete the entire installation as soon as the condition of the building will permit.

B. Coordination with Electrical Work: Section 230529.

C. Utility Interruptions: Coordinate mechanical utility interruptions with the Owner and the Utility Company. Plan work so that duration of the interruption is kept to a minimum.

D. Cutting and Patching: Section 230529.

E. Drawings and Specifications: The Mechanical Drawings indicate the general design and arrangement of lines, equipment, systems, etc. Information shown is diagrammatic in character and does not necessarily indicate every required offset, fitting, etc. Do not scale the Drawings for dimensions. Take dimensions, measurements, locations, levels, etc., from the Architectural Drawings and equipment to be furnished.

F. Each Division 22/23 subcontractor shall coordinate with all other contractors to make certain that any of his equipment, piping or ductwork which is mounted on isolators or flexibly connected does not become "grounded" by another contractors work (e.g. walls, ceiling, etc.).

G. Coordinate with all subcontractors to maintain adequate access to all equipment for maintenance and for future replacement of equipment.

H. Discrepancies: Examine Drawings and Specifications for other parts of the work, and if any discrepancies occur between the plans for the work of this Division and the plans for

the work of others, report such discrepancies to the Construction Manager/General Contractor and obtain written instructions for any changes necessary.

I. Order of Precedence: The precedence of mechanical construction documents are as follows:

1. Addenda and modifications to the Drawings and Specifications take precedence over the original Drawings and Specifications.
2. Should there be a conflict within the Specifications or within Drawings of the same scale, or between the Specifications and the Drawings, the more stringent or higher quality requirements shall apply.
3. In the Drawings, the precedence shall be Drawings of larger scale over those of smaller scale, figured dimensions over scaled dimensions and noted materials over graphic indications.
4. Should there be a conflict in dimensions or locations between Mechanical Drawings and Architectural Drawings, the Architectural Drawings shall have precedence.

1.15 START-UP PROCEDURES

A. Before start-up, each piece of equipment comprising a part of the system shall be checked for proper lubrication, drive rotation, belt tension, proper control sequence, and any other condition which may cause damage to equipment or endanger personnel.

B. Insure that all control systems are fully operational in automatic mode. Individually test each control loop to make certain it is operating as intended and is communicating properly with other devices.

C. If systems are not to continue in use following the start-up procedures, steps should be taken to insure against accidental operation or operation by unauthorized personnel. Provide padlocks on disconnect switches where applicable.

D. Factory personnel shall be notified as appropriate to start systems requiring their services.

E. Notify engineer at least 2 weeks prior to the scheduled start-up date of all major mechanical equipment and systems.

1.16 SCHEDULE OF TESTING

A. Provide testing in accordance with the General Conditions of the Contract.

B. A schedule of testing shall be drawn up by the Division 23 Contractor in such a manner that it will show areas tested, test pressure, length of test, date, time and signature of testing personnel.

C. All testing must be performed in the presence of the Architect's/Construction Manager's/General Contractor's representative; his signature for verification of the test must appear on the schedule.

D. All testing must be performed in accord with the procedures set forth in Division 23 and other Sections of the Specifications where referenced. At completion of testing, the completed schedule shall then be submitted in triplicate to the Architect and a copy shall be forwarded to the 230593 Contractor for inclusion in Operation and Maintenance Manual.

E. Make all specified tests on piping, ductwork and related systems as specified in this specification.

F. Make sure operational and performance tests are made on seasonal equipment.

G. Complete all tests required by Code Authorities, such as smoke detection, life safety, fire protection and health codes.

H. After test runs have been completed and systems have been demonstrated to be satisfactory and ready for permanent operation, all permanent pipeline strainers and filters shall be cleaned, air filters cleaned or replaced, settings on pressure relief valves properly adjusted, valve and pump packings properly adjusted, belt tensions adjusted, drive guards secured in place, lubrication checked and replenished if required.

1.17 CLEANING AND FINISHING

A. Provide cleaning in accordance with the General Conditions of the Contract and Division.

B. Cleaning shall include but not be limited to removing grease, dirt, dust, stains, labels, fingerprints and other foreign materials from sight-exposed piping, ductwork, equipment, fixtures and other such items installed under Division 23 of the work. If finishes have been damaged, refinish to original condition and leave everything in proper working order and of intended appearance.

C. Section 232113 Contractor shall be responsible to certify that all HVAC Piping Systems have been cleaned in accordance with Section 232500 - HVAC Water Treatment whether actually done by the Section 232113 Contractor or by the 232500 Contractor.

1.18 WARRANTIES

A. Warranty: Provide a written warranty to the Owner covering the entire mechanical work to be free from defective materials, equipment and workmanship for a period of one year after Date of Acceptance. During this period provide labor and materials as required to repair or replace defects. Provide certificates for such items of equipment which have warranties in excess of one year. Submit to the Construction Manager/General Contractor for delivery to the Architect. Include a copy of all warranties in the Operation and Maintenance Manual.

B. This warranty will be superseded by the terms of any specific equipment warranties or warranty modifications resulting from use of equipment for construction heat or ventilation.

C. All refrigeration compressors shall have a (5) four year extended warranty from the manufacturer of the equipment in addition to the standard one-year warranty.

1.19 PROJECT CLOSEOUT

A. Project Observation Reports:

At or near the completion of the construction phase of this project, the Engineer will generate one or more Project Observation Reports for the owner. These reports will list the items of construction observed by the Engineer which are not in compliance with the Contract Documents.

The Mechanical Contractor and/or subcontractors shall certify completion of each listed item in writing and forward copies to the Architect, Engineer and General Contractor. The Engineer will not recommend the payment of retainage until this compliance certification has been received.

Each item on the Project Observation Report shall have a signature/date in the margin of the report indicating completion of that item.

1.20 CERTIFICATES AND KEYS

A. Certificates: Upon completion of the work, deliver to the Construction Manager/General Contractor one copy of Certificate of Final Inspection.

B. Keys: Upon completion of work, submit keys for mechanical equipment, panels, etc. to the Construction Manager/General Contractor.

END OF SECTION 230500

SECTION 230529 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED WORK

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Work furnished but not installed by this Contractor:

1. Access doors in accordance with paragraph 2.3 in this Section 230529.

1.2 SYSTEM DESCRIPTION

A. The work includes, but is not limited to the following:

Materials and methods common to the work in general of Division 23 and other Divisions and Sections of the Specifications where referenced.

1.3 QUALITY ASSURANCE

A. Welder Qualifications: Welding shall be performed by an ASME Certified welder with current certificate in accordance with ANSI B31.1 for shop and project site welding of piping work. Welder Qualifications:

1. Each welder shall have passed a qualification test within the past 6 months.
2. The test shall be in accordance with the ASME Boiler and Pressure Vessel Code, Section IX, "Welding Qualifications", ASME Section VIII, and ANSI 313.
3. The test report shall certify that the welder is qualified to weld the material to be used at the job site.
4. The Contractor shall submit three copies of each welder's qualification test report to the Project Manager for approval prior to commencing the work. No welder shall be used on the project until so certified.

1.4 REFERENCES

A. Reference Standards: Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:

1. For electrical equipment and products, comply with applicable National Electrical Manufacturers Association (NEMA) Standards, and refer to NEMA Standards for definitions of terminology herein.

2. Comply with National Electrical Code (NEC) NFPA-70 for electrical installation requirements.
3. Certified Pipe Welding Bureau (NCPWB) and American National Standards Institute (ANSI) Code Numbers B31.2, & B31.9 as applicable for welding requirements.
4. Comply with American National Standards Institute (ANSI A13) for identification of piping systems.
5. Comply with American National Standards Institute (ANSIB31.1) Code for Pressure Piping.
6. Owner and architect Design Criteria.

1.5 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings and Product Data for the following items in accordance with the General Conditions of the Contract:

1. Legend and color of piping and equipment identification.
2. Freeze Protection Systems for Piping and Equipment (Heat Tracing).
3. Domestic Hot Water Heat Maintenance System.
4. Proposed access door sizes and locations**.**

B. Operating Instructions and Maintenance Data: Submit printed Operating Instructions and Maintenance Data for the following items in accordance with Operating and Maintenance Data Paragraph in Section 230500.

1. Motors.
2. Starters.

C. Certificates: Before proceeding with the Work, submit to the Architect/Construction Manager/General Contractor, two copies of Certification that the welding work will be done according to ANSI B31.1 by welders who have been tested and whose qualification test sheets are available, attesting to their ability to weld in accordance with the Standard Procedure Specifications as established by the National Certified Pipe Welding Bureau.

PART 2 - PRODUCTS

2.1 MOTORS

A. General: Furnish motors necessary to operate mechanical equipment.

B. Motor Characteristics: Comply with the following requirements:

1. Variable Speed Drive Compatibility: All motors which are powered through a variable frequency drive shall conform to NEMA MG-1, Part 31 for inverter duty and shall be capable of continuous operation at 20% of nominal speed and

shall meet the requirements of the Variable Frequency Drive specification in Section 230810 or Division 26 as applicable.

2. Altitude Deration: Motors to be furnished to maintain specified rated service factor at altitude of project.
3. NEMA Temperature Rating: Rated for 40 deg.C environment for continuous duty at full load, Class B motor temperature rise. Motors for use with variable frequency drives shall be Class F insulated.
4. Starting Capability: Provide each motor capable of making starts as frequently as indicated by the automatic control system.
5. Phases and Current Characteristics: Provide squirrel-cage induction polyphase motors for 3/4 horsepower and larger, and provide capacitor-start single-phase motors for 1/2 horsepower and smaller. One-sixth horsepower and smaller may, at equipment manufacturer's option, be split-phase type. Coordinate current characteristics with power specified in Division 26 and with individual equipment requirements specified in other Sections of Division 23. Provide two separate windings on polyphase two speed motors. Do not purchase motors until power characteristics available at locations of motors have been confirmed, and until rotation directions have been confirmed.
6. Power Factor: All motors rated greater than 1000 watts shall have a Power Factor of not less than 95% under rated load conditions. The 95% PF may be obtained by design of the motor or by providing a capacitor. Capacitors, if provided to obtain the 95% PF, must be switched with the motor. If the motor draws less than 1000 watts at full load, it is excluded from the 95% power factor requirement.
7. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors. Motors shall be selected such that the brake horsepower requirement is not within the service factor at design load.
8. Efficiency: All motors shall be premium efficiency type in accordance with the current State Energy Code, except where a higher efficiency is noted on drawings.
9. Motor Construction: Provide Design "B" motors for general purpose continuous duty and Design "C" motors where required for high starting torque such as the low speed motor on fans with a two-motor drive arrangement. Small motors that are part of packaged equipment may be manufacturer's standard motors meeting Energy Code requirements for efficiency.

    a. Bearings: Ball or roller bearings with inner and outer shaft seals: regreasable; except permanently sealed where motor is normally inaccessible for regular maintenance. Where belt drives and other drives produce lateral or axial thrust in the motor, provide bearings designed to resist the thrust loading. Refer to individual sections of Division 23 for fractional horsepower light-duty motorized equipment where sleeve-type bearings are permitted.
    b. Enclosure Type: Except as otherwise indicated, provide open drip-proof motors for indoor use where satisfactorily housed during operation, and provide guarded drip-proof motors where exposed to contact by employees or building occupants. Provide weather-protected Type I for outdoor use, Type II where not housed. Refer to individual Sections of Division 23 for other enclosure requirements.

c. Overload Protection: Provide built-in thermal overload protection for each leg of each phase and, where indicated, provide internal sensing device suitable for signaling and stopping the motor at the starter. Thermal overload protectors shall be sized to accommodate the altitude of installation.
d. Name Plate: Provide metal nameplate on each motor, indicating full identification of manufacturer, ratings, characteristics, construction, NEMA efficiency, power factor, special features and similar information.
e. Motor Connections: Provide conduit connection boxes.
f. Motors shall not exceed 80dbA rating when running their full speed and power range.

2.2 STARTERS

A. Note that some starters are furnished and installed under Division 26. Review electrical plans before bidding.

B. General: Furnish starters and contactors necessary to operate mechanical equipment motors. **Starter manufacturer shall be the same brand for ALL motors furnished under Division 23.** Approved manufacturers shall be those listed in Division 26 or this specification.

C. Motor Starter Characteristics: Comply with NEMA standards and NEC. Furnish Type I general purpose enclosures with padlock ears, and with frames and supports for mounting on wall, floor or panel as required. Furnish the type and size of starter recommended by the motor manufacturer and equipment manufacturer for the applicable protection and start-up condition; refer to individual equipment sections for basic load requirements. All starters shall be by the same manufacturer. Only manufacturers approved by Division 26 will be accepted. All starters shall comply with Division 26 requirements.

D. Manual Control:

1. Furnish maintained-contact push buttons and pilot lights, properly arranged for single-speed or multi-speed operation as indicated.
2. Furnish manual switch and pilot light for motors 1/3 horsepower and smaller, except where interlock or automatic operation is indicated.

E. Automatic Control:

1. Furnish magnetic starters for motors 1/2 horsepower and larger and for smaller motors where interlock or automatic operation is indicated. Include the following:

a. Maximum number of auxiliary contacts available: three or more.
b. "Hand-Off-Automatic" switches in starter cover.

c. Interlocks, pneumatic switches and similar devices as required for coordination with the control requirement specified in Section 230900-Electronic Controls.
d. Built-in 120 volt control circuit transformer, fused from line side, where service exceeds 240 volts.

1) Control circuit conductors to be protected in accord with the National Electrical Code.

e. Trip-free thermal overload relays, each phase.
f. Externally operated manual reset except on refrigeration compressors which shall have automatic reset. Automatic reset shall be limited to three attempts. If motor fails to start after three attempts, manual reset shall be required.
g. Undervoltage release or protection.
h. Phase failure/phase reversal protection on all legs.

F. Weather Protection: Provide weather-proof mounting of magnetic starters for equipment outside of the building.

2.3 ACCESS DOORS

A. Furnish steel access doors, minimum size required for normal service use or as sized on drawings as manufactured by Inryco/Milcor, Walsh, where shown on mechanical or architectural drawings, and where required for access to valves, shock absorbers, dampers, mechanical equipment or appurtenances.

B. Standard Doors:

1. Frames: 16 ga. steel.
2. Panels: 14 ga. steel.
3. Finish: Chemically bonded prime coat of baked enamel.
4. Hinge: Concealed spring hinges openable to 175 degree; removable pins. Provide number of hinges as recommended by manufacturer for size of door.
5. Locking Devices: Flush steel, screwdriver operated, cam type locks. All access doors below 8'-0" in public areas shall be key-operated cylinder lock with two keys. Same key shall open all access doors.
6. Style of doors shall be appropriate for architectural finish at door location, coordinate with arhcitect. Furnish masonry anchors where required.

B. Fire Rated Doors:

1. Frames: 16 ga. steel.
2. Panels: Sandwich type, 20 ga. steel sheets, manufacturer's standard insulated core.
3. Finish: Chemically bonded prime coat of baked enamel.
4. Hinge: Continuous type, steel with stainless steel pin.
5. Closer: Automatic closing mechanism.

6. Locking Devices: Self-latching, key-operated cylinder lock with two keys; interior, latch release mechanism.
7. Style of doors shall be appropriate for architectural finish at door location.
8. Fire rated doors shall have components and assemblies meeting requirements of the American Insurance Association, Factory Mutual Insurance Association and listed by Underwriters Laboratories, Inc.

C. Exact location of access doors shall be as directed by Mechanical Contractor and approved by the Architect. Coordinate with General Contractor and Architect.

2.4 VALVES

A. General:

1. Provide valves as specified herein and as indicated on the Drawings complete with accessories and attachments as required and appropriate for the pressure/temperature of system.
2. Supply valves for proper pressure ratings determined by the system working pressures at point of use and of proper types for systems and functions indicated.
3. Provide like type valves of one manufacturer only unless specified otherwise.
4. Plainly and permanently mark valves with manufacturer's name or trademark, pressure rating, both Cold Working Pressure (CWP) as applicable and flow direction when required to prevent improper installation.
5. Mark valves requiring approval by Underwriter's Laboratories (UL) or Factory Mutual Engineering Division (FM) with appropriate markings cast into the valve body.
6. Provide extended necks as appropriate for insulation.

B. Manufacturers:

1. The following manufacturers are acceptable providing the product to be considered is equivalent in every respect to the nomenclature provided by the specified make and model.

    a. Bronze Valves: Powell, Milwaukee, Crane, Hammond, Nibco.
    b. Iron Body Valves: Powell, Milwaukee, Traverse City, Kennedy, Iowa, American, Nibco.
    c. U.L., F.M. Approved or Listed Valves: Nibco, Demco, Pratt, Kennedy, Mission, Milwaukee, Hammond.
    d. Ball Valves: Hammond, Watts, Jamesbury, Worcester, Milwaukee, Apollo, Powell, Dynaquip, Nibco, Spirax Sarco, FNW.
    e. Butterfly Valves: Milwaukee, Hammond, Centerline, DeZurik, Fisher, Victaulic, Keystone, Posi-Seal, TEC, Flowseal, Nibco, IFC, FNW, Bray, EBRO.
    f. Lubricated Plug Valves: Homestead, Nordstrom, Powell.
    g. Non-Lubricated Eccentric Plug Valves: DeZurik.
    h. Stop and Drain and Drain Valves: Milwaukee, Hammond, Prier, Nibco or United Brass.

i. Gas Cock: Peter Healy or Crane.
j. Check Valves: Nibco, IFC, DFT.

C. Valve Schedule:

1. Standard Bronze Valves - 150 SWP/300 CWP, per ASTM B61/B62. No brass materials will be accepted.

a. Check, Gate, and globe with union bonnet and rising stem.
b. Sizes 1/8 through 2 inches.
c. Schedule:

Plan Code:	G.V.	GL.V.	C.V.	L.C.V.
Valve Type:	Gate	Globe	Swing	Lift
Make:	Nibco	Nibco	Nibco	Crane
Straight Threaded:	T-134	T-235Y	T-433Y	365.5
Straight Soldered:	S-134	S-235Y	S-433Y	--
Angle Threaded:	--	T-335Y	--	--
Angle Soldered:	--	--	--	--

2. Standard Bronze Valves - 300 SWP/600 CWP, per ASTM B61/B62, no brass materials will be accepted.

a. Gate, globe and check.
b. Sizes 1/8 through 2 inches.
c. Schedule:

Plan Code	G.V.	GL.V.	C.V.	L.C.V.
Valve Type:	Gate	Globe	Swing	Lift
Make:	Nibco	Nibco	Nibco	Crane
Straight Threaded:	T-134	T-235Y	T-433Y	365.5
Straight Soldered:	S-134	S-235Y	S-433Y	--
Angle Threaded:	--	T-335Y	--	--
Angle Soldered:	--	--	--	--

3. Standard Iron Body Valves - 125 SWP/200 CWP.

a. Gate, globe and check.
b. Sizes 2-1/2 through 12 inches.
c. Schedule:

Plan Code:	G.V.	OS&Y	GL.V.	C.V.	W.C.V.	N.S.C.V.
Valve Type:	Gate	Gate	Globe	Swing	Weighted	Non Slam

Make:	Nibco	Nibco	Nibco	Nibco	Nibco	Crane
Straight Threaded:	T-619	T-617-0	T-718B	T-918Y	T-918YBLW	--
Straight Flanged:	F-619	F-617-0	F-718B	F-918Y	F-918YBLW	23
Angle Threaded:	----	----	T-818B		----	----
Angle Threaded:	----	----	F-818B	----	----	----

4. Standard Iron Body Valves - 150 SWP/300 CWP.

   a. Gate, globe and check.
   b. Sizes 2 through 12 inches.
   c. Schedule:

Plan Code:	G.V.	OS&Y	GL.V.	C.V.	N.S.C.V.
Valve Type:	Gate	Gate	Globe	Swing	Non Slam
Make:	Nibco	Nibco	Nibco	Nibco	Crane (Chapman)
Straight Threaded:	T-669	T-667-0	--	--	--
Straight Flanged:	F-669	F-667-0	F-768B	F-968B	223
Angle Threaded:	--	--	--	--	--
Angle Flanged:	--	--	F-868B	--	

5. Standard Iron Body Valves - 250 SWP/500 CWP.

   a. Gate, globe and check.
   b. Sizes 2 through 12 inches.
   c. Schedule:

Plan Code:	G.V.	OS&Y	GL.V.	C.V.	N.S.C.V.
Valve Type:	Gate	Gate	Globe	Swing	Non Slam
Make:	Nibco	Nibco	Nibco	Nibco	Crane
Straight Threaded:	T-669	T-667-0	--	--	--
Straight Flanged:	F-669	F-667-0	F-768B	F-968B	223
Angle Threaded:	--	--	--	--	--
Angle Flanged:	--	--	F-868B	--	--

6. UL and FM Approved Valves.

   a. Gate, check and butterfly.
   b. Sizes all.
   c. Schedule:

Plan Code:	OS&Y	C.V.	W.V.C.	BF.V	D.V.
Valve Type:	Gate	Swing	Wafer	BTFY	Drain
Make:	Nibco	Nibco	Nibco	Demco	Nibco
Straight Threaded:	T-104-0	T-413W	--	--	T-211Y
Straight Flanged:	F-607-0	F-908-W	--	--	--

Wafer:	--	--	W-900-W	NE-H	--

7. UL and FM Approved Valves - 175 Pound Water.

   a. Post indicator with indicator post.
   b. Sizes 4 through 12 inches.
   c. Schedule:

Plan Code:	P.I.V.	P.I.V.B.F.
Valve Type:	Gate	BTFY
Make:	Nibco	Demco
Straight Flanged:	F-609	NE-H (Wafer)
Mechanical Joint:	M-609	--
Indicator Post Vertical:	NIP-1	Stem extension and gear operator with post indicator U.L. Listed only.
Indicator Post through Wall:	NIP-2	--

8. Underground Valves - 175 Pound Water, American Water Works Association (AWWA).

   a. Gate valves with service boxes.
   b. Sizes (see schedule).
   c. Schedule:

Plan Code:	GV & SB	GV & SB
Size/Inches:	3/4 thru 2	2 thru 16
Valve Type:	Oriseal	Gate
Make:	Mueller	Mueller
Model:	H-15201	A-2380-22 or 2380-18
Service Box:	H-10396-86	H-10357
Base:	H-10396-7-8-9 or H-10400	No. 6 Oval
Key:	Stationary rod attached.	A-24610 Furnish one each box.

9. Ball Valve:

   a. Blowout proof stem.
   b. Full port type with appropriate seals and seat, as specified.
   c. Bronze bodies per ASTM B61/B62 or ASTM B-584. No brass material will be accepted.
   d. Stainless steel bodies per ASTM A-351, Grade CF3M.
   e. Schedule:

Plan Code:	B.V.	B.V.	H.V.	S.B.V.

Service:	Balancing	In line control and isolation	Refrigeration	Steam and Steam Condensate
Pressure:	150 SWP/300 CWP	150 SWP/300 CWP	500 CWP	150 SWP
Sizes/Inches:	1/4 thru 2-1/2	1/4 thru 3"	3/8" thru 2 1/8"	½” thru 2”
Make:	Nibco	Nibco	Nibco	Nibco
Straight Threaded:	T-580-70-66	T-585-70-66	--	T-595-Y-S6R-66
Straight Solder End:	S580-70	S585-70	S595-Y-66	--
Actuator:	Lever with memory stop	Lever	Lever	Lever
Port:	Standard	Full	Full	full

* Steam ball valve includes a three-piece body, seals rated for steam operating temperatures up to 400°F.

10. Butterfly Valves:

    a. Schedule; standard 150 psi with 150 psi ANSI companion flanges for use where system pressures cannot exceed 200 psig shut off (static) pressure.

Plan Code:	BFV	
Style:	Lugged	
Pressure Rating ANSI Class:	150 minimum	
Body:	ASTM A126 Cast Iron or ASTM A395 Ductile Iron	
Disc:	Aluminum Bronze	
Stem:	316 Stainless	17-4 PH Stainless or 18-8 Stainless
Seat:	EPDM (-40 deg.F to 250 deg.F)	
Actuator:	2" thru 5" Infinite position lever with memory stop. 6" thru 24" Self-locking worm gear with adjustable limit stops, and position indicator. Provide chain wheel and chain where indicated by contract documents.	
Make:	Keystone	
Size:	2"-12"”	14”-36
Model:	222	AR2

b. Schedule: High performance 300 psi with 300 psi ANSI companion flanges for use where system pressures are more than 200 psig but cannot exceed 700 psig shut-off (static) pressure.

Plan Code:	BFV	
Style:	Lug	
Pressure Rating ANSI Class:	300 minimum	
Body:	Carbon steel ASTM A-216	
Disc:	316 stainless steel ASTM A-216	
Stem:	Stainless steel ASTM A564 Type 630 (17-4PH)	
Seat:	Virgin TFE	
Actuator:	3" and 4": Rachet handle with lock. 6 and over: Worm gear with lock.	
Make:	Flowseal (Mark Controls Corp.)	
Size:	3" and 4"	6" and over
Model:	XX-3L-121TTH-L	XX-3L-121TTH-2

11. Stop Check Valve:

a. Schedule:

Plan Code:	S.C.V.
Pressure:	250 SWP/500 CWP
Size/Inches:	2-1/2 thru 10"
Make:	Crane
Straight Flanged:	28E
Angle Flanged:	30E

12. Eccentric Plug Valve:

a. Schedule:

Plan Code:	E.P.V.	E.P.V.
Pressure:	175 lb. CWP	175 lb. CWP
Size/Inches:	1/2 thru 3	4 thru 8
Make:	DeZurik	DeZurik
Model:	400	100
Actuator:	483-487	159 w/Memory Stop
Ends:	Threaded	Flanged

13. Gas Valves:

a. Gas cock and lubricated plug.
b. Schedule:

Plan Code:	G.C.K.	L.P.V.	L.P.V.	G.B.V.
Pressure:	100 PSI Air	200 lb. CWP	200 lb. CWP	250 PSI LP-Gas
Size/Inches:	1/2 thru 1	1/2 thru 3	4 thru 12	1/4" thru 3"
Make:	Peter Healy	Walworth	Walworth	Apollo
Model:	1500-F	1700	1707-F	80-100
Actuator:	None	E-2	Wrench as required	1/4 turn
Ends:	Threaded	Threaded	Flanged	Threaded

14. Specialty Valves:

a. Petcock, stop and drain, drain, needle.
b. Schedule:

Plan Code:	PTK	S&D.V.	D.V.	N.V.
Type:	Petcock	Gate	Ball	Needle
Pressure:	250 LB.	125 LB.	125 LB.	200 LB.
Size/Inches:	1/8	1/2 and ¾	3/4	1/8 thru 3/4
Make:	Powell	Nibco	Apollo	Jenkins
Model:	922	76 or 726	78-104	743G
Ends:	Threaded	Threaded or Soldered	Threaded and Hose End Adaptor	Threaded

2.5 PIPE HANGERS, SUPPORTS, AND ACCESSORIES PROTECTION

A. General:

1. Provide hangers, rods, clamps, brackets, attachments, inserts, bracing, nuts, coach screws, eye bolts, clips, plates, and washers as required for appropriate installation for building structure provided.
2. All hangers and accessories shall be manufactured by one manufacturer for compatibility of all components.
3. All hangers, attachments, and accessories shall be provided with a certified manufacturers safety factor of five (5).
4. All hangers, attachments and accessories shall comply with the following:

a. Safety factor of 5 (actual load vs. ultimate load).

b. National Fire Protection Association (NFPA) (except as amended by provisions of this Specification for minimums) and as applicable.
c. Factory Mutual Engineering Division (FM) as applicable.
d. Manufacturers Standardization Society (MSS).

5. Support and positioning of piping shall be by means of engineered methods that comply with IAPMO PS 42-96.

B. Material:

1. Hangers in contact with steel, iron, cast or ductile iron shall be hot dipped galvanized or cold galvanized with "Galvilite by ZRC" cold galvanized compound only to a thickness of not less than 3.0 mil (.003 inches). "Galvilite by ZRC Worldwide, Marshfield, MA. Tel: (800) 831-3275, www.zrcworldwide.com" or equal.
2. Hangers in contact with copper piping shall be copper clad or provided with heavy density felt (20 oz.) pad permanently attached to the hanger and placed so as to prevent direct contact between pipe and hanger. Felt shall be mildew and moisture rot-proof. Heavy polyvinyl chloride coating on hanger, 5 mil thickness minimum will be acceptable in lieu of felt.
3. Hangers in contact with "plastic" or "glass" piping shall be galvanized in accordance with Sub-paragraph B-1, above and padded in accordance with Sub-paragraph B-2, above.
4. Hangers for insulated piping shall be sized to accommodate the insulation. Provide with insulation shields or insulation saddles* as applicable and appropriate and in accordance with the following schedule:

Nominal Pipe or Tubing Size	Shield Length	Shield Gauge Thickness	Material
½" thru 3"	12"	18	Galvanized
4"	12"	16	Galvanized
5"	15"	16	Galvanized
6"	18"	16	Galvanized
8"	24"	--	B-line (B3160-3165)
over 8"	36"	--	B-line (B3160-3165)

* Insulation inserts between piping and shield shall be furnished by 230700 Contractor for appropriate pipe size and insulation thickness for all insulated piping requiring a vapor barrier.

5. Provide swivel ring hangers similar and equivalent to B-Line B-3170, 3170CT, and 3170C for pipe sizes 1/2" thru 8".
6. Clevis type hangers may, at the Contractors option, be provided when similar and equivalent to B-Line B-3100, and 3100C.

7. Beam and bar joist clamps shall be appropriate for attachment locations, top beam, bottom beam, etc., and provided with retainer rods, clips or straps as required.
8. Hanger spacing and minimum rod sizes shall be based on the applicable Mechanical and Plumbing Codes for the type of piping installed.
9. Riser clamps shall be provided on all vertical risers at each floor and shall conform to materials and protective coatings or pads as specified in Paragraph B of this Article 2.05. Clamps shall be similar and equivalent to B-Line B-3131 and B-3148.
10. Provide concrete inserts where required in flat slab construction similar and equivalent to B-Line B-22-1 Series 2000 lbs. per foot load capacity and spaced per hanger spacing schedule (sub-paragraph B-9 above) provide all accessories and nuts required.
11. Trapeze hangers shall be constructed of channel similar and equivalent to B-Line Series B-11 thru B-72 as appropriate complete with pipe clamps, nuts, rollers etc., as required. Channel to bear 5 times actual weight of all piping on trapeze system with minimum deflection. (.01 inch maximum). At a minimum, install pipe clamps on every other trapeze hanger, and where required to comply with seismic restraint design.
12. Wall brackets shall be fabricated "knee" brackets conforming to requirements of sub-paragraph B-12 above and made up with B-Line Series B-11 thru B-72 channel. Angle clips may be used in wood joist construction when similar and equivalent to B-Line B-3060 or 3061.
13. Hangers attached to wood construction shall be attached by use of eye bolts, coach screws or lag bolts when load bearing ratings maintain a safety factory of 5.
14. All other means of support i.e., special construction, pipe stands, earthquake bracing, sway bracing, etc., shall be provided as required and in conformance with jurisdictional authority and these Contract Documents, submit all special or required support and bracing systems for review by the Architect/Engineer prior to installing any item.
15. All vertical refrigeration suction and hot gas, and all steam piping shall be provided with insulation shields and calcium silicate inserts at each support location.
16. All piping systems exposed to motorized traffic shall be fully protected by installation of concrete-filled pipe bollards. Bollards shall be cleaned and painted as directed by the Architect.
17. For plenum applications use pipe supports that meet ASMT E-84 25/50 standards.

C. Acceptable Manufacturers:

1. Manufacturers acceptable to this Specification are as follows, all other manufacturers must submit for acceptance.

    a. B-Line
    b. Fee & Mason
    c. Grinnell
    d. Hubbard Enterprises/HOLDRITE

e. P.H.D.
f. Michigan
g. Tolco
h. MAPA
i. Hilti

2.6 IDENTIFICATION MATERIALS FOR PIPING AND EQUIPMENT

A. Materials for identification shall be as follows:

1. Metal Tags: Round brass discs, minimum 1-1/2" diameter with edges ground smooth. Each tag shall be punched and provided with brass chains for installation.
2. Engraved Nameplates: Fabricate from plastic sheet stock of sufficient thickness to allow engraved lettering in contrasting color. Attach nameplates to equipment with screws.

3. Painted Stencils: Of size and color per ANSI A13.1 using clean cut letters and oil base paint. Paint material shall comply with Architectural Painting Specifications. See Part 3 for legend and size for Stencils.

Insulation or Pipe Diameter	Length of Color Field	Size of Letters
3/4" to 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"
2-1/2" to 6"	12"	1-1/4"
8" to 10"	24"	2-1/2"
over 10"	32"	3-1/2"
Ductwork and Equipment	NA	2-1/2"

2.7 FREEZE PROTECTION SYSTEMS FOR PIPING AND EQUIPMENT (HEAT TRACING)

A. General:

1. Provide freeze protection for all water, sewer, sumps, tanks, pumps, equipment drains, etc., where piping and equipment are subject to ambient temperatures of less than 35 deg.F, and as indicated on Contract Drawings.
2. Approved Manufacturers: Raychem, Thermon, Heat Trace Solutions.
3. Freeze protection shall consist of electrical self regulating semi-conductive "core" heat cable complete with all accessories including but not limited to an adjustable thermostat sensing the pipe or vessel contents temperature in lieu of ambient sensing, and contactors to enable power to the heat cable when temperature is below thermostat setpoint.

4. The self-regulating heater shall consist of two (2) 16 AWG tinned-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature all along its length, allowing the heater to be crossed over itself without overheating, to be used directly on plastic pipe, and to be cut to length in the field. The heater shall be covered by a radiation cross-linked modified polyolefin dielectric jacket.

   (Optional: For installation on plastic piping, the heater shall be applied using aluminum tape (AT180). To provide a good ground path where none exists and to enhance the heater's ruggedness, the heater shall have an outer braid of tinned-copper and an outer jacket of modified polyolefin (-CR).

5. In order to provide energy conservation and to prevent overheating, the heater shall have a self-regulating factor of at least 90 percent. The self-regulation factor is defined as the percentage reduction, without thermostatic control, of the heater output going from 40°F pipe temperature operation to 150°F pipe temperature operation.
6. The heater shall operate on line voltages of either 120 or 208-277 volts without the use of transformers.
7. Heater shall operate from a circuit breaker for each tracing circuit.
8. The heat tracing shall maintain minimum "contents" temperature of 40 deg.F at ambient temperature of -20 deg.F when enclosed within a minimum of 1" fiberglass insulation on piping and vessels and pumps, no insulation required on sumps, etc., unless otherwise indicated.
9. Installation:

   a. Apply the heater linearly on the pipe after piping has been successfully pressure tested. Secure the heater to piping with cable ties or fiberglass tape.
   b. Apply "electric traced" signs to the outside of the thermal insulation.

10. Tests:

    After installation and before and after installing the thermal insulation, subject to testing using a 2500 VDC megger. Minimum insulation resistance should be 20 to 1000 megaohms regardless of length.

B. Manufacturers:

1.	Manufacturer:	Raychem	Raychem	Raychem
2.	Product:	Chemelex	Chemelex	Chemelex
3.	Trade Name:	XL-Trace	XL-Trace	XL-Trace
4.	Pipe Size:	½”-3”	½” - 3”	4” & Larger
5.	Product No.:	5XL-1	5XL-2	8XL-2-CR
6.	Voltage:	120V	277V	277V
7.	Max Circuit Length:	270 Ft.	470 Ft.	350 Ft.
8.	Thermal Rating:	5 Watts/Ft.	5 Watts/Ft.	8 Watts/Ft.
9.	Connection:	RAYCLIC-PL	RAYCLIC-PL	RAYCLIC-PL
10.	Splice Kit & Tee Kit:	RAYCLIC-T	RAYCLIC-T	RAYCLIC-T

11. End Seal Kit:	RAYCLIC-S	RAYCLIC-S	RAYCLIC-S
12. Thermostat:	RAYCLIC-E	RAYCLIC-E	RAYCLIC-E
13. Glass Cloth Adhesive Tape:	GT-66	GT-66	GT-66

C. Responsibilities:

1. Heat trace including all accessories shall be furnished as part of the Work included in Division 23. Installation of cable on pipe including splices, strapping and bulb placement shall be by Division 23 Contractor.
2. Installation of power wiring including breakers and mounting thermostat enclosure shall be part of the Work included in Division 26.
3. Work under Division 23 includes coordination of material quantity and delivery, tracing installation, and insulation of piping after heat trace has been installed, inspected and tested.

2.8 DIELECTRIC PIPE FITTINGS AND ISOLATORS

A. Manufacturer: Epco Sales Inc., Victaulic.

B. Schedule: (complete unions)

Model:	FX	GX
Sizes:	½" thru 2"	2" thru 12"
Maximum Pressure:	250 psi	175 psi
Maximum Temp.:	210 deg. F	210 deg. F
Epconite Gasket:	#2	#2
Ends:	FPT x Solder	FPT x Solder
Type:	Union	Flanged Union

C. Schedule: (companion flanges)

Model:	X	W	H
Sizes:	1-1/2" - 10"	1-1/2" - 12"	1-1/2" - 12"
Maximum Pressure:	175 psi	175 psi	175 psi
Maximum Temp.:	210 deg. F	210 deg. F	210 deg. F
Epconite Isolators:	#2	#2	#2
End Style:	Solder (Brass)	Weld neck	Iron Pipe Thread
Type:	Companion	Companion	Companion
Face Gasket:	Same as Isolators		

D. Dielectric fittings shall conform to ASA B16.8, and shall be plated as applicable a minimum of .0005" and have no flow restriction when assembled.

2.9 SOLVENTS FOR PLASTIC PIPING

A. Solvents for plastic piping joints shall be certified to meet SCAQMD Rule 1168/316A. This includes but is not limited to PVC, CPVC, and ABS piping, all grades and sizes.

2.10 EQUIPMENT DRAINS AND OVERFLOWS

A. Steel Pipe: ASTM A53, Schedule 40 galvanized.

1. Fittings: Galvanized cast iron, or ANSI/ASTM B16.3 malleable iron. Joints: Screwed, or grooved mechanical couplings.

B. Copper Tubing: ASTM B88, Type M, hard drawn.

1. Fittings: ANSI/ASME B16.23 cast brass, or ANSI/ASME B16.29 solder wrought copper.
2. Joints: ASTM B32, solder, Grade 95TA.

C. PVC Pipe: ASTM D1785, Schedule 40.

1. Fittings: ASTM D2466 or D2467, PVC.
2. Joints: ASTM D2855, solvent weld.

D. ABS Pipe: ASTM D2680 or D2751.

1. Fittings: ASTM D2751.
2. Joints: ASTM D2235, solvent weld.

2.11 ELEVATOR SHAFT ROOF VENT

A. Approved Manufacturers: Bilco, Dur-red, or approved equal.

B. Covers shall be 14 gauge paint bond galvanized steel with 3" beaded flange neatly welded. Insulation shall be glass fiber 1" in thickness, fully covered and protected by a 22 gauge galvanized paint bond steel cover liner. Curb shall be of 14 gauge galvanized paint bond steel, 12" in height on hinge sides, with a 5° pitch to the fixed center channel. Curb shall be formed with a 3-1/2" flange with holes for securing to the roof deck and with an integral metal capflashing of the same gauge and material as the curb, full welded for weathertightness. Insulation on the exterior of the curb shall be rigid fiberboard 1" in thickness. All hardware shall be cadmium plated and factory finish shall be red oxide paint on steel.

C. Vent shall be completely assembled with heavy pintle hinges, compression spring operators, neoprene draft seal, heavy duty shock absorbers and pull handles for inside and outside operation. <It shall open automatically when heat breaks the 165°F fusible link and shall be labeled as being FM Approved, UL Listed>. Installation shall be in accordance with manufacturer's instructions. Manufacturer shall guarantee against defects in material and workmanship for a period of five years.

D. Vent shall be provided with electrically actuated fusible link to melt upon receiving current from smoke detector. Mechanical contractor shall provide photoelectric smoke detector with auxiliary contacts, transformer and wiring to fusible link. Mount smoke detector on inside of elevator shaft and in each elevator lobby.

E. Provide owner with replacement fusible links (2 per roof vent) for both fire and smoke testing.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. General: Unless otherwise specifically indicated on Drawings or in Specifications, install equipment and materials in accordance with recommendations of manufacturer, including performance of tests as manufacturer recommends.

B. Protection:

1. Close ends of pipe and ductwork during construction and cover equipment to prevent entry of foreign material. Protect insulation against dirt, water, chemical or mechanical damage before, during and after installation. Cover floor drains and protect fixtures and equipment against damage during concrete pours and mechanical work.

C. Quiet Operation and Vibration:

1. All work shall operate in accordance with Section 230540 - Mechanical Sound and Vibration Control under all conditions of load.
2. Sound or vibration conditions not in accordance with Section 230540 and considered objectionable shall be corrected in a manner approved by the Architect under the Work of Division 23.

3.2 WELDING

A. Joints between sections of pipe, between pipe and fittings, shall be fusion welded. Use only certified welders. Strength of finished welded joints to be equal to strength of pipe. Width of finished weld to be at least 2-1/2 times the thickness of the part joined. Thickness of weld to be at least 25% greater than the thickness of pipe or fittings. Finished welded joints to present neat and workmanlike appearance.

B. Make no direct welded connections to valves, strainers, apparatus, and related equipment. Make connections to flanged valves, and flanged equipment with welded pipe connection flanges.

C. Radii of weld ells to be 1-1/2 times nominal diameter of fittings. Fittings used for all branch connections, whether full-size or reducing, to have interior surfaces smoothly contoured. Wall thickness of welded fittings equal to adjacent piping.

3.3 ELECTRIC WIRING

A. Furnish equipment requiring electrical connections to operate properly and to deliver full capacity at electrical service available.

B. All control wiring to be in accordance with manufacturer's recommendations; all wiring shall be color coded to facilitate checking.

C. Unless otherwise indicated, all mechanical equipment motors, starters, and controls shall be furnished, set in place, and wired in accordance with the Electrical Equipment/Wiring Responsibility Matrix on the drawings. Contractor should note that the intent of this electric wiring matrix is to have the Division 23 Contractor responsible for coordinating all control wiring as outlined, whether or not specifically called for by the mechanical or electrical drawings and specifications. Mechanical Contractor shall comply with the applicable requirements of Division 26 for electrical work of this Division 23 which is not otherwise specified. No extras will be allowed for Contractor's failure to provide for these required items. The Division 23 Contractor shall also refer to the Division 26 specifications and plans for all power and control wiring and shall advise the Architect/Engineer of any discrepancies prior to bidding.

ELECTRICAL EQUIPMENT/WIRING RESPONSIBILITY MATRIX

Item	Furnished By*	Set By*	Power Wiring*	Control Wiring*
Equipment Motors	MC	MC	EC	MC
Motor Starters & Overload Heaters	MC – Except when shown on MCC	EC	EC	MC
Variable Frequency Drives (VFDs)	MC	EC	EC	MC
Fused & Unfused Disconnect Switches, Thermal Overload & Heaters	EC	EC	EC	--
Manual Switches & Speed Control Switches carrying full load currents.	MC	EC	EC	EC

Item	Furnished By*	Set By*	Power Wiring*	Control Wiring*
Fire/Smoke and Smoke Dampers	MC	MC	EC – Requires emergency power circuit if air system served is on emergency power.	EC
Control Relays & Transformer (See Note 2)	MC	MC	EC	MC
Thermostats (Line Voltage)	MC	EC	EC	EC
Temperature Control Panels	MC	MC	EC	MC
Building Fire Alarm System Fire & Smoke Detectors, including Relays in Starters for Fan Shutdown.	EC	EC	EC	EC
DDC Interface to Fire Alarm System	MC	MC	EC	MC
Electric Plumbing Fixtures, Sensor Faucets, Sensor Flush Valves, Electric Water Coolers, and required Transformers.	MC	MC	EC	MC
Motor & Solenoid Valves, Damper Motors, PE & EP Switches, Control Valves, Low Voltage Thermostats	MC	MC	MC	MC
Pushbutton Stations & Pilot Lights carrying fully load current.	MC	EC	EC	N/A
Exhaust fans when switched with room lights.	MC	MC	EC	EC
Boiler Controls including Gas Train	MC	MC	EC	MC
Fire sprinkler system alarms, tamper switches, flow switches and fire alarm systems tie-ins to provide a complete fire protection system.	FPC	FPC	FPC	FPC
Water Softener Timeclocks, Timers, Lock-out Devices, Wheatstone Bridges and Meters	MC	MC	EC	MC
Temporary Heating Connections	MC	MC	EC	MC
Freeze Protection Heat Cable	MC	MC	EC	MC
Heat Maintenance Cable	MC	MC	EC	--
HVAC Water Treatment Interlocks and Glycol Pumps	MC	MC	EC	MC

* MC = Mechanical Contractor under Division 23 of the work.
* FM = Mechanical Contractor under Section 212200 - FM-200 Fire Suppression System.

* FPC = Fire Protection Contractor.
* EC = Electrical Contractor under Division 26 of the work.
* MGES = Medical Gas Equipment Supplier (Section 226313).

D. All temperature control conduit and wiring shall be furnished and installed under Section 230900. All motorized damper and motorized valve wiring shall be furnished and installed under Section 230900.

3.4 SLEEVES, PLATES AND CLOSURES

A. Division 23 Contractor shall provide and locate pipe sleeves, and inserts required before new floors and walls are built or shall be responsible for the cost of cutting and patching required where sleeves and inserts were not installed or where incorrectly located.

B. Provide sleeves for mechanical piping passing through concrete floor slabs and through concrete, masonry, tile, and gypsum wall construction. Provide metal collars to close and protect openings.

C. Where sleeves are placed in exterior walls below grade, pack spaces between the pipe or conduit and the sleeves with Hornflex Thiokol L-32 Sealant or Link Seal and make water-tight. Provide metal rodent collars securely fastened to structure.

D. Where pipe motion due to expansion and contraction will occur, make sleeves of sufficient diameter to permit free movement of pipe. Where sleeves pass insulated pipes, the sleeves shall be large enough to pass the pipe only and the insulation shall be made to butt against the construction, except for pipes requiring insulation having a vapor barrier, in which case, the sleeves shall be large enough to pass the pipe and insulation. Check floor and wall construction finishes to determine proper length of sleeves for various locations, make actual lengths to suit the following:

1. Terminate sleeves flush with floors, walls, partitions, and ceilings.
2. Seal annular space around pipes watertight at floor penetrations.
3. In areas where pipes are concealed, as in chases, terminate sleeves flush with floor.
4. In all areas where pipes are exposed, extend sleeves 1/4" above finished floor, except in rooms having floor drains, where sleeves shall be extended 2" above floor and in Kitchens and Mechanical Equipment Rooms, where sleeves shall be extended 4" above floor.

E. Sleeves shall be constructed of 24 gauge galvanized sheet steel with lock seam joints for all sleeves set in concrete floor slabs terminating flush with the floor. All other sleeves shall be constructed of galvanized steel pipe unless otherwise indicated on the drawings. Hilti or Hydroflame.

F. Fasten sleeves securely in floors and walls so that they will not become displaced when concrete is placed or when other construction is built around them.

G. Provide tight fitting floor and ceiling plates on pipes passing thru walls, ceilings, and floors. Nickel or chrome plated in finished areas, galvanized cast iron in unfinished areas. Provide wall and ceiling flanges for ducts in finished areas.

H. Provide all cutting, patching of holes, openings, notches. Obtain written approval for notching, boring, chipping, burning, drilling, welding to structural members in accordance with the General Conditions of the Contract and paragraph 3.7 of this Section.

I. Where pipe sleeves penetrate fire rated walls and floors, this contractor shall use fire safing to seal openings.

3.5 FOUNDATIONS, PADS AND CURBS

A. Provide dowels, anchor bolts, groutings, concrete foundations and pads for pumps, plumbing, heating and ventilating or air conditioning equipment in accordance with Concrete Specifications.

B. Dimensions and exact locations for foundations and concrete curbs for mechanical equipment to be field verified and located accurately by Division 23 Contractor.

C. When water heaters and similar equipment are installed in a suspended application, an engineered and manufactured platform shall be used. Weight loading capability shall include a minimum safety factor of 2.

3.6 EXCAVATING AND BACKFILLING

A. Excavate for all mechanical equipment such as fuel tanks, ductwork, sump pumps, manholes and trenches for underground pipelines to required depths. Compact bottoms of excavations. Slope to obtain required grade. Remove rocks, trash and debris before installation of equipment and backfilling. Backfill by hand tamping earth under the haunch of the pipe to specified compaction. Backfill and compact in thin layers until top of pipe is covered. Complete backfill by methods required or directed for soil characteristics to comply with the Architectural section of these specifications.

B. Excavations near footings shall be such that, when nearing building footings, or bearing foundation walls, the excavation bottom shall not be nearer the footing than a normal 45 degree bearing line from edge of footing bottom to bottom of excavation. When it is necessary to perpendicularly cross under a continuous foundation wall, care shall be taken to insure that crossing is clear of the structural foundation and of minimal width.

C. Do not place backfill over pipe lines until lines are properly tested.

D. When trenching through specially tested areas, such as paving, asphalt, etc., Contractor shall be responsible for restoring the surface to its original condition, and in a manner approved by the Architect. Repair trenches where settlement occurs, and restore the

surface for the period of one year after final acceptance of the project. All cutting of paving, asphalt, etc. shall be by saw cutting.

3.7 CUTTING AND PATCHING

A. Openings in New Construction:

1. Provisions for New Openings: The Division 23 Contractor shall verify all openings required in the new construction in connection with the work under Division 23 with the Architectural and Structural Drawings and shall then meet with and verify same with the General Contractor/Construction Manager who will assign the work to the appropriate contractor to provide all openings in the new construction of the correct size and location in walls, floors or through roofs required for the installation of the mechanical work.

B. Cutting in New Construction:

1. Failure on the part of the Division 23 Contractor to make the above arrangements for required openings shall cause the cost of cutting and patching for the necessary openings for the installation of his work to be borne by him, either by being assigned to the General Contractor/Construction Manager or in the form of performing the required cutting himself. In either case, all patching shall be done by the appropriate finishing contractor as determined by the General Contractor/Construction Manager. No cutting or drilling of holes shall be done without approval of the Architect/Engineer.

C. Patching in New Construction:

1. The appropriate finishing contractor as determined by the General Contractor/Construction Manager shall patch all openings in the new structure. All openings made in fire rated walls, floors, or ceilings, shall be patched and made tight to conform to the fire rating for the enclosure. All materials used in patching shall match the materials specified in the Architectural Specifications and all patched areas shall be restored to the specified finish surface to the satisfaction of the Architect.
2. The Division 23 Contractor shall pay the appropriate Finishing Contractor as determined by the General Contractor/Construction Manager for all patching resulting from cutting to accommodate mechanical work.

D. Cutting in Existing Building:

1. The Construction Manager/General Contractor shall make arrangements for required openings in the existing building to facilitate the passage of ductwork, piping, etc. thru existing floors, walls, and beams. Division 23 Contractor to coordinate all requirements.

E. Patching in Existing Building:

1. The General Contractor shall patch all existing walls and floors to match existing.

3.8 PIPE HANGERS/SUPPORTS

A. Use inserts, anchors, expansion bolts or other approved and acceptable means of attachment to concrete construction. Set inserts in advance of concrete installation, provide required reinforcement rod for all inserts carrying loading equivalent of one 4" pipe or more. Concrete drilling for anchoring is acceptable if required. All inserts shall be flush with face of slab or wall containing insert.

B. Provide flat square washers for rods thru metal decking with nut above washer, when acceptable and approved.

C. Cinch hangers to carry appropriate share of loading and slope piping without sags or "pocketing" as appropriate and required.

D. Rod offsets, or angle installation, plumber tape or wire will not be accepted. Hanger rods shall be true and plumb.

E. Piping shall not be hung from other piping or equipment items. Provide attachments to building structure only. Use trapeze, wall brackets, knee brackets, etc., where hanger rods cannot be attached within spacing plumb to structures.

F. Provide sway and earthquake bracing where required in accordance with Section 230548 - Mechanical Seismic Control.

3.9 INSTALLATION OF VALVES

A. General:

1. Provide valves as shown on Contract Documents and as required for pressure relief, balancing and/or control of flow.
2. Provide isolation valves for maintenance and service on each piece of equipment regardless of whether or not shown on Contract Drawings.
3. Provide isolation valves for all branch line take-offs that serve more than two items of fixtures or equipment.
4. Provide balancing valves for each branch of domestic hot water circulating system, all heating water returns or supplies to equipment, and as shown on Contract Documents.
5. Provide access means for each valve or group of valves either by access panels or utilization of inherent access provided by building methods i.e., lift out ceiling construction or exposed valve installations in non critical areas such as janitor’s closets, storage rooms, etc.
6. Install all valves with valve bonnets or operating stems in vertical (upright) position when possible, valves may be installed with bonnets or stems not less than 35 degrees downward from vertical plane except valves on vertical piping

may be 90 degrees from vertical plane. Swing type check valves shall be installed on horizontal piping no more than 45 degrees upward slope from horizontal plane, using lift checks on vertical piping. Lift check valves shall not be used on sewage or sump pump discharge piping.

7. Inspect and tighten all bonnet nuts, bolts, packing glands, lubricate all valves requiring lubrication, secure all hand wheels and identification plates, be responsible for all valves having manufacturers name, trade name, working pressure and size stamped or cast into the body of the valve. Perform all maintenance, repacking and inspection prior to installation of valve.

B. Proper Installation of Valves:

1. Provide valves in accordance with the following schedule unless specified otherwise in Contract Documents.

a. Dead-end shut off: Gate, ball, butterfly, plug, stop and drain.
b. Throttling: Ball, plug, globe, diaphragm, needle, butterfly (when using butterfly valves for throttling, additional valves must be provided for service shutoff.)
c. Backflow prevention: Check.
d. Water hammer prevention: Silent or pilot operated non slam check.
e. Gas piping: Lubricated plug (or ground joint cock up to 1" only), or UL-Listed ball valve.

C. Removal and Repair Provisions:

1. Provide all valves which are not accessible for repair without removal from piping with union connection immediately adjacent to valve outlet.

3.10 PAINTING

A. Surfaces of exposed equipment and materials to be thoroughly cleaned and left ready for painting in accordance with Architectural Painting Specifications.

B. Duct interiors visible through registers, grilles and diffusers shall be painted flat black.

C. Exposed gas piping to be cleaned, primed and painted 2 coats (grey).

D. All other painting of mechanical equipment and piping, unless otherwise noted, shall be performed under other divisions of the work with the exception of identification of piping and equipment which will be the responsibility of the Division 23 Contractor.

3.11 IDENTIFICATION OF PIPING AND EQUIPMENT

A. General: Provide pipe identification, valve tags, stencils, or engraved nameplates to clearly identify the mechanical equipment, piping and controls of the various mechanical systems and direction of flow in piping.

B. Methods for identification shall be as follows:

1. Metal Tags: Stamp tags with letter prefixes to indicate service, followed by a number for location in system.
2. Engraved Nameplates: Attach nameplates with brass screws. Pressure-sensitive embossed labels are not acceptable. Nameplates shall bear the same identifying legend used on the Contract Documents.
3. Painted Stencils: Stenciled markings shall be neatly performed with no overspray, drips, or other imperfections. Pipes and equipment to be stenciled shall first be wiped clean of dirt, dust, rust, grease and moisture. Pipes and smooth, hard surface in the area the stencil is to be applied. Paint application shall comply with Architectural Painting Specifications.
Size of Legend and Letters for Stencils:

Insulation or Pipe Diameter	Length of Color Field	Size of Letters
¾" to 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"
2-1/2" to 6"	12"	1-1/4"
8" to 10"	24"	2-1/2"
over 10"	32"	3-1/2"
Ductwork and Equipment	NA	2-1/2"

4. Piping Legend and Color (Contractor shall obtain written approval of colors from Owner's representative prior to starting work.)

Legend	Background Color	Direction Arrow	Pressure
Steam	Yellow	Arrow	PSI
Condensate	Yellow	Arrow	PSI
Feed Water	Yellow		
Blow Down	Yellow		
Domestic Cold Water	Light Green		
Domestic Hot Water	Yellow		
Sprinkler-Fire	Red		
Natural Gas	Orange		
Refrigerant Liquid	Yellow	Arrow	
Refrigerant Suction	Yellow	Arrow	

Legend	Background Color	Direction Arrow	Pressure
Refrigerant Hot Gas	Yellow	Arrow	

5. Pressure Sensitive Markers: Apply pressure sensitive markers in accordance with manufacturer's recommendations with complete wrap around may be used at Contractor's option. Marker adhesion will be tested for permanence. Any markers showing dog ears, bubbles, or other failings shall be replaced.
6. Semi-Rigid Plastic Identification Markers: Seton Setmark premolded (not pressure sensitive) identification markers may be used at Contractor's option on service piping which is accessible for maintenance operations (but not on piping in finished spaces). This type marker shall not be installed on bare pipe when surface temperature exceeds 180 deg.F unless a 1" thick insulation band is first provided under marker for protection from the hot pipe.

C. Identification of Piping: Identify all piping accessible for maintenance, above ceilings, and access spaces as well as exposed to view utilizing semi-rigid plastic markers or stenciled markings according to the following procedures:

1. Use an arrow marker for each pipe-content legend. The arrow shall always point away from the pipe legend and in the direction of flow: color and height of arrow to be same as content legend lettering.
2. If flow can be in both directions, use a double-headed arrow indication.
3. Apply pipe legend and arrow indication at every point of pipe entry or exit where line goes thru wall or ceiling cut.
4. Apply pipe legend and arrow indication within 3" of each valve to show proper identification of pipe contents and direction of flow.
5. The legend shall be applied to the pipe so that lettering is in the most legible position. For overhead piping, apply legend on the lower half of the pipe where view is unobstructed, so that legend can be read at a glance from floor level.
6. For pipes under 3/4" O.D., fasten brass tags securely at specified legend locations.
7. Legend on steam piping, condensate return, compressed air, medical air, gas, and vacuum systems shall include working pressure or vacuum.
8. Insulated piping equipped with electric heat trace shall additionally be labeled "Electric Traced" with label of same size and color as the pipe legend.

D. Valves: All valves, including but not limited to domestic hot and cold water, hot water recirculation, heating water, chilled water, condenser water, steam, steam condensate return, fire protection, gas, medical gas, vacuum and special service valves located inside the building, shall be tagged and identified as to type of service, location number, and normal valve position (normally open or normally closed).

E. Controls: All magnetic starters and relays, shall have nameplates or be stenciled to identify connecting or controlled equipment. All manual operating switches, fused disconnect switches and thermal over-load switches which have not been specified as furnished with indexed faceplates shall also have nameplates or be stenciled as to "connected" or "controlled" equipment. All automatic controls, control panels, zone

valves, pressure electric, electric pressure switches, relays, and starters shall be clearly identified.

F. Pumps: All pumps shall be identified as to service and zones served. Base mounted pumps shall be stenciled or have system served nameplates. Brass tags secured by brass chains may be used on small in-line pumps.

G. Storage Tanks, Water Treatment Equipment and Heaters: All tanks and heaters shall be stenciled as to service. The connecting pipes to each shall be identified and the service temperature entering and leaving the tank or heater shall be indicated.

H. Fans: All supply and exhaust fans and air handling units and connecting ductwork supplying one or more areas from an equipment room or isolated crawl or furred space shall have nameplate or be stenciled as to plan code number, service and areas of zones served.

I. Air Conditioning Equipment: Air conditioning <and evaporative cooling> equipment such as chillers, pumps, condensers, or roof-top equipment shall be identified by stencils, or system nameplates.

J. Access Doors: Provide engraved nameplates or painted stencils to identify concealed valves, controls, dampers or other similar concealed mechanical equipment. Obtain Architect approval before installation on all access doors in finished areas.

K. Lift Out Ceilings: Provide engraved nameplates or black lettering on transparent adhesive labels on ceiling tee stem to identify concealed valves, controls dampers or similar concealed mechanical equipment which is directly above nameplate in ceiling space. Obtain Architect approval before installation.

L. Expansion tanks shall be labeled to indicate system served and precharge pressure.

M. Access Flooring: Provide thin engraved nameplate on access panel to indicate location of underfloor fan coils and smoke/fire dampers.

3.12 DRIP PANS

A. Provide drip pans under all fluid conducting piping which runs over servers, telecom equipment, electric switchgear, busway, or electric motor starters, and under all point-of-use water heaters.

B. Pans: 18 gauge galvanized iron. Pans shall be two inch deep, with rolled top edges, and shall extend six inches each side of the pipe or group of pipes and six inches beyond the equipment below. Keep pans as close to the underside of the pipes as practicable. All seams shall be soldered, and pans shall be crossbraced as required to prevent sagging and warping.

C. Pitch each pan to a drain connection, and pipe a 1-1/2 inch or larger copper tube drain to discharge over nearest available open drain.

D. Provide a drip pan under all coils that may have condensate during operation like heat recovery coils, etc. Pipe drain to nearest drain.

3.13 FIRE SAFING

A. Mechanical Contractor shall provide fire safing for his work as follows: Where fire rated separations are penetrated by pipes, conduit or ductwork, the annular space around the pipe, conduit or ductwork shall be filled with a U.L. Rated fire safing material. Refer to Division 7 for materials and application specifications.

3.14 HEAT MAINTENANCE CABLE AND FREEZE PROTECTION CABLE

A. Comply with National Electric Code Section 427 for installation.

B. Protect heater strips from damage before, during and after installation.

C. Provide waterproof insulation for all heat traced and heat maintained piping one inch thick minimum in accordance with Section 230700.

D. When installing do not twist buss wires together.

E. Test each circuit prior to and immediately after installation of thermal insulation using a megger under 500 volts D.C. Minimum insulation resistance reading shall be ten (10) megohms regardless of length, if less than ten (10) megohms investigate cause and replace damaged sections - do not repair!

F. Install heat cable on lower quadrant of pipe 45 degrees up from vertical, provide ties or fiberglass tape 12" on center max.

G. Install all accessories and kits per manufacturers' recommendations and standards. Careful attention to manufacturers’ installation instructions as pertains to valves and equipment will be strictly adhered to and enforced.

3.15 DIELECTRIC PIPE FITTINGS AND ISOLATORS

A. Provide dielectric pipe fittings and isolators at all connections between dissimilar metals in the domestic water, heating water and fire protection systems to control corrosion potential caused by galvanic or electrolytic action.

B. Typical locations for dielectric isolation are; water heaters, storage and pressure tanks, water conditioning equipment, pumps, changes in service piping materials, make-up connections to boilers and chilled water systems, valves, deaerators, flexible connectors and the like where materials of different electrode potential are joined.

C. Hangers for piping shall be isolated per Section 230529 when hanger and piping materials are dissimilar and subject to production of electrolysis or galvanic action.

D. Storage tanks shall be isolated from piping and tank stands by use of anti-electrolytic and galvanic isolators.

3.16 DRAIN LINES

A. Provide condensate drain lines from each cooling coil and evaporative media sump drain pan to nearest drain or to termination indicated.

B. Do not route condensate lines above electrical panels, switch gear, transformers, motor starters, elevator equipment, servers, or telecom equipment. Should there be a conflict with the plans and this paragraph, notify the Engineer immediately for corrective instruction prior to starting work.

3.17 HEATING SYSTEM USED FOR TEMPORARY HEAT DURING CONSTRUCTION

A. Permanent heating system shall not be used until building is totally and permanently enclosed (no temporary barriers for weather protection), and source of heat supply is permanently installed.

B. Once the heating system has been placed into operation, it shall not be shut down except for moderate weather, and all heated areas shall be maintained at a minimum temperature of 50 deg. F 24 hours a day.

C. When any air-handling equipment is used for temporary heat, the filters (MERV 13) shall be installed and maintained. Before building acceptance by Owner, these units shall be thoroughly cleaned and new filters shall be installed. This is over and above the extra set of filters to be provided the Owner as called for in the specifications. Coils shall be cleaned if necessary, as determined by the Engineer.

D. Any and all systems being used for temporary heat shall become the Contractor's responsibility to maintain, and be put into first class working order before acceptance by the Owner.

E. Any manufacturer's guarantees that start with the use of equipment for temporary heat shall be extended by the contracting firm holding the prime contract for construction, so that the Owner will have his one-year guarantee from date of acceptance.

3.18 ELEVATOR SHAFT SMOKE VENT

A. Contractor shall test for operation to insure that vent is in working order.

B. Installation shall be in accordance with manufacturer's instructions.

END OF SECTION 230529

SECTION 231126 - FUEL GAS SYSTEMS (LP)

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe and Fittings

B. L.P. Gas Service Valves

C. Regulators

D. Flexible Connectors and Quick Couplers

1.2 RELATED REQUIREMENTS

A. The General and Supplementary Conditions and Division 1, General Requirements apply to this section, and Contractor shall review and adhere to all requirements of these documents.

B. Section 230500 - Basic Mechanical Requirements.

1.3 RELATED SECTIONS

A. Section 230529 -Basic Mechanical Materials and Methods.

B. Section 224450 - Plumbing Equipment: Gas supply and runout with drip leg and gas cock or valve to water heater connection points.

C. Section 235216 - Boilers: Gas supply and runout with drip leg and gas cock or valve to boiler connection points.

1.4 REFERENCES

A. ANSI B31.2 Fuel Gas Piping.

B. NFPA 54 (ANSI A223.1) National Fuel Gas Code and (ANSI Z223.1A Supplement.

C. NFPA 59 Standard for the Storage and Handling of Liquefied Petroleum Gases at Utility Gas Plants.

D. NFPA 59A Standard for the Production, Storage and Handling of Liquefied Natural Gas (LNG).

1.5 DEFINITIONS

A. The following are references with definition acronyms required in this section:

1. U.L. - Underwriters Laboratory Listed for Fire Protection Systems.

2. F.M. - Factory Mutual Engineering Division
3. IRI - Industrial Risk Insurors AKA: F.I.A. Factory Insurance Association.
4. Jurisdictional Agencies:

   a. Building Department.
   b. Fire Department or Fire Prevention Bureau or Marshal.
   c. Insurance Agency, Carrier, and/or Underwriter.

5. Engineer refers to the consulting Mechanical Engineer of record.

1.6 SYSTEM DESCRIPTION

A. Provide gas supply from fuel storage tanks through vaporizer(s) and to daylight entry to building.

B. Provide lockable gas valve on gas entry to building outside of building.

C. Provide all safety valves and gas monitoring equipment per contract documents.

D. Provide storage tanks, enclosures, beams, and tank supports as required.

E. Concealed piping in walls and above ceilings to be installed using welded joints and fittings. No unions, threaded joints/fittings, or flared fittings are allowed at concealed locations.

1.7 QUALITY ASSURANCE

A. The firm, company, corporation, or partnership producing and providing the material and labor of this Section shall have at least 3 years experience performing scope of work described and required by these Contract Documents.

B. Brazing shall be accomplished in strict accordance with the recommended practice as required by Copper Development Association including pipe and fittings preparation.

1.8 REGULATORY REQUIREMENTS

A. Conform to Regulatory Requirements listed in this Section and Section 230500.

1.9 JOB MOCK-UP

A. Job Mock-Up: Refer to Section 01430 where scope and description for job mock-up are given.

1.10 SUBMITTALS

A. Submit shop drawings and product data for the following items:

1. Engineered fabrication drawings showing storage tank and piping.
2. Valve and alarm wiring diagrams.
3. Gas valve control panel.

B. Submit Product Data for the following items:

1. Pipe, fittings, hangers, attachment devices, and valves.
2. Regulators.
3. Specialty valves and devices.

C. Submit printed Operating Instructions and Maintenance Data for the following items:

1. Provide operating and maintenance data for all products and devices requiring service and maintenance.
2. Drawings and diagrams, as required.
3. Calculations for system and leak detection.
4. Test reports for monitoring system.
5. Certified test of monitoring equipment and valves.
6. Wiring diagram for system and devices.

1.11 PRODUCT CONDITIONS

A. Contractor shall not fabricate or install any piping until he has assured himself that the piping can be run as contemplated in cooperation with Contractors of other Divisions of the work and the physical constraints of the Structural and Architectural work.

1.12 WARRANTIES

A. Provide original copies of all warranties for specific equipment where specified and in accordance with Section 230500.

B. Provide 2-year full warranty on all cathodic protection and pipe wrapping against corrosion of piping due to electrolytic or active soil conditions.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Buried Exterior:

1. Liquefied Petroleum Gas (Butane and Propane):

a. Type K temper drawn with minimum fittings. Use pipe bends and where couplers are required, use wrought couplers brazed with B Cup-5 brazing joint filler alloy.
b. Wrapping: Scotchwrap 10 mil PVC tape.
c. Contractor's Options, when acceptable to jurisdictional authorities:

1) High density Polyethylene pipe and fittings; ASTM D-3350:335434C, PPI:PE 3408/3406, Type III, Grade P34 Category 5 per ASTM D 1248, SDR 11 pipe, U.L. Listed for L.P. Gas service.
2) Schedule 40 steel with welded fittings and wrapped with Scotchwrap 10 mil PVC tape.

B. Interior Piping:

1. Type K temper drawn with minimum of fittings, using pipe bends and couplers only, ASTM B-88.
2. Where fittings are necessary, use wrought fittings, ANSI B16.26.
3. Provide B Cup-5 brazing alloy for all joint make-up. Do not use 50-50 for joints nor backup finishing.
4. Contractor's option: Schedule 40 steel with welded fittings.
5. Automatic Switch Co. (ASCO) Series 8044 valves, modified as required for propane gas.

2.2 L.P. GAS SERVICE VALVES

A. Valve: Weld neck lubricated plug or standard port ball valve certified for L.P. Gas service, including lubricant, locking device and case-hardened padlock with 4 keys.

2.3 REGULATORS

A. Provide two stage regulation of bulk system propane, delivery pressure shall be 10" wc at outlet of second stage regulator. Regulator shall be as manufactured by "REGO".

B. Provide mounting brackets mated to regulator supplied.

C. Provide two stage regulators with automatic throw-over manifold or dual cylinder supply as manufactured by "REGO" and set for 10" w.c. at outlet of regulator.

D. Provide all required safety devices, i.e., relief vents to exterior, check tees, excess flow valves, flash or surge tanks, regulator suppressor assemblies ballards, stations, etc.

2.4 FLEXIBLE HOSE GAS CONNECTORS AND QUICK COUPLERS

A. Manufacturers:
Flexible Connector: Parker SS25UL
Quick Coupler: Hansen Manufacturing Co.,"Gas Mate".

B. Description:
Flexible Connector: 350 psig hose with stainless steel
braid, and heavy flexible armor shield.

Quick Coupler: Hansen Gas Mate for L.P. service, one-way quick coupler with gas rating in cubic feet per hour equal to equivalent gas appliance rating.

PART 3 - EXECUTION

3.1 GENERAL

A. Brazing, welding, wiring, sleeves, plates, brackets, foundations, pads, cutting and patching, excavation, compaction and backfill, pipe installation, valves, hangers, supports, cathodic protection, expansion compensation and identification shall be in accordance with Section 230529 - Basic Mechanical Materials and Methods.

B. Provide all fuel gas piping from source to each connection point of all gas fired equipment items listed in "Related Work" paragraph in Part 1. Provide drip leg and gas cock for each equipment item. Make final connections in compliance with equipment manufacturer's instructions. Flexible connections will not be allowed except where explicitly specified.

3.2 PIPING

A. Provide piping from exterior tank supply exterior to building and entering building as indicated on Drawings at least 24" above grade. Provide lockable gas valve for L.P. gas on this riser complete with lock device, case hardened padlock and 4 keys.

B. Provide all piping valves, hangers and devices in accordance with jurisdictional codes and in conformity with standards listed in "References" paragraph in Part 1 and recommendations and requirements of the manufacturer

C. Plug each gas outlet, including valves, with threaded plug or cap immediately after installation and retain until continuing piping, or equipment connections are completed.

D. Dirt legs shall be at least 6" long and full size of drop or connection branch required, provide Teflon taped threaded cap for termination of dirt leg, leg shall be accessible for removal of cap.

E. No pipe shall be below building substrate or in crawl spaces beneath building. Concealed propane piping inside stud walls and above ceilings (hard and lay-in) shall be installed using welded joints and fittings. No unions or threaded fittings allowed at concealed locations.

F. Exterior buried piping shall be wrapped as follows:

1. Hand wrap or machine wrap buried exterior gas piping with Scotchwrap 10 mil PVC tape using 50% overlap wrap minimum. Double wrap fittings and joints. Extend fitting wrapping not less than 6 inches past the end of the fitting onto the pipe section. Test pipe and fittings prior to wrapping fittings. Coat pipe with Scotchwrap pipe primer before wrapping.

2. Pipe wrapping shall conform to the following schedule:

Pipe Size	Tape Width	Scotchwrap No.	
		Standard	Cold
¼ - ¾ inch	1 inch	50	40
1 - 1-1/2 inch	2 or 4 inch	50	40
2 inch and larger	4 inch	50	40
Color Backing		Black	Green

3. During application of wrap, if the ambient temperature is 40°F or less, use only Scotchwrap No. 40 tape. If ambient temperature is 41°F or more, use only Scotchwrap No. 50.

G. Buried Pipe Identification: Install bright colored continuously printed plastic ribbon tape of not less than 6 inches width and 4 mil thickness 6 to 8 inches below finished grade directly over buried pipe.

3.3 HANGERS AND SUPPORT SYSTEMS (Interior)

A. Provide pipe hangers, supports, and accessories in accordance with Section 230529 - Basic Mechanical Materials and Methods.

3.4 VALVES

A. Provide valves in accordance with Section 230529 - Basic Mechanical Materials and Methods.

3.5 GAS SOLENOID VALVES

A. General:

1. Valves shall be mounted with solenoid in the vertical upright position only.
2. Valves shall be installed in wall box or exposed as required by the Contract Documents.
3. Valves shall be installed with unions, or other means to provide removal or repair without disassembly of connecting piping or of cabinet.
4. Provide electric wiring in accordance with Section 230529 - Basic Mechanical Materials and Methods.
5. Provide neoprene gromets for all piping and electrical conduit entering and exiting cabinets.

3.6 GAS COCKS AND GAS VALVES

A. Provide at supply runout connection for each gas-fired equipment item; and on risers and branches where indicated.

B. Locate gas cocks and valves where easily accessible, and where they will be protected from possible damage.

3.7 L.P. GAS SERVICE VALVES

A. Provide locking device where accessible to public or unauthorized personnel.

3.8 GAS PRESSURE REGULATOR

A. Install per manufacturer's instructions as indicated. Pipe atmospheric vent to outdoors, one pipe size larger than size of outlet. Terminate outdoors with gooseneck turndown at end and a stainless steel screen at pipe termination. Install gas shutoff valve upstream of each pressure regulating valve.

3.9 FLEXIBLE HOSE GAS CONNECTORS AND QUICK COUPLERS

A. Provide flexible stainless steel connectors with full size quick coupler for all kitchen and heavy movable gas appliance equipment.

B. Connectors shall be approved for L.P. gas and of construction and lengths required to displace equipment for complete cleaning under and around gas appliance.

C. Provide U.L. listed, F.M. approved L.P. gas ball or lubricated plug valve at service connection on equipment branch and quick coupler at service end of flexible hose connector.

D. Provide union connection on appliance on or manifold end of hose connection <as shown on detail on drawings> <as shown in "Standard Installation Detail" in project manual detail book>.

3.10 TESTS

A. General: Test fuel supply lines with air under pressure before being covered. Use a calibrated, certified static gauge graduated to one pound per square inch.

B. Testing shall be of the complete piping system, before covering, or of individually separable larger portions of the system. Only the last connection to the appliance may be tested under operating conditions. This connection will be tested with soap and brush under line pressures. This connection must remain exposed.

C. Test Procedures: Use either of the following methods at the Contractor's option:

1. 50 psig air pressure for a period of 24 hours with no drop in gauge pressure, indicating the line to be airtight.
2. 125 psig air pressure, with joints tested with standard soap and brush inspection and maintain for 3 hours without drop in pressure.

D. Retesting: Retest piping failing initial tests following correction of defective work. Requirements of initial tests shall apply.

E. Test Records: Record pressure and ambient temperature at start and end of test. Submit written results of test to the Architect/Engineer.

END OF SECTION 231126

SECTION 23 34 00 - AIR HANDLING FANS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Exhaust Fans (Ceiling Type)

1.2 RELATED WORK

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this section and Contractor shall review and adhere to all requirements of these documents.

1. Section 230500 - Basic Mechanical Requirements.
2. Section 230529 - Basic Mechanical Materials and Methods.
3. Section 230540 - Mechanical Sound and Vibration Control.
4. Section 230548 - Mechanical Seismic Control.
5. Section 230593 - Testing, Adjusting and Balancing.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of specified fans with characteristics, sizes, and capacities required, whose specified fan has been in satisfactory use in similar service for not less than 3 years.

1.4 SUBMITTALS

A. Submit shop drawings and product data for the following items under provisions of the General Conditions of the Contract:

1. Shop Drawings: Submit assembly-type shop drawings showing unit dimensions, weight loadings, required clearances, construction details, and field connection details for each fan.
2. Product Data: Submit manufacturer's technical product data for all fans showing dimensions, weights, capacities, ratings, fan performance curves with operating point clearly indicated, motor electrical characteristics, gages and finishes of materials. Provide multiple-speed performance curves for fans with variable speed drives.

B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

1. All fans.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver fans with factory-installed shipping skids and lifting lugs; pack components in factory-fabricated protective containers.

B. Handle fans carefully to avoid damage to components, enclosures, and finish. Do not install damaged components; replace and return damaged components to fan manufacturer.

C. Store fans in clean dry place and protect from weather and construction traffic.

D. Comply with Manufacturer's rigging and installation instructions for unloading fans and moving them to final location.

1.6 EXTRA STOCK

A. Provide one spare set of belts for each belt-driven fan.

PART 2 - PRODUCTS

2.1 EXHAUST FANS (CEILING TYPE)

A. Acceptable Manufacturer: Subject to compliance with requirements, provide ceiling type exhaust fan of one of the following: Penn Co. (Zephyr Model), ILG, Pace, Cook, Jenn-Air, Greenheck, ACME, Carnes, Twin City Fan, Broan, Soler and Palau.

B. Type: Shall be of the centrifugal fan, integral grille, and housing type, all completely self-contained.

C. Capacity: Capacity and model number of the units shall be as shown on drawings and shall be certified by AMCA.

D. Motor and Drive: Fan shall be of the direct drive type, and maximum fan motor speed shall be 1150 RPM. Motor shall be of the permanently lubricated ball bearing type and shall be directly coupled to the fan. The motor and fan shall be easily removable thru the intake grille for service.

E. Housing: Shall be constructed of heavy gauge steel and shall be completely insulated internally with acoustical insulation material to deaden sound.

F. Backdraft Damper: Each fan shall be equipped with a nonmetallic backdraft damper constructed of neoprene and shall be shatterproof under all conditions.

G. U.L. Label: Each fan shall be approved by the Underwriters' Laboratories, Inc. and shall carry the U.L. Label.

H. Intake Grille: Shall be constructed of steel frame and woven steel grille with a minimum free area of 85%. Intake grille shall have a white, factory baked enamel finish.

PART 3 – EXECUTION

3.1 INSTALLATION OF FANS

A. Install fans where indicated, in accordance with equipment manufacturer's installation instructions, and with recognized industry practices, to ensure that equipment complies with requirements and serves intended purposes.

B. Coordinate with other work, including ductwork, floor construction, and electrical work as necessary to interface installation of air handling equipment with other work.

C. Access: Provide access space around fans for service as indicated, but in no case less than that recommended by manufacturer.

D. Do not operate fans for any other purpose, temporary or permanent, until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

E. Support: Install floor-mounted fans on 4" high reinforced concrete pad, 6" larger on each side than unit base in accordance with Section 230529.

F. Mounting: Mount fans on vibration isolators, in accordance with manufacturer's instructions and Section 230540.

G. Seismic Restraint: Provide seismic restraints in accordance with Section 230548.

H. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer with rotation in direction indicated and intended for proper performance. If there is no rotation arrow supplied by the manufacturer, install a correct rotation arrow.

I. Duct Connections: Refer to Division 23 Air Distribution sections. Provide ductwork, accessories, and flexible connections as indicated.

3.2 FIELD QUALITY CONTROL

A. Upon completion of installation of air handling equipment, and after motor has been energized with normal power source, test equipment to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment which cannot be satisfactorily corrected.

3.3 EXTRA BELTS

A. Deliver one spare set of belts for each belt-driven fan unit, obtain receipt from Owner that belts have been received.

END OF SECTION 23 34 00

SECTION 235216 - CONDENSING BOILERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes gas-fired, fire-tube condensing boilers, trim, and accessories for generating hot water.

1.3 SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for boilers.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings: For boilers, boiler trim, and accessories.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. ASME Stamp Certification and Report: Submit "A," "S," or "PP" stamp certificate of authorization, as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.
5. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.

1.4 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Fire-Tube Condensing Boilers:

a. Leakage and Materials: 10 years from date of Substantial Completion.
b. Heat Exchanger Damaged by Thermal Stress and Corrosion: prorated for five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Utah State and Pressure Vessel Compliance Manual, issued by Utah Labor Utah Labor Commission Division of Boiler, Elevator, and Coal Mine Safety

C. ASME Compliance: Fabricate and label boilers to comply with 2010 ASME Boiler and Pressure Vessel Code.

D. ASHRAE/IES 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil-Fired Boilers - Minimum Efficiency Requirements."

E. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N.

F. UL Compliance: Test boilers for compliance with UL 795. Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

G. Mounting Base: For securing boiler to concrete base.

1. Seismic Fabrication Requirements: Fabricate mounting base and attachment to boiler pressure vessel, accessories, and components with reinforcement strong enough to withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC" when mounting base is anchored to building structure.

2.2 FORCED-DRAFT, FIRE-TUBE CONDENSING BOILERS

A. Acceptable Manufacturers: Aerco Benchmark, Camus Advantus, Cleaver Brooks Clearfire C, Fulton Endura, Fulton Vantage, Lochinvar Crest, Viessmann CA3, Viessmann CM2

B. Description: Factory-fabricated, -assembled, and -tested, fire-tube condensing boiler with heat exchanger sealed pressure tight, built on a steel base, including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls.

C. Heat Exchanger: Nonferrous, corrosion-resistant combustion chamber.

D. Pressure Vessel: Carbon steel with welded heads and tube connections.

E. Burner: Natural gas, forced draft.

F. Gas Train: Combination gas valve with manual shutoff and pressure regulator.

G. Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.

H. Casing:

1. Jacket: Sheet metal, with snap-in or interlocking closures.
2. Control Compartment Enclosures: NEMA 250, Type 1A.
3. Finish: Baked-enamel protective finish.
4. Insulation: Mineral-fiber or polyurethane-foam insulation surrounding the heat exchanger.
5. Combustion-Air Connections: Inlet and vent duct collars.

I. Capacities and Characteristics

1. Heating Medium: Hot water.
2. Design Water-Pressure Rating: 160 psig.
3. Safety Relief Valve Setting: 125 psig.

2.3 TRIM

A. Include devices sized to comply with ASME B31.1.

B. Aquastat Controllers: Operating, and high limit.

C. Safety Relief Valve: ASME rated.

D. Pressure and Temperature Gage: Minimum 3-1/2-inch diameter, combination water-pressure and -temperature gage. Gages shall have operating-pressure and -temperature ranges, so normal operating range is about 50 percent of full range.

E. Boiler Air Vent: Automatic.

F. Drain Valve: Minimum NPS 3/4 hose-end gate valve.

2.4 CONTROLS

A. Controls:

1. Control transformer.
2. Set-Point Adjust: Set points shall be adjustable.
3. Sequence of Operation: See control specification 230900.

B. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.

1. High Cutoff: Automatic reset stops burner if operating conditions rise above maximum boiler design temperature.
2. Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be manual-reset type.
3. Blocked Inlet Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.

C. Building Automation System Interface: Factory install hardware and software to enable building automation system to monitor, control, and display boiler status and alarms.

1. Hardwired Points:

a. Monitoring: On/off status, common trouble alarm low-water-level alarm.
b. Control: On/off operation, hot-water-supply temperature set-point adjustment.

2. A communication interface with building automation system shall enable building automation system operator to remotely control and monitor the boiler from an operator workstation. Control features available, and monitoring points displayed, locally at boiler control panel shall be available through building automation system.

2.5 ELECTRICAL POWER

A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in electrical Sections.

B. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

1. House in NEMA 250, Type 1 enclosure.
2. Wiring shall be numbered and color coded to match wiring diagram.
3. Install factory wiring outside of an enclosure in a metal raceway.
4. Field power interface shall be to nonfused disconnect switch.
5. Provide branch power circuit to each motor and to controls with a disconnect switch or circuit breaker.
6. Provide each motor with overcurrent protection.

2.6 VENTING KITS

A. Kit: Complete system, ASTM A 959, Type 29-4C stainless steel, pipe, vent terminal, thimble, indoor plate, vent adapter, condensate trap and dilution tank, and sealant.

B. Combustion-Air Intake: Complete system, stainless steel pipe, vent terminal with screen, inlet air coupling, and sealant.

2.7 SOURCE QUALITY CONTROL

A. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

B. Test and inspect factory-assembled boilers, before shipping, according to 2010 ASME Boiler and Pressure Vessel Code.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting performance of the Work.

1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where boilers will be installed.

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

3.2 BOILER INSTALLATION

A. Equipment Mounting:

1. Install boilers on cast-in-place concrete equipment base(s).
2. Comply with requirements for vibration isolation and seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

B. Install gas-fired boilers according to NFPA 54.

C. Assemble and install boiler trim.

D. Install electrical devices furnished with boiler but not specified to be factory mounted.

E.

F. Install control wiring to field-mounted electrical devices.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to boiler to allow service and maintenance.

C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

D. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service. Flexible connectors and their installation are specified in Section 232116 "Hydronic Piping Specialties."

E. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas-train connection. Provide a reducer if required.

F. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.

G. Install piping from safety relief valves to nearest floor drain.

H. Boiler Venting:

1. Install flue venting kit and combustion-air intake.

I. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

J. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and water temperature.
b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

D. Boiler will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

G. Performance Tests:

1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
2. Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment to comply.
3. Perform field performance tests to determine capacity and efficiency of boilers.

    a. Test for full capacity.
    b. Test for boiler efficiency at low fire 20, 40, 60, 80, 100, 80, 60, 40, and 20 percent of full capacity. Determine efficiency at each test point.

4. Repeat tests until results comply with requirements indicated.
5. Provide analysis equipment required to determine performance.
6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are inadequate.
7. Notify engineer 24 hours minimum in advance of test dates.
8. Document test results in a report and submit to Architect.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 235216

SECTION 235700 - HEAT TRANSFER

PART 1 - GENERAL

1.1 RELATED WORK

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Related work specified in other Sections:

Section 230500 - Basic Mechanical Requirements
Section 230529 - Basic Mechanical Materials and Methods
Section 230540 - Mechanical Sound and Vibration Control
Section 230700 - Mechanical Insulation
Section 232113 - HVAC Piping and Specialties
Section 235200 - Boilers
Section 230593 - Testing, Adjusting and Balancing

1.2 SYSTEM DESCRIPTION

A. The work includes, but is not limited to providing the following:

1. Snowmelt Systems
2. Radiant Floor Heating Systems
3. Electric Radiant Ceiling Panels
4. Electric Unit Heaters

1.3 QUALITY ASSURANCE

A. Quality control shall be in accordance with Section 230500 - Basic Mechanical Requirements.

1.4 REFERENCES

A. Reference Standards: Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:

1. Comply with American National Standards Institute (ANSI B31.1) Code for Pressure Piping.

1.5 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings and Product Data for the following items in accordance with the General Conditions of the Contract:

1. Snowmelt System
2. Radiant Floor Heating Systems

B. Operating Instructions and Maintenance Data: Submit printed Operating Instructions and Maintenance Data for the following items in accordance with Operating and Maintenance Data paragraph in Section 230500:

1. Snowmelt System
2. Radiant Floor Heating Systems

PART 2 - PRODUCTS

2.1 SNOWMELT SYSTEM

A. Furnish and install in accordance with manufacturer's recommendations the hot water snowmelt system as indicated.

B. All components of system shall be provided by one manufacturer including pipe, manifold, manifold support brackets, wire ties, pipe bend supports, pipe couplings and splicing nipples.

C. Pipe shall be Onix, Crosslinked Polyethylene (PEX) or prior approved equal.

1. The minimum bend radius of the pipe shall not be greater than 7 times the diameter in cold bending.
2. The pipe shall include an oxygen diffusion barrier capable of limiting oxygen diffusion through the pipe to no greater than 0.1 mg/1 (104°F) and a hypalon jacket to protect the oxygen diffusion barrier and inner layer from moderate jobsite abuse.

D. Manifolds shall be of Type L or K hard copper body with brass branches and fittings.

E. All snowmelt and radiant piping and headers (tubing not included) to be insulated per energy code.

F. Contractor shall coordinate with GC for the radiant insulated shield beneath tubing.

G. Installations shall be made in accordance with the manufacturer's current written installation procedures, using manufacturer's approved fittings.

2.2 RADIANT FLOOR HEATING SYSTEM

A. Furnish and install in accordance with manufacturer's recommendations the radiant floor heating system as indicated.

B. All components of system shall be provided by one manufacturer including pipe, manifold, manifold support brackets, wire ties, pipe bend supports, pipe couplings and splicing nipples.

C. Pipe shall be crosslinked polyethylene rated at 180°F maximum working temperature and 100 PSI working pressure. Pipe shall be nominal 1/2" diameter and shall be manufactured in accordance with ASTM standard F876877.

1. The minimum bend radius of the pipe shall not be greater than 7 times the diameter in cold bending.
2. The pipe shall consist of three layers of materials. The interior layer shall be crosslinked polyethylene manufactured by the Engle method. The second layer shall be an oxygen diffusion barrier capable of limited oxygen diffusion through the pipe to no greater than .005 mg/ld (104°F). The third layer shall be crosslinked polyethylene and shall protect the oxygen diffusion barrier and inner layer from moderate jobsite abuse.
3. EPDM, Polybutylene piping and any type of polyolephine piping shall not be approved or considered on this project due to oxygen penetration characteristics.

D. Manifolds shall be cast bronze or stainless steel construction and have integral circuit balancing valves (with individual circuit control valves where required). Manifolds shall be provided with support brackets for wall mounting and pipe bend supports to allow tight bend of pipe up from slab to manifold. Manufacturer to provide bronze angle or straight valves to connect manifolds to supply and return piping. Straight or Angle valve to be suitable for isolation and balancing. Provide end cap with vents and hose adaptor on each manifold.

E. Warranty:

1. Crosslinked polyethylene pipe shall carry a 10 year non-prorated warranty against failure due to manufacturing defect or exposure to stress cracking agents. Manifolds and other for 1 year from system startup.

2.3 ELECTRIC UNIT HEATERS

A. Acceptable Manufacturers: Chromalox, Indeeco, Modine, Electromode, Sterling, Raywall, Markel, QMark.

B. Provide electric cabinet heaters and unit heaters of size and capacity as shown on Drawings.

C. Unit Cabinet: Shall be 14 gauge steel, enameled cabinet, color as selected by Architect, adjustable discharge louvers.

D. Motor and Blower Fans: Direct drive, blow-through design, two-speed motors and switch, resilient mounted. Motor and blower to be easily accessible for servicing. Bearings to be factory lubricated.

E. Electric Heating Elements: Fin-tube with helical fins with overheat protection. Unit to be furnished with thermostat for remote mounting as shown on drawings, tamperproof. Provide all contactors, relays, etc., as required. Entire unit to be U.L. approved.

F. Units to be provided with a summer-winter switch to allow operation without heat when desired. Operation as follows: Fan to be cycled by remote thermostat to maintain space temperature. Provide delay switch to keep fan from operating on call for heat until heating elements have warmed up.

2.4 ELECTRIC RADIANT CEILING PANELS

A. The required panels shall be constructed of 26 gauge galvanized steel back overlapping and riveted to a 22 gauge galvanized steel front. The panel heating element shall be a carbon (graphite) element, no resistance wires. The surface shall be a multi-faceted crystalline type which will demonstrate a watt density of 0.72 watts per square foot at a distance of six feet down from the center of the panel, if a low density panel (62.5 watts/sq. ft.) or 1.00 watt per square foot, if a high density panel (95 watts/sq. ft.). The rated input shall be: (95 watts sq. ft. with a surface temperature of not more than 200 degrees F.) The panel voltage and sizes shall be as scheduled. All panels shall come with not less than ten year warranty.

B. Panels shall contain 1", 1 PCF high temperature fiberglass insulation.

C. Provide frame as required for non-lay-in ceilings and assembly clips for all types of installation.

D. Provide minimum 40" flexible conduit and wiring per NEC.

E. Approved manufacturers: Airtex, Aztec, Vulcan, Chromalox, Raywall, QMark.

PART 3 - EXECUTION

3.1 SNOWMELT SYSTEM

A. Pipe joints beneath the pavement slab shall be avoided.

B. Provide factory supplied manifolds to terminate pipe loops:

1. Provide manifold supporting brackets to secure the assembly in a workmanlike manner.
2. Simple bend supports shall be provided to retain the pipe radius when a 90° bend is required. Two bend supports shall be supplied with each loop for use where the pipe run changes from horizontal to vertical.

C. Locate piping in slab with approximate 2" cover:

1. Utilize wire or plastic ties to secure piping to wire mesh to ensure that piping remains in place during pour. Division 23 Contractor is responsible for providing wire mesh and any chairs required to maintain the correct depth in the slab.
2. Insulation per Architectural drawings and specifications shall be provided by General contractor below topping slabs.
3. Each circuit of manifold shall have a balance valve.
4. Each manifold shall have a ball valve to balance flow to each manifold.

D. Tubing supplier shall provide tube layout for snowmelt areas indicated on contract documents.

E. Prior to pouring the slab, the completed piping system shall be filled with water, all air removed, and a pressure of 40 psi maintained for 24 hours.

F. Prior to pouring slab a detailed as-built drawing shall be prepared with the location of all piping dimensioned and accurately located. The supplier shall visit the site and certify that the installation is in conformance with the manufacturer's instructions and that as-built drawings are accurate.

3.2 RADIANT FLOOR SYSTEM

A. Pipe joints beneath the concrete topping slab shall be avoided. When essential, use splicing nipple to join piping in floor.

B. Provide factory supplied manifolds to terminate pipe loops.

1. Provide manifold supporting brackets to secure the assembly to the wall in a workmanlike manner.
2. Simple bend supports shall be provided to retain the pipe radius when a 90^{E} bend is required. Two bend supports shall be supplied with each loop for use where the pipe run changes from horizontal to vertical.

C. Locate piping in 8" concrete slab with approximate 1 1/2" cover.

1. Utilize wire or plastic ties to secure piping to wire mesh to ensure that piping remains in place during pour. Division 23 Contractor is responsible for providing wire mesh and any chairs required to maintain the correct depth in the slab.
2. Insulation per Architectural drawings and specifications shall be provided by General Contractor below slabs.

D. Radiant tubing supplier shall provide tube layout for snowmelt areas indicated on contract documents.

E. Prior to pouring the topping slab, the completed piping system shall be filled with water, all air removed, and a pressure of 100 psi maintained for 24 hours.

F. Prior to pouring topping slab a detailed as-built drawing shall be prepared with the location of all piping dimensioned and accurately located.

END OF SECTION 235700

DIVISION 26 – ELECTRICAL

SECTION 26 05 00 – BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Provide all items, articles, materials, equipment, operations and/or methods listed, mentioned, shown and/or scheduled on the drawings and/or in these specifications, including all labor, services, permits, fees, utility charges, and incidentals necessary and required to perform and complete the electrical work described in this Division. Apply for all permits early in the project to avoid problems due to code revisions.

B. See the contract conditions (general and supplementary) and Division 1 for requirements concerning this Division including, but not limited to, submittals, shop drawings, substitution requests, change orders, maintenance manuals, record drawings, coordination, permits, record documents and guarantees.

C. Division 26 Contractor shall be responsible for all work indicated by divisions 26, 27, 28, and the electrical portions of 33 within the drawings and specifications. Any work indicated by Division 16 shall be provided and installed by the Division 26 Contractor.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

A. Mechanical equipment motors to be furnished under another Division but connected under this Division. Starters to be mounted and connected by this Division, but furnished by another Division unless otherwise noted on the electrical drawings. Motor control centers shall be furnished and installed under this Division of the work. Verify and coordinate all equipment locations and electrical characteristics with other trades involved in the work. Coordination shall be done prior to rough-in or ordering equipment.

B. Control wiring for mechanical equipment beyond provisions shown on the Electrical Drawings shall be performed under another Division of the work.

1.3 QUALITY ASSURANCE:

A. Do all work in accordance with regulations and requirements of serving electric utility, telephone utility, cable TV utility, National Electrical Code, state and local codes and amendments, National Fire Codes, and all other applicable codes. Coordinate with local utility services prior to work and product release. Where Owners Design Standards have been incorporated into the design, the contractor shall refer to these Standards for additional clarification.

1.4 PROJECT CONDITIONS:

A. The Contractor shall inspect the job site prior to bidding and familiarize himself with existing conditions which will affect the work. Prior to start of work, obtain "As built", "Record", or other Drawings showing existing underground utilities.

B. Electrical drawings are diagrammatic indicating approximate location of outlets, lighting fixtures, electrical equipment, etc. Consult the Architectural, Structural, and Mechanical Drawings to avoid conflicts with equipment, structural members, etc. When required make all deviations from Drawings to make the work conform to the building as constructed, and to related work of others. Minor relocations ordered prior to installation may be made without added cost to Owner.

C. Call to the attention of the Architect any error, omission, conflict or discrepancy in Drawings and/or Specifications. Do not proceed with any questionable items of work until clarification of same has been made.

D. Under no conditions are beams, girders, footings or columns to be cut for electrical items unless so shown on Drawings or written approval obtained from the Architect.

E. Verify the physical dimensions of each item of electrical equipment to fit the available space and promptly notify the Architect prior to roughing-in if conflicts appear. Coordination of equipment to the available space and to the access routes through the construction shall be the Contractor's responsibility.

1.5 SHOP DRAWINGS:

A. Prior to ordering equipment, and prior to Contractor’s first application for payment, the Contractor shall, within 14 days after award of this work, submit complete shop drawings, electronic PDF copy with PDF index tabs, or six (6) hard copies neatly bound in 3-ring binder form, with indexed tabs, to the Architect, of materials and equipment he proposes to furnish. It is preferred that all sections be submitted at once, however, in the event that one or more sections need approvals quickly and others are not prepared yet, the Engineer will agree to review the individual section submittals needing immediate approval. However, each individual submittal section must be complete and remaining submittals that are not a rush shall be submitted all in one package as quickly as possible. Submitting individual sections over many weeks/months will not be tolerated.

B. List shall bear Contractor’s stamp, signature or other means to show that he has inspected same and certified that submitted material is correct in regard to quantity, size, dimension, quality and is coordinated with the Contract Documents.

C. See individual sections within this Division for products requiring submittal.

D. Each shop drawing submittal shall be prepared by the manufacturer, and shall clearly show manufacturer’s name, catalog numbers, pictures, details, layout, type, size, rating, style, and all options identified in a permanent fashion. Specific items or options shall be permanently marked on sheets containing more than one option – do not rely on the Engineer to mark options. Yellow highlight will not be an acceptable means of marking.

E. Large equipment drawings such as UPS systems, generators, transformers, switchboards, and similar large equipment shall include the size, weight, seismic rating, emissions data, elevation, and wiring diagrams in addition to the product data.

F. Some sections of this Division may require shop drawings prepared on full size floor plans in AutoCAD or other CAD software. Where required, contact the Architect for the latest version of the electronic plans and match the size and scale of the construction drawings. Drawings delivered to the contractor from the Architect/Engineer may not include addenda changes. Contractor shall only use electronic plans for purposes of the construction on this job, and not for any other use or reuse. Add any required addenda items prior to finishing shop drawings and submittals.

G. Provide complete materials (all materials) list at the beginning of each tabbed section showing “Submittal Number”, “Specification Section”, “Material Item”, “Manufacturer’s Name and Catalog Number”, and all pertinent data.

H. Provide samples where required in individual sections of this Division.

I. Contractor agrees that Shop Drawing Submittals processed by the Architect are not Change Orders; that the purpose of Shop Drawing Submittals by the Contractor is to demonstrate to the Architect that the Contractor understands the design concept, that they demonstrate their understanding by indicating which equipment and material they intend to furnish and install and by detailing the fabrication and installation methods they intend to use.

J. Contractor further agrees that if deviations, discrepancies or conflicts between Shop Drawings and Specifications are discovered either prior to or after Shop Drawing Submittals are processed by the Architect/Engineer, the design Drawings and Specifications shall control and shall be followed.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. All materials shall be new and bear manufacturer's name, model number, electrical characteristics and other identification. All equipment to be U.L. approved or listed by another testing agency approved by authorities having jurisdiction.

B. Material and equipment shall be standard product of manufacturer regularly engaged in production of similar material for at least five years (unless specifically exempted) and shall be manufacturer's latest design.

C. If the description of a product is in conflict with the product as specified in the catalog number, the description shall generally take precedence. Contact the Architect for clarification if this occurs.

D. All equipment must be rated and certified for the appropriate seismic design category or seismic use group for the installed geographical location. For essential or life safety equipment, provide an additional seismic factor of 1.5.

2.2 DISCONNECTS:

A. Safety and disconnect switches to be Heavy duty quick-make, quick-break, dual rated, lockable, and of such electrical characteristics as required for the load served. Switches to have defeatable cover interlock.

B. Fuse clips shall accept Class R or Class L fuses if required. Motor rated toggle switches equal to Square D Class 2510, type F with thermal overloads may be used as motor disconnects in dry locations.

C. Disconnect switches required by code shall be installed whether or not specifically shown on the Drawings.

D. Disconnect switches for refrigeration equipment and multiple motor HVAC equipment shall be fusible type.

E. Safety and disconnect switches (fuse, non-fuse or circuit-breaker type) to be of same manufacturer as switchgear and panelboards.

2.3 FUSES:

A. Provide fuses as indicated on the drawings, sized per NEC, or as required by the equipment manufacturer, whichever provides maximum protection, for a fully operational system.

B. All fuses shall be furnished of the same manufacturer.

C. All fuses shall be installed by the electrical contractor at job-site and only when equipment is to be energized. Fuses shall not be installed during shipment.

D. All fuses to be 200,000 AIC, Current-limiting, U.L., Time Delay, Dual-element Type as follows:

1. For feeders 601 Amps to 6000 Amps:

    a. Class L, KRP-C, KLPC, & A4BQ

2. For feeders 600 Amps and less:

    a. Class RKk-1 for 600 volt; LPS-RK, LLS-RK, & A6D-R
    b. Class RK-1 for 250 volt; LPN-RK, LLN-RK, & A2D-R
    c. Class J; JHC, JTD, & AJT

3. For motor circuits beyond the main and sub distribution boards, 600 volt and below:

    a. Class RK-5 for 600 volt; FRS-R, FLS-R, & TRS-R
    b. Class RK-5 for 250 volt; FRN-R, FLN-R, & TR-R

E. Approved Manufacturers, with catalog numbers listed in order: Bussman, Littelfuse, Ferraz Shawmut.

F. If the electrical contractor wishes to furnish materials other than those specified, a written request, along with a complete short circuit and selective coordination study, shall be submitted to the engineer for evaluation at least 8 days prior to the bid date. If the engineer's evaluation indicates acceptance, a written addendum will be issued listing the other acceptable manufacturer.

2.4 BOXES:

A. Outlet and junction boxes shall be sized in accordance with code requirements or as noted on the drawings.

B. Unless otherwise specified or shown on the drawings, all outlet boxes for new work shall be galvanized steel knockout, outlet boxes. Gangable boxes are not acceptable. Outlet boxes shall not be smaller than 4" square and 1-1/2 inches in depth, unless otherwise noted. All outlet box covers, rings, or other fittings shall be galvanized. Boxes which are exposed to the weather shall be cast metal. Outlet boxes for phone and data outlets shall be 2.5" deep boxes.

C. Outlet boxes shall be designed for the intended use, and shall be installed flush with finish surface lines or not more than 1/8 inch back and shall be level and plumb. Long screws with spaces or shims for mounting devices are not acceptable. No combustible materials shall be exposed to wiring at outlets.

D. Outlet boxes on opposite sides of fire or sound isolating partitions shall have a minimum horizontal separation of 24". Back to back boxes are not permitted in any walls.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION METHODS:

A. All items, articles, materials, and equipment specified under this Division shall be installed per the manufacturer's installation instructions. Where the manufacturer's instructions are in conflict with the directions provided elsewhere in this Contract, the Engineer shall be notified prior to beginning rough-in.

B. Cutting or notching shall be kept to an absolute minimum and done when, and in a method approved by the Architect. Patch and correct finished surfaces damaged by electrical work.

C. Relays, panels, cabinets and equipment shall be level and plumb and installed parallel with structural building lines. All equipment and enclosures shall fit neatly without gaps, openings, or distortions. Provide approved devices for closing all unused openings.

D. Arrange circuit wiring as shown on the Drawings and do not alter or combine runs or homeruns without the specific approval of the Architect. Feeder runs shall not be recombined or altered.

E. Contactors, transformers, starters and similar noise producing devices shall not be placed on walls which are common to occupied space.

F. Ballasts, contactors, starters, transformers and like equipment which are found to be noticeably noisier than other similar equipment on the project will be deemed defective and shall be replaced.

G. In general, the mounting heights shall be as noted on the Drawings, or as listed below, the Architectural Interior Elevations and drawing notes taking precedence. Where no heights are indicated, request clarification from the Architect. Consult the Architectural, Mechanical and Structural drawings to avoid conflicts prior to roughing-in and for exact locations. All dimensions are to the top of the back box or device whichever is higher. Lighting dimensions are to the bottom of suspended fixtures and center of wall mounted fixtures unless otherwise noted.

Light Switches	48 inches to center
Convenience Receptacles	18 inches to center
Data/Telephone Outlets	18 inches to center
Receptacles and Outlets Over Counters	10 inches above counter or 5 inches above Backsplash to top, whichever is greater.
Panelboard	72 inches to top
Disconnects and Motor Controllers	72 inches to top
FACP and NAC panels	72 inches to top
Fire Alarm Signals	96 inches to top (but at least 6" below ceiling)
Fire Call Stations	48 inches center
Fire Alarm Annunciator	66 inches to top

H. Where raceways penetrate floors, ceilings, ducts, chases, and fire walls, provide fire stopping to maintain integrity of the fire assembly. Firestopping method shall be approved by the Code Authority having jurisdiction.

I. All materials and equipment installed under this work shall be properly and adequately supported from the building structure except where ceiling construction or other provisions are specifically designed to support them. Support systems shall provide a safety factor of four. This shall apply to chains, hangers, anchors, clamps, screws, structural iron, and all other hardware and appurtenances associated with the support system.

J. Rough-in for communications outlets for phone and data systems shall consist of a 4" square deep (4SD) box with a single gang mud ring. Provide a .75" conduit for wall phones and a 1" conduit for combination voice and data outlets to an accessible ceiling space. Conduit shall be terminated above the ceiling in a bushing and a pull string installed.

K. Maintain the following minimum separations from voice and data cables. Power conduit - 12", transformers and motors - 40", fluorescent lighting - 12". Coordinate with the voice and data installer to assure these separations are met.

3.3 LABELING:

A. Clearly and properly label the complete electrical system to indicate the loads served or the function of each item of equipment provided under this work.

B. Permanent Engraved nameplates: shall be 1/16 inch thick, laminated three-ply plastic, center-ply white, outer-ply black (for normal power) or red (for emergency power) or orange (for UPS power) "Lamicoid" or equal. Letters shall be formed by engraving outer colored ply, exposing white center-ply, and shall be a minimum of 5/8 inch high. Nameplates shall be secured with screws or pop rivets.

C. Provide permanent engraved nameplates for the equipment listed below as well as all other similar equipment; refer to each section for specific labeling requirements:

1. Medium Voltage Switches, Switchgear and Sectionalizing Cabinets
2. Service Equipment, including the maximum available fault current and date calculated as provided by Engineer
3. Switchboards and Panelboards
4. Transformers, UPS's, and Surge Protection Devices
5. Motor Control Centers (MCC), Motor Controllers, Variable Frequency Drives (VFD), Safety Disconnects
6. Generators and Automatic Transfer Switches
7. Other similar electrical devices and equipment

D. Self-Adhesive Labels: shall have self-adhesive "P-Touch" or equivalent sticky backs, black lettering with a clear (see through) background.

E. Provide self-adhesive labels for the devices and equipment listed below as well as all other similar equipment; each label shall list the applicable circuit number feeding the device and devices fed from Emergency or UPS power shall also list "EMERGENCY" or "UPS" as applicable next to the circuit number (for example, a receptacle fed from circuit 2 in panel 1P1 would read "1P1-2" on the label):

1. Thermal Switches and Manual Starters
2. Power outlet receptacles
3. Light Switches, Wall Mount Occupancy Sensors, and Wall Mount timeswitches

F. For Service switchboards, panelboards, and/or disconnecting means, provide a permanent engraved label indicating maximum available fault current as calculated by the Engineer. Include the date calculation was made.

G. Where existing service entrance components are modified, including where conductors are increased in size, or the service transformer or service disconnecting means is replaced or increased in size, provide a new permanent engraved label on each service switchboard, panelboard, and/or disconnecting means with required information as indicated by the National Electrical Code.

H. Provide neat and clearly legible handwritten labeling using a permanent “Sharpie” or equivalent chisel tip black marker for all junction boxes containing power and fire alarm wiring. Label each junction box with the applicable circuit number(s) for the cables contained within each junction box in a location and large enough to be clearly visible from the floor.

3.4 SAFETY:

A. The Engineer has not been retained or compensated to provide design and construction review services relating to the Contractor's safety precautions or to means, methods, techniques, sequences or procedures required for the contractor to perform the work.

3.5 TVSS (Transient Voltage Surge Suppression) INSTALLATIONS

A. When TVSS units are specified, they are to be shipped with complete installation instructions which are to be followed in detail. The manufacturer’s representative is always to be contacted and is to supervise the TVSS installation.

B. Supplemental installation information is as follows:

1. Use the breaker space closest to the neutral bus. Nipple the suppressor to the panel where the suppressor can be installed so as to keep both the hot leads and the neutral lead as short and straight as possible from the suppressor to the breakers and the neutral bus.
2. The best performance is achieved with the shortest leads and neutral. All efforts within the code should be used to minimize the lead lengths. Ideally the leads should be less than eight inches long. Each inch of lead above six inches will add approximately 20 volts to the quoted let-through voltage. Cut the leads down to the shortest size that will allow installation.
3. If the neutral bus is out of reach of the leads, then a #4 AWG conductor is to be run from the remote neutral bus to a lug near the suppressor, and the lead from the suppressor should be cut as short as possible.
4. The ground is to be connected to the case of the panel (equipment ground only). Do not connect the suppressor ground wire to an isolated ground (IG) bus.

3.6 EQUIPMENT CONNECTIONS:

A. The location and method for connecting to each item of equipment shall be verified prior to roughing-in. The voltage and phase of each item of equipment shall be checked before connecting. Motor rotations shall be made in the proper direction. Pump motors are not to be test run until liquid is in the system and proper lubrication to all bearings in unit is checked.

B. Conduit, wire and circuit breaker sizes for mechanical, elevator and similar equipment are based on the equipment ratings of one manufacturer. The equipment actually furnished may have entirely different electrical characteristics. Conduit, wire, circuit breakers, disconnects, etc. shall not be ordered or installed until exact electrical requirements are obtained. Responsibility for this coordination rests with the Contractor.

3.7 SEISMIC BRACING:

A. Furnish and install all seismic bracing of equipment, feeders, lighting fixtures, and other electrical items in accordance with prevailing codes. Refer to ASCE 7-10, section 13.3 and 13.6 for calculation methods. Provide and submit the required designs, calculations, certifications, and stamped drawings to the authority having jurisdiction and obtain their approval prior to installation or fabrication.

B. Where conduit, cable trays, or busducts are attached to structures where they cross a seismic isolation interface, the electrical components shall be designed to accommodate the seismic relative displacement.

3.8 PAINTING:

A. All electrical equipment and conduit exposed in finished areas and on exterior walls are to be painted to match surrounding surfaces.

B. Contractor shall coordinate the timing of painting requirements.

C. Refer to Architectural specifications for methods and materials.

3.9 PROJECT RECORD DOCUMENTS:

A. Maintenance of Documents:

1. Maintain at Jobsite, One Record Copy of: Contract Drawings, Specifications, Addenda, Reviewed Shop Drawings, Change Orders, Other Modifications to Contract and Field Test Records.
2. Keep apart from documents used for construction.
3. Keep documents available at all times for inspection by Architect.

B. Recording:

1. Label each document "PROJECT RECORD."
2. Keep record documents current. Do not permanently conceal any work until required information has been recorded.
3. Contract Drawings, legibly mark to record actual construction; including but not limited to the following:

   a. Depths of various elements; locations of underground items, with dimensions to building walls and corners; changes of dimensions and details; changes made by Addendum, Field Orders or Change Order.
   b. Specifications and Addenda; legibly mark each Section to record changes made by Addendum, Field Order or Change Order.

C. As-Built Submittals:

1. At completion of project, transfer changes, addenda items, variations from drawings, exact routes of all feeders and service conduits, and locations of stubbed conduits to clean new prints and specifications which will be supplied by the Architect and deliver to the Architect as "As-reported Record" drawings. Include dimensions to all buried or concealed conduits to permanent structures.

D. Operation and Maintenance Manuals

1. At completion of project, prepare Operation and Maintenance Manuals with operation and Maintenance Data, contractors warranties, and copies of approved electrical permits. Include corrected copies of original submittals and shop drawings.
2. See Division 1 for additional requirements.

3.10 WARRANTIES:

A. Provide a minimum 1 year warranty on all electrical equipment, devices, labor, and work by Division 26 whether specified or not.

B. Provide warranties greater than 1 year as specified in other sections where stated. The warranty requirement most stringent shall be used where conflicts arise.

C. Provide copies of all warranties to the owner upon completion of the project.

3.11 COMPLETION:

A. Complete each system as shown or specified herein and place in operation except where only roughing-in or partial systems are called for. Each system shall be tested and left in proper operation free of faults, shorts or unintentional grounds. Demonstrate system in the presence of the Architect, the Owner or their representative when requested.

3.12 FINAL OBSERVATION:

A. Contractor shall submit written certification that:

1. Contract Documents have been reviewed.
2. Contractor has inspected Project for compliance with Contract Documents.
3. Work has been completed in accordance with Contract Documents.
4. Equipment and Systems have been tested and are operational.
5. Project is completed and ready for final inspection.

B. Architect will make final inspection as soon as possible after receipt of Certification.

C. Should Architect consider that work is finally complete in accordance with Contract Document requirements, Contractor shall make Contract Closeout submittals.

D. Should Architect consider that work is not finally complete:

1. He will so notify Contractor, stating reasons.
2. Contractor shall take immediate steps to remedy deficiencies, and send second written notice to Architect certifying that work is complete.
3. Architect will re-inspect work.

E. The Architect will make two final inspections. The first will determine deficiencies and errors in the work and the second will determine whether or not the noted deficiencies and errors have been satisfactorily corrected.

F. If additional inspections are required because of the Contractor's failure to complete the deficiencies and errors prior to the second inspection, costs for the successive inspections will be back-charged to the Contractor by the Owner, who, in turn, will reimburse the Architect. Charges will be based as follows:

1. Architect time at current billing rates.
2. Travel time, and all other expenses incurred in making inspections.

G. Contractor to provide one (1) journeyman, tools, meters, instruments and other test equipment required by Architect. Contractor to remove and replace trims, covers, fixtures, etc., for Architect to review and test materials, systems, methods and workmanship. (Example: Removing switchboard and panel covers to take voltage/amp readings, review connections and wire size, etc.)

END OF SECTION

SECTION 26 05 13 – WIRES AND CABLES OVER 600 VOLTS

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Provide all medium voltage 15 kV wires and cables as herein specified and shown on the associated drawings.

B. Provide all required terminations, splices, raceway, mounting equipment as required for a complete medium voltage wiring system.

C. Provide all required testing and testing reports as herein specified and shown on the associated drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

A. Basic Materials and Methods – Section 26 05 00.

B. Raceways – Section 26 05 33.

1.3 QUALITY ASSURANCE:

A. All wire and cable shall meet or exceed the following standards:

1. ASTM-B series specifications
2. Insulated Cable Engineers Association (ICEA) ICEA S-94-649
3. NEMA WC74
4. AEIC
5. U.L. listed.
6. National Electric Code (NFPA 70) – Latest edition

B. Testing shall be by High Potential DC (new cables only) and/or Offline VLF Partial Discharge testing and/or high frequency Online Partial Discharge testing in accordance with the following standards.

1. NETA 7.3.3 and Table 100.6 (Hi Pot testing)
2. ANSI/IEEE 400
3. ICEA S-93-639/NEMA WC74-2000
4. ANSI/ICEA S-94-659-2000
5. ANSI/ICEA S-97-682-2000

C. Only journeyman or master electricians with medium voltage termination training and experience of at least three years working on medium voltage projects shall perform the splicing and terminations of the medium voltage cable. Apprentices or non-experienced journeyman may witness, but shall not perform any of the work.

D. Manufacturers shall be engaged in the manufacturing of industry accepted quality wires and cables for a period of no less than 5 years for all types and sizes required.

E. Each reel of cable furnished shall be newly manufactured (no more than 12 months old) and shall bear a tag containing the name of manufacturer, NEC designation and year of manufacture.

1.4 SUBMITTALS:

A. Submit complete and descriptive shop drawings indicating compliance with the specifications herein as well as any additional information requested by the A/E. Include submittals for all cables, terminations and splices.

B. Include shop drawings for termination products to each new and existing switch and transformer after field verifying the termination product on the existing switches.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Subject to the final approval and acceptance by the A/E and Owner, provide cable products from one of the following manufacturers:
1. General Cable
2. Okonite

B. Subject to the final approval and acceptance by the A/E and Owner, provide molded product deadbreak and loadbreak termination products from one of the following manufacturers:
1. Thomas and Betts Elastimold
2. Cooper
3. 3M

C. Subject to the final approval and acceptance by the A/E and Owner, provide splice products from one of the following manufacturers:
1. Raychem
2. 3M

D. Subject to the final approval and acceptance by the A/E and Owner, provide Fire and Electric Arc Proofing Tape products from one of the following manufacturers:
1. 3M

E. Requests for substitution of other products will be considered if submitted in accordance with the General Conditions, Division 01, and Section 26 05 00 to the A/E office within (8) business days prior to the bid opening day.

2.2 MEDIUM VOLTAGE WIRES & CABLES:

A. Provide single conductor cables only, (3) conductor cables are not allowed.

B. Conductor shall be stranded, Class B annealed copper, covered with an extruded semi-conducting EPR strand screen, 220 mil ethylene propylene rubber insulation extruded EPR semi-conducting insulation screen, 5 mil bare copper shielding tape with 12-1/2% minimum overlap, with 80 mil flame retardant PVC jacket overall, 15kV type, ungrounded neutral, 133% insulation level.

C. Conductor strand screen, insulation and insulation screen shall be extruded simultaneously (triple tandem extrusion). Color differentiation shall be accomplished by using black semi-conducting layers and red insulation.

2.3 MEDIUM VOLTAGE TERMINATIONS:

A. Provide terminations as shown on the associated drawings and as required for the complete installation of the cable system.

B. Terminations at existing switches shall be as required to terminate to the existing switch and shall match the existing switch termination type, confirm termination type for all existing switches prior to submittals to ensure compatibility.

2.4 MEDIUM VOLTAGE SPLICES:

A. Provide splices as shown on the associated drawings and as required for installation of the cable based on the conditions of the installation and other factors such as length of remaining cable on reels.

B. Provide Raychem heat shrink splices or 3M cold shrink splices for all through cable splices. Size splices as required for cables, confirm size of all existing cables prior to submittals to ensure compatibility.

C. Where splicing from copper wiring to aluminum wiring, provide a splice kit that is compatible with both materials. Follow manufacturers written instructions on how to prepare the cables for splicing.

2.5 FIRE AND ELECTRIC ARC PROOFING TAPE:

A. Provide tape composed of a flexible conformable intumescent elastomer. Tape shall be not less than 0.30 inch thick and white in color.

B. Tape shall be noncorrosive to the cable sheath, noncombustible, and shall self-extinguish.

C. Tape must not deteriorate when exposed to oil, water, gases, salt water, sewage, or fungus.

PART 3 – EXECUTION

3.1 GENERAL INSTALLATION METHODS:

A. Cable shall be installed in conduit as shown on drawings. All conduits with horizontal bends shall have a minimum bending radius of five feet. All conduits with vertical bends shall have a minimum bending radius of four feet.

B. Terminate cable in stress cones and/or load break ells at transformers and pad mounted switchgear as applicable.

C. Splices shall not be allowed in raceway. Splices in vaults shall be racked to vault walls on porcelain insulators.

D. All terminations shall be taped and wrapped per manufacturer's instructions and industry standards

E. Feeders within manholes shall be color coded, phase 1 Red, phase 2 Yellow, phase 3 Blue.

3.2 LABELING:

A. Provide a 1/16" thick x 2" tall x 3" wide laminated three-ply plastic, center-ply black, outer-ply yellow "Lamicoid" or equal. Letters shall be formed by engraving outer yellow ply to expose black lettering. Lettering shall be a minimum of ½" high. Attach label by drilling a small hole in one corner of the label and affixing the label to the cable with the use of nylon cable ties or equivalent.

B. Labels shall be provided for each cable at the following locations:

1. In the manhole or vault within 12" to 24" of where the cable enters and exits the manhole or vault where easily visible.
2. Within approximately 36" of termination on each switch or transformer where easily visible.
3. Each individual phase shall be provided with it's own label at the required locations.

C. Label information shall be coordinated with the Owner prior to creation of labels and will include at minimum: Feeder name (for example – South Loop 1), phase (for example - Phase A), cable construction type (for example – EPR), cable size (for example #350) and date of cable installation (for example - 08/01/2017).

3.3 COMMISSIONING AND TESTING: HIGH POTENTIAL DC TESTING (NEW CABLES ONLY):

A. All Testing shall be provided by an independent subcontractor to the Electrician.

B. Test the insulations of the new installed cables by standard high potential methods with DC voltages.

C. Do not test existing cables with high potential DC method as damage may result. Make sure all existing cables are disconnected from test aperatus where new cable testing is occurring. Use high frequency partial discharge testing for existing cables or mixes of new and existing cables.

D. Exercise suitable and adequate safety measures prior to, during and after the high potential tests including placing warning signs and preventing people and equipment from being exposed to the test voltages. Prior to applying the test voltages to the cables, disconnect all equipment that might be damaged by the test voltages.

E. Test cables after all terminations and splices are completed. Where cable terminations are seperable, or where installed switch allows isolation, test each section independently.

F. Increase and decrease the test voltages on the cables (between the voltage levels at which the test readings are made) at a rate of not more than 200 volts per second. Monitor the testing equipment closely and stop applying the test voltages when the equipment indicates that the leakage currents are increasing excessively.

G. Where weak points are detected in the new cables, eliminate the weak points and replace the cables.

H. Test voltages shall be maintained at each step for the full recommended time (usually 15 minutes). Exception will be the maximum test voltage. Maintain the maximum test voltage for five minutes for each test.

I. Read and record the test voltages and leakage currents for the cables being tested at approximately 4000 volt intervals, starting and finishing with zero test voltages. Allow the charging currents to diminish before reading the meter so that correct values can be determined for the leakage currents.

J. Plot curves for the test voltages and leakage currents on a separate graph for each test. Use log-log graph paper with time and voltage along the horizontal axis and current along the vertical axis, one curve for current versus voltage, and one curve for current versus time.

K. Submit four certified copies of each of the graphs in O&M manuals to the Engineer, with adequate information shown for identifying the cable locations, types, voltage ratings and sizes.

3.4 WARRANTY:

A. Cable shall carry a two-year warranty after shipment.

B. General 1 year warranty shall apply to installation and other products and installation used under this section.

END OF SECTION

SECTION 26 05 19 – WIRES & CABLES (600V)

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Provide all wires and cables as herein specified and shown on the associated drawings for service conductors, feeder conductors and branch circuit conductors.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

A. Basic Material & Methods – Section 26 05 00.

B. Raceways – Section 26 05 33.

1.3 QUALITY ASSURANCE:

A. All wire and cable shall meet or exceed the following standards:

1. ASTM-B series specifications
2. ICEA S-61-402/NEMA WC 5 - Thermoplastic insulated cables 0-2000 volt
3. UL Standard 62 and 83 – Thermoplastic insulated cable
4. UL VW-1 Flame Test for sizes #12 through #1
5. National Electric Code (NFPA 70) – Latest edition

B. Manufacturer's shall be engaged in the manufacturing of industry accepted quality wires and cables for a period of no less than 5 years for all types and sizes required.

1.4 SUBMITTALS:

A. None required.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Provide products of Southwire, Houston Wire, Rome Cable, or similar manufacturer located within the continental North American market. Cables made in Europe, Asia, South America, Africa, or other overseas markets are not acceptable.

B. Substitutions: Equivalent manufacturers are allowed at contractors option, no submittals or prior approvals are necessary if cable meets specifications.

2.2 MATERIALS:

A. Application: For use in general wiring applications for lighting and power in ducts, conduits, wireways and other approved raceways with a maximum conductor temperature of 90 degrees C in dry locations and 75 degrees C in wet locations.

B. Provide wires and cables that are chemical, gasoline, and oil resistant. Provide wires and cables that are sunlight resistant.

C. Minimum conductor size shall be No. 12 AWG unless otherwise noted.

D. Where adverse conductor exposure exists, code approved insulation suitable for the conditions encountered shall be used unless shown otherwise on the Drawings.

E. Wire and cable shall be new, shall have grade of insulation, voltage and manufacturer's name permanently marked on outer covering at regular intervals and shall be delivered in complete coils or reels with identifying size and insulation tags.

2.3 COPPER CONDUCTORS:

A. For No. 10 AWG and smaller provide soft drawn stranded copper conductors with type THHN/THWN insulation.

B. For No. 8 AWG and larger provide soft drawn stranded, Class B stranded copper conductors with type THHN/THWN insulation.

2.4 ALUMINUM AND/OR METAL CLAD (MC) CABLING OPTIONS:

A. Aluminum and MC Cabling not acceptable – Provide copper only conductors.

2.5 COLOR CODE:

A. All wires shall be fully colored in sizes 12 through 6 AWG, and color banded at each end with colored tape at all terminations, panels, equipment, junction boxes, and pull boxes for sizes 4 AWG and larger.

B. Color Code throughout the project shall be:

1. 480Y/277V System

Phase A	Brown
Phase B	Orange
Phase C	Yellow
Neutral	Grey
Neutral A (dedicated)	Grey w/brown stripe #12 & #10
Neutral B (dedicated)	Grey w/orange stripe #12 & #10
Neutral C (dedicated)	Grey w/yellow stripe #12 & #10
Equipment Ground	Green

2. 208Y/120V System

Phase A		Black
Phase B	Red	
Phase C	Blue	
Neutral		White
Neutral A (dedicated)		White w/black stripe #12 & #10
Neutral B (dedicated)		White w/red stripe #12 & #10
Neutral C (dedicated)		White w/blue stripe #12 & #10
Equipment Ground		Green

C. Provide a permanent, plastic engraved label on the inside of each branch-circuit panelboard throughout the project identifying the Color Code used throughout the project. Refer to NEC 200.6 (D).

2.6 SPLICES AND TERMINATIONS:

A. Splices shall utilize Scotch "Hyflex" or "Ideal" wing nut connector installed properly. Crimp on splices designed to be used without wire stripping are not acceptable.

B. Splices for No. 8 and larger wires shall be made with mechanically applied pressure type connectors.

C. All taped joints shall be with "Scotch 33+" or equal, applied in half-lap layers without stretching to deform.

D. Where splice box is subject to rain, weather, or moisture, provide “Rain Tight” termination device.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Inspect exposed cables for physical damage and remove as length allows.

B. Utilize pulling compound on long pulls. Ensure that cable reels and pulling apparatus are firmly secured prior to pulling. Use pulling attachments and materials including approved swivel connections, pulling eyes, and/or friction tape as applicable. Carefully follow all applicable safety requirements when pulling cables.

C. Do not exceed manufacturers recommendations for maximum allowable tension, or side wall pressure. In all cases, pulling tension applied to the conductors shall be limited to 0.008 lbs. per circular mil of conductor cross-section area.

D. Do not exceed manufacturers recommendations for minimum allowable bending radius. For training of cables, minimum bend radius to inner surfaces of cable shall be 12 times cable diameter. Where cable is pulled under tension over sheaves, conduit bends, or other curved surfaces, make minimum bend radius 50% greater than specified above for training.

E. Provide dedicated neutrals on all branch power receptacle circuits of 120/208 volt.

3.2 BRANCH CIRCUIT GROUNDED CONDUCTOR (NEUTRAL) WIRING METHODS:

A. Dedicated (separate) neutral wiring methods

2. Provide dedicated (separate) neutral for each branch circuit; shared/common neutral wiring is not allowed.
3. For dedicated neutral branch wiring, there shall be no more than six (6) current carrying conductors allowed within a single raceway unless specifically allowed otherwise in the drawings. All neutral conductors shall be considered current carrying. Provide all required wire size increases to account for the applicable NEC wire ampacity deratings.
4. Provide dedicated neutral cables with colored stripe as required in wire color coding section for identification.

B. Shared neutral wiring methods

1. Shared neutral wiring is not permissible.

3.3 PARALLELED CONDUCTORS:

A. Under no condition shall conductors less than #1/0 AWG copper be run in parallel. Where paralleled runs are used, the contractor must cut to exact length on each phase leg. Where parallel conductors are run in parallel conduits, each conduit shall carry all phase legs as well as neutral, equipment ground, and/or isolated ground conductor as applicable.
B. Size parallel ground conductors as per NEC 250.

3.4 SPLICES AND TERMINATIONS:

A. Splices are to be made up complete promptly after wire installation.

B. Single wire pigtails shall be provided for fixture and device connections. Wirenuts may be used for fixture wire connections to single wire circuit conductor pigtails.

C. Install wing nut connector properly, according to manufacturers written instructions. Crimp on splices designed to be used without wire stripping are not acceptable.

D. Torque bolted connections to manufacturers recommendations. Torque both ends of the cable, or parallel cables, to the same Torque level.

E. Insulation shall be removed with a stripping tool designed specifically for that purpose. A pocket knife is not an acceptable tool. All conductors shall be left nick-free.

F. Thermoplastic insulated wire and cable shall not be installed or handled in temperatures below +14 degrees F (-10 C). Cross-linked polyethylene insulated wire and cable may be installed to -40 degrees F (-40 C).

3.5 LABELING:

A. Service Cables - Provide an engraved laminated 3-ply plastic "Lamicoid" or equal label which designated as "SERVICE CABLE(S)" attached with a nylon wire tie to the cables at each entry and exit from pullboxes, wireways and any other similar locations.

B. Feeders – Provide an engraved laminated 3-ply plastic "Lamicoid" or equal label with feeder name attached with a nylon wire tie to the feeder at each entry and exit from pullboxes, wireways and any other similar locations.

C. Branch Circuits – Clearly mark and identify the circuit number(s) at each junction box and similar location with a permanent black marker or equivalent that is clearly visible. For concealed junction boxes the marking shall be made on the outside coverplate; for exposed boxes or boxes with finished coverplates marking shall be made on the interior of the box where visible when removing the coverplate.

3.6 COMMISSIONING AND TESTING:

A. Contractor shall provide for access and inspection of installed wires and cables by the Architect/Engineer, owner and commissioning agent.

B. Document all tests and provide written copies in the O&M manuals.

C. Perform continuity tests and resistance measurements through bolted connections to ensure correct cable connections.

D. Perform insulation resistance test on all feeder conductors exceeding 100 amps, size #2 and larger. Values shall not be less than 50 megaohms.

END OF SECTION

SECTION 26 05 26 – GROUNDING AND BONDING

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Provide all grounding and bonding as code required and as herein specified and shown on the associated drawings.

1.2 APPLICATION:

A. All grounding and bonding shall be by copper only connectors, copper cable and wire, and/or copper braids.

1.3 RELATED WORK SPECIFIED ELSEWHERE:

A. Basic Material & Methods – Section 26 05 00.

B. Wires & Cables – Section 26 05 19.

1.4 QUALITY ASSURANCE:

A. All installation of grounding and bonding conductors shall meet or exceed the following standards:

1. ANSI/IEEE 142 for service ground electrode resistance (5 ohms).
2. Ground electrode resistance at manholes and pad vaults (5 ohms)
3. Ground electrode resistance at transformers (10 ohms)
4. ASTM B 8 stranded conductors
5. ICEA S-61-402/NEMA WC 5 - Thermoplastic insulated cables 0-2000 volt
6. UL Standard 62 and 83 – Thermoplastic insulated cable
7. UL VW-1 Flame Test for sizes #12 through #1
8. National Electric Code (NFPA 70) – Latest edition
9. UL listing is required

B. Manufacturers shall be engaged in the manufacturing of industry accepted quality grounding connectors for a period of no less than 5 years for all types and sizes required.

1.5 SUBMITTALS:

A. None required.

PART 2 - PRODUCTS

2.1 GROUNDING CONNECTORS AND GROUND RODS:

A. ACCEPTABLE MANUFACTURERS: Subject to compliance with all requirements, provide products of one of the following manufacturers for grounding connectors or ground rods:

1. Chance/Hubbell
2. Copperweld Corporation
3. Erico Inc., Electrical Products Group
4. Burndy Electrical
5. Kearney/Cooper Power Systems
6. O-Z/Gedney Co
7. Raco/Hubbell
8. Thomas & Betts Electrical

B. Provide products of a quality manufacturer located within the continental North American market. Grounding connectors made in Europe, Asia, South America, Africa, or other overseas markets are not acceptable.

C. Provide products that are listed and labeled by UL for all applications used, and for specific types, sizes and combinations of conductors and other items connected.

D. For buried connections, provide crimp style connections or welded type connections. For accessible connections, provide bolted pressure-type, torque as per manufacturers recommendations.

E. Substitutions: Equivalent manufacturers are allowed at contractor's option, no submittals or prior approvals are necessary if ground connectors and rods meet specifications.

2.2 CONDUCTORS:

A. Provide copper or tinned-copper wire and cable insulated for 600 volt unless otherwise required by applicable code or authorities with jurisdiction.

B. Provide minimum of #6 AWG copper stranded grounding electrode conductor for the portion of the conductor which is the sole connection to the ground rod grounding electrode. Where this conductor is not the sole connection to a single ground rod (for example if the conductor connects multiple grounding electrodes in series), then the minimum conductor size shall comply with NEC table 250.66.

C. Provide minimum of #4 AWG copper stranded grounding electrode conductor for the portion of the conductor which is the sole connection to the concrete encased (UFER) grounding electrode. Where this conductor is not the sole connection to the concrete encased grounding electrode only (for example if the conductor connects multiple grounding electrodes in series), then the minimum conductor size shall comply with NEC table 250.66.

D. The grounding electrode conductor for the portion of the conductor which is the sole connection to a ground ring grounding electrode shall be no smaller than the conductor used for the ground ring. Where this conductor is not the sole connection to the ground ring grounding electrode only (for example if the conductor connects multiple grounding electrodes in series), then the minimum conductor size shall comply with NEC table 250.66.

E. Provide No. 4 and/or No. 6 AWG stranded conductor for bonding conductors.

F. Bonding Jumper: Provide copper tape, braided copper conductors, terminated with copper ferrules, 1-5/8 inches wide and 1/16 inch thick.

G. Where specified for lightning protection systems, provide listed conductors as specified in the Lightning Protection specification.

PART 3 - EXECUTION

3.1 GROUNDING INSTALLATION:

A. Ground all electric equipment, raceways and enclosures in accordance with code rules and established safety practices. All grounding systems inside the building must be bonded to the main power service ground, including telecomm closets, TV cabling entrances, lightning protection systems, and computer data center grounds.

B. Install insulated equipment grounding conductors in all types of raceways for all power feeders and branch circuits

C. Route grounding electrode conductors along the shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subject to strain, impact, or damage.

D. Grounding electrode conductors and bonding jumper connections to grounding electrodes shall be accessible (unless allowed by NEC 250.68(A) exceptions) and provide a continuous effective grounding path.

E. Where ground connections are made underground or in inaccessible locations, they shall be made using an exothermic weld process, Cadweld or equivalent, or Ampact pressure connectors.

F. Install main grounding electrode conductors in approved metallic raceways unless specifically shown or specified otherwise. Bond at each end and at all intervening boxes and enclosures between the service equipment and grounding electrode.

G. No. 8 and smaller grounding conductors shall have green insulation. No. 6 and larger shall be marked with green colored tape at each end and at every box, panel, switchboard, or point where conductor is accessible.

H. Provide bonding jumpers to steel structure as indicated on the plans. Use exothermic welded connectors for steel connections below slab, and/or bolted clamp connections where accessible above slab.

I. For equipment subject to vibration, install bonding jumper so that vibration is not transmitted through the grounding connection.

3.2 PERIMETER GROUNDING ELECTRODE:

A. Bond to perimeter grounding electrode as shown on the drawings. Bare Copper conductors shall be placed feet underground. There shall be no plastic sheeting or other insulating material placed between the copper conductor and earth.

B. Bond Perimeter ground to all other grounding conductors in the area.

3.3 GROUND RODS

A. Grounds rods shall be installed where accessible for future inspection and servicing, located in a “ground rod well” where located exterior. Install Ground rod well flush with grade.

B. Where ground rods are driven inside manhole or tunnel structures, leave 4 inches of exposed ground rod above the concrete floor.

3.4. CONNECTIONS

A. For equipment grounding connections #10 and smaller, grounding conductors may be terminated with appropriate winged pressure type connectors (wirenuts). For #8 and larger, use pressure-type grounding lugs.

B. For Service metal conduits, and where metallic raceways terminate at metal housings without appropriate electrical connection to housing, terminate each conduit with an insulated throat grounding bushing. Connect grounding bushing with a bare copper grounding conductor to grounding bus and/or grounding terminal electrically bonded to housing.

C. For all main telephone/data conduits and sleeves exceeding 1-1/2 inches, where serving telephone/data closets and data rooms, provide insulated throat grounding bushings. Connect grounding bushing with a bare copper grounding conductor to grounding bus inside telecomm room. Where sleeves go from closet to closet, only the lowest closet penetration needs to be bonded.

D. For cable trays entering telephone/data closets and data rooms, provide bonding jumper from the tray to the grounding bus inside the telecomm room. Bond sections of the tray that are not electrically contiguous together to provide a complete low impedance grounding path.

E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturers published torque-tightening values. If manufacturers data is not available, tighten according to UL468A.

F. For compression type connections, use hydraulic compression tools and dies to provide the correct circumferential pressure for all connectors. Use only tools and dies as recommended by the connector manufacturer. Provide embossing die code or other standard method to make a visible, permanent indication that a connector has been adequately compressed onto the grounding conductor.

3.6 COMMISSIONING AND TESTING:

A. Contractor shall provide a time for access and inspection of grounding system for the Architect/Engineer, telecommunications installer and the commissioning agent. Correct all defects and flaws found prior to testing.

B. Test all grounding systems per NETA 7.13 Inspection and Test Procedures.

C. Test the electrical service entrance ground and ensure that it does not exceed 5 ohms. Test grounding measurements at medium voltage switchgear and switches, pad-vaults, and manholes and ensure they do not exceed 5 ohms. Test the grounding at transformers and ensure they do not exceed 10 ohms.

D. If measurements exceed allowed values, notify the Architect/Engineer and provide additional electrode conductor, ground rods, chemical rods, and other mitigation methods to ensure that readings are below requirements. Retest after mitigation and report both the initial test readings, the mitigation efforts made, and the final readings in test reports. Include test reports in the O&M manual.

E. Demonstrate electrical continuity at selected connections to the commissioning agent using an electrical ohmmeter. Point to point resistance values shall not exceed 0.5 ohms. Provide additional bonding as necessary to ensure these resistance values are less than 0.5 ohms.

END OF SECTION

SECTION 26 05 33 - RACEWAYS

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Provide all raceways, wireways, and associated fittings as herein specified and shown on the associated drawings.

1.2 APPLICATION:

A. Electric metallic tubing (EMT), galvanized rigid conduit (GRC), intermediate metal conduit (IMC), flexible metal conduit, and PVC conduit may be used.

B. Schedule 40 PVC conduit may only be used below grade and below slabs on grade. PVC shall not be used above grade. PVC shall not be used in masonry walls and shall not be used in suspended slabs. Conduits larger than 1 inch may be run below the slab. Type EB and DB utility duct shall not be substituted for Schedule 40 PVC.

C. GRC and IMC shall be used in locations subject to mechanical injury, for penetrations of building and manhole walls, and for service conduit under concrete slabs. GRC and IMC may be used: outside, where exposed to weather, in wet locations, in hazardous locations (as approved by code). Schedule 80 PVC may not be substituted for GRC and IMC.

D. EMT may be used only in dry and protected locations and in suspended slabs. EMT may not be used: outside, where exposed to weather, in hazardous locations or where subject to mechanical injury.

E. Flexible metal conduit (FMC) will be permitted only where flexibility is necessary. FMC may be used only where flexibility is necessary in dry protected locations, such as: connections to recessed light fixtures, work fished into existing concealed dry locations, wood frame construction. Flexible metal conduit shall be used for connection to all equipment subject to movement or vibration such as motors and transformers. Length shall not exceed 6 feet unless fishing in existing construction.

F. Liquid-Tight Flexible Metal Conduit (LFMC) shall substitute only in those locations where flexible metal conduit is required and additional moisture protection is desired or needed. LFMC may be used: for connections to motors or fixed equipment where subject to moisture or weather and subject to movement or vibration. Length shall not exceed 6 feet unless specified otherwise.

G. Drawing notes requiring a specific type of raceway shall take precedence over the specifications.

H. Surface metal or Plastic raceways (Wiremold) shall not be used unless approved by the Architect where fishing is not possible.

I. Electrical wiring shall be in U.L. approved raceways and enclosures throughout.

J. 4" and larger conduits intended for use on primary services and communications services shall have minimum 48" radius sweep on all bends.

1.3 RELATED WORK SPECIFIED ELSEWHERE:

A. Basic Material & Methods – Section 26 05 00.

B. Wires and cables (600V) – Section 26 05 19.

D. Seismic Restraint for Electrical – Section 26 05 48

1.4 QUALITY ASSURANCE:

A. All installation of conduits and raceways shall meet or exceed the following standards:

1. Polyvinyl Chloride (PVC): in accordance with ANSI C80.1 and NEMA Std. Pub. No. RN 1.
2. Rigid Metal Conduit (RMC): in accordance with ANSI C80.1.
3. Electric Metallic Tubing (EMT): in accordance with ANSI C80.3.
4. Seismic Bracing: ASCE 7-10, Section 13.6, latest edition
5. National Electric Code (NFPA 70) – Latest edition
6. UL listing is required

B. Manufacturer's shall be engaged in the manufacturing of industry accepted quality raceway for a period of no less than 5 years for all types and sizes required.

1.5 SUBMITTALS:

A. Conduit and conduit fitting product data submittals are not required.

B. Submit seismic bracing calculations, bracing and anchoring products, and bracing designs for suspended conduits and conduit racks as a deferred submittal as required per section 26 05 48. Submittal shall be as early as possible in the contract and prior to installing suspended conduits and conduit racks. Installation shall comply with the deferred submittal including all components and anchors used.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Provide products of a quality manufacturer located within the continental North American market. Conduit and Raceways and Fittings made in Europe, Asia, South America, Africa, or other overseas markets are not acceptable.

B. Substitutions: Equivalent manufacturers are allowed at contractor's option, no submittals or prior approvals are necessary if conduit and fittings meet specifications.

2.2 RACEWAYS:

A. Galvanized Rigid Metal Conduit (GRC): Provide zinc-coated, hot-dipped galvanized, rigid metallic conduit in sizes indicated on the drawings. Provide RMC in ¾ inch minimum size.

B. Intermediate Metal Conduit (IMC): Provide hot-dipped galvanized, intermediate metal conduit in sizes indicated on the drawings. Provide IMC in ¾ inch minimum size.

D. Electric Metallic Tubing (EMT): Provide electric metal tubing in sizes indicated on the drawings. Provide EMT in ¾ inch minimum size; EMT in ½" inch minimum size may be used for fire alarm and low voltage (< 30 volts) control wiring only.

E. Liquid-Tight Flexible Metal Conduit: Provide liquid-tight, flexible metal conduit, constructed of single strip, flexible continuous, interlocked, and double-wrapped steel, galvanized inside and outside, coated with liquid-tight jacket of flexible Polyvinyl Chloride (PVC). Provide Liquid-Tight Flexible conduit in ¾ inch minimum size.

F. Provide Schedule 40 PVC conduit (where installed below grade or below slab on grade) in one inch minimum size.

G. Surface metal raceways equal to Wiremold (700 series unless noted otherwise) may be used only where specifically called for on the drawings or in the specifications. Such installation shall be directed and approved by the Architect prior to ordering raceway.

H. Surface plastic raceways are not acceptable.

I. Aluminum conduit is not acceptable.

J. Provide PVC conduit in one inch minimum size.

2.3 FITTINGS:

A. Provide listed fittings and connectors that are suitable for the application and the environment installed. Use concrete tight fittings where EMT is installed in suspended slabs or in concrete. Fittings that can be made concrete tight by taping are acceptable in this application.

B. For Service Entrance switchboards and panelboards, use insulated throat grounding bushings for all service conduit entries. Tie ground jumpers to the equipment grounding bus inside the switchboard or panelboard.

C. EMT Connectors and couplings shall be steel, set screw type for interior application. EMT connectors and couplings where located outside in protected locations or where subject to damp environments shall use compression type connections.

D. For EMT connections to panelboards and boxes that exceed one inch size, or where #4 or larger conductors are pulled, or for any size conduit where subject to vibration, provide with insulated throats on connectors or other identified fitting providing a smoothly rounded insulating surface integral to the fitting. Use insulated throat set-screw connectors for smaller conduit sizes up to one inch, and use O-Z/Gedney type SBT/SB insulated bushings or equal selected by the contractor for sizes 1-1/4 inch and larger.

E. Aluminum fittings, Die-cast fittings or fittings made from pot metal shall not be allowed. Indenter type fittings are not acceptable.

F. Plastic only bushings are not to be used on power conduits.

G. Plastic only bushings may be used on telecommunication conduits and sleeves, as long as at least one end of the conduit/sleeve is fully grounded using a listed fitting on the conduit. An insulated throat grounding bushing or a listed conduit ground clamp may be used for this purpose. Tie ground jumper to the telecommunications ground bus.

H. GRC and IMC shall be coupled and terminated with threaded fittings. Provide fully-threaded, malleable steel fittings, rain-tight and concrete-tight as applicable. Provide double locknuts and metal bushings with insulated throat at all conduit terminations at boxes, panels, cabinets, switchboards, and stub-outs Fittings of O-Z/Gedney type B or equal As selected by the contractor are acceptable for these applications.

I. PVC shall be provided with matching schedule 40 fittings.

J. FMC and LFMC fittings shall be in accordance to industry standards.

K. Sealing bushings are to be provided equal to O-Z/Gedney Type FSK, WSK or CSMI as required by application. Provide equal to O-Z/Gedney Type CSB for internal sealing busings.

L. Expansion fittings shall be equal to O-Z/Gedey AXDX.

H. Cable Supports: Provide OZ Gedney, or equivalent cable supports for vertical risers, type as required by application.

2.4 SUPPORT AND SEISMIC BRACING COMPONENTS

A. Provide C clamps, beam clamps, and other type clamps for direct installation on structural beams or wall structures.

B. For suspended conduits, refer to section 26 05 48 for required deferred submittals and seismic bracing design requirements. Provide rigid support for all conduits, tie wire and systems that utilize wire as main vertical support are not allowed, wire may be used for horizontal and longitudinal bracing only if calculated and detailed in the contractors deferred submittal and approved by the shop drawing process.

C. As necessary and as shown in deferred submittal for suspended conduits, provide the following components for vertical support and lateral/longitudinal seismic bracing:

1. Strut: Unistrut (or equal) P1000 Metal Framing Channel
2. Allthread: Stainless Steel, 3/8 minimum size
3. Angles/Hinges: Bline B335-2 or Mason Industries SCB Swivel Anchor
4. Expansion anchors: Hilti Kwik Bolt II (or equal) minimum 3/8 inch x 2-1/4 inch depth
5. Hardware: Miscellaneous cap screw/spring nuts and other hardware required for a complete system.
6. Other hardware as designed in the contractors deferred submittal per section 26 05 48.

2.5 BOXES

A. Refer to section 26 05 00 for appropriate boxes.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Provide pull boxes where shown or required to limit the number of bends in any run to not more than three 90 degree bends. Use code gauge galvanized sheet steel boxes of code required size with removable covers, installed so that covers will be accessible after work is completed. Verify with the Architect any locations in finished areas.

B. Exposed raceways shall be parallel to structural lines and location must be approved by Architect/Engineer prior to installation. Where exiting from masonry walls in exposed rooms, particular attention and detail should be taken to exit in a neat and orderly fashion, at the correct elevation to hit structural steel roof supports.

C. Do not place conduits within 1-1/2 inches of the upper flutes of roof decking.

D. Maintain a minimum of 6 inches spacing from Hot water and/or steam lines, and 2 inches from Chilled Water and Culinary Water lines. Do not support conduit from other utility services.

E. 4" and larger conduits intended for use on primary services and communications services shall have minimum 48" radius sweep on all bends.

F. Conceal all raceways and wiring in finished spaces.

G. All conduit leaving building envelope (e.g. site lighting, roof mounted HVAC requirement, etc.) to be 0.75" minimum.

H. Field bends and offsets shall be made without flattening, kinking, rippling or destroying the smooth internal bore or surface of the conduit and to not less than NEC minimum radius. Conduit that shows signs of rippling or kinking shall not be installed. Any conduits installed with wrinkles or kinks or otherwise in an unworkmanlike manner shall be replaced at no additional cost to owner.

I. Precaution shall be exercised to prevent accumulation of water, dirt, concrete, or other foreign matter in the conduits during the execution of the project. Conduits in which water or foreign matter has been permitted to accumulate shall be thoroughly cleaned or the conduits runs replaced where such accumulation cannot be removed by methods approved the engineer.

J. Permanently cap all spare conduits. Cap or plug conduit ends during construction to prevent entrance of foreign material.

K. For metal conduit systems, provide electrically continuous conduit systems throughout.

L. Conduit stubbed from a concrete slab or wall to serve an outlet under a table or to supply a machine shall have a rigid conduit coupling flush with the surface of the slab. Provide plug where conduit is to be used in future.

M. Conduits in above grade suspended slabs, where written approval is obtained from the Structural Engineer of Record, shall be located in the middle of the slab and spaced according to the minimum recommendations of the ACSE 9-91. There shall be no crossovers, and conduit must be spaced a minimum of 18 inches on center. Conduits larger than one inch shall not be run in suspended slabs.

N. If work in suspended slabs is approved, EMT must be placed on stands and tied down to prevent floating prior to concrete pour. A minimum of 1-1/2 inch of concrete cover below the conduit and above the conduit is required. The Architect/Engineer must be invited to review and approve the installation prior to the concrete pour. Contractor shall rework any conduit rough that is disapproved.

O. Where drilling through existing floors or walls, use x-ray or penetrating location device to identify steel elements prior to drilling. Avoid cutting existing reinforcing bars. If nicked or damaged, consult with a licensed structural engineer for repair and support methods and provide required materials and repair.

P. Avoid placing conduits in pre or post tensioned slabs. The maximum size, spacing, and location of conduits in pre or post-tensioned slabs shall be subject to approval by the Structural Engineer.

Q. Provide ground wire within all conduits sized per NEC code.

3.2 SUPPORT AND SEISMIC BRACING INSTALLATION:

A. Individual suspended conduits and conduit racks shall be adequately braced for Seismic Restraint, as required per ASCE 7-10, section 13.3, latest edition. All life safety conduits, all conduits 2 inches and larger exceeding 12 inch suspension, and all multi-conduit racks exceeding 12 inch suspension shall be calculated and braced using the calculations methods of the ASCE and reviewed by the Architect/Engineer. Contractor shall perform the required calculations as early as possible in the contract and prior to installing suspended conduit racks.

B. For 3 or more conduits install conduit racks with trapeze style hanging system, with stainless steel 3/8 inch all-threads hanging down to a Galvanized steel strut assembly. Provide conduit clips to rigidly clip conduit to strut.

C. Provide a diagonal lateral seismic restraint braces at maximum 10 foot intervals (alternating directions), and a longitudinal brace (alternating directions) at maximum 30 foot intervals. Braces must be made of strut or similar rigid material, and will be tied directly to trapeze strut with hinges or rigid angles. Wire ties for bracing will not be acceptable. All hardware made for bracing shall be seismically rated.

D. If a large number of suspended conduit feeders (more than 12 each exceeding 2-1/2 inches in size) are grouped together, the contractor shall review the layout with the structural engineer, provide estimated weights, and obtain approval for the proposed layout.

E. Hanger rods shall be fastened to structure in an approved manner. Pullout resistance shall have a safety factor of 4.

F. Support individual suspended feeder conduits by metal ring or trapeze hangers with threaded steel rods.

G. Support spacing shall be in accordance with the following table, in addition to these maximum spacing requirements the seismic support and bracing may require additional support and/or spacing supports less than the maximum distance indicated below; the most stringent requirement and shortest spacing distances shall be enforced.

Conduit Type:	Conduit Size:	Maximum Distance Between Conduit Supports:	Maximum Distance From outlet box, junction box, cabinet, fitting, conduit termination or bends larger than 22 degrees.
IMC/GRC	½" to ¾" 1" 1.25" to 1.5" 2" to 2.5" 3" and larger	10 feet 12 feet 14 feet 16 feet 20 feet	3 feet for all sizes
EMT	All Sizes	10 feet	3 feet
FMC	All Sizes	4.5 feet	1 foot
LFMC	All Sizes	4.5 feet	1 foot

3.3 FIELD CUTS AND THREADS:

A. Cut all conduits perpendicular and square. Remove all sharp or rough edges and ream all burrs, inside and outside.

B. Provide clean sharp threads on RMC and IMC. Engage at least five full threads on all RMC and IMC fittings.

C. Before couplings or fittings are attached, apply one coat of red lead or zinc chromate to male threads of RMC or IMC.

D. Apply coat of red lead, zinc chromate or special compound recommended by manufacture to conduit where conduit protective coating is damaged.

3.5 CONDUITS BURIED BELOW GRADE (SINGLE CONDUITS LESS THAN 3 INCHES)

A. Refer to Ductbanks section 26 05 34 where concrete encasement is called out. All multi-conduit medium voltage campus power distribution and all multi-conduit campus telecommunications distribution must be concrete encased. Encasement is also required for building service entrance. Elsewhere on site, provide concrete encasement for single conduits where size is 3 inches and larger.

B. Where PVC conduit is below building slab on grade, conduit must be installed to be at least 2 inches below the slab. Provide 2 inches of sand or pea sized gravel to cover conduit. Protect conduit from vehicle traffic and construction traffic prior to concrete pour. Conduit poured inside the slab for slab on grade construction is not acceptable.

C. Elbows larger than 30 degrees and one inch shall be galvanized rigid conduit, wrapped with PVC tape.

D. Provide a ground wire sized per code in all PVC conduits intended for power circuits when pulling wire. Conductor quantities indicated in conduits do not include ground wires unless otherwise noted.

E. Provide trenching, backfilling, compaction, re-paving or other site restoration as required by the work done in this division. Minimum trench depth shall be as required to install conduit at 24" below grade to top of conduit unless otherwise noted.

F. Install a detectable 6 inch wide yellow vinyl tape with letter "Caution: Buried Electrical Line Below" 12 inches above all buried service conduit and wire not under structures.

G. Backfill material for all trenches under paved areas shall be coarse sand or crushed rock, installed in layers not to exceed eight inches and compacted to 96% of maximum density at optimum moisture content to preclude subsequent settlement. Compaction by water method is not allowed.

H. The top 18 inches of trenches in landscaped or grassed areas shall be backfilled with native soil and tamped.

I. Conduits piercing a building waterproof membrane shall be provided with flanges, using two neoprene washers, one washer on each side of membrane, between each flange and membrane.

J. All underground conduits which enter the building shall be sloped to drain away from the building and shall be water sealed to prevent moisture from passing through the conduit into the building. All joints to be threaded and taped or glued to prevent entry of water into the conduits.

K. All underground conduits entering the building shall be poured-in-place, or provided with watertight conduit sleeves and rubber seals, Link-seal system by Thunderline Corporation or equivalent.

3.6 CLEANING:

A. Pull a mandril and swab through all conduits before installing conductors. Raceways shall be left clean and free of debris.

B. Provide a pull string in all empty conduits.

3.7 COMMISSIONING AND FINAL INSPECTION:

A. Contractor shall provide a time for access and inspection of raceway system for the Architect/Engineer, telecommunications installer and the commissioning agent. Correct all defects and flaws found prior to wall and ceiling installation and prior to cabling installation.

B. Demonstrate electrical continuity at selected joints to the commissioning agent using an electrical ohmmeter.

C. Demonstrate rigid seismic bracing to ensure minimal movement of the raceways on suspended racks in a seismic event. Demonstration shall be by pushing with at least 25 pounds force laterally and longitudinally at selected (mid-span) locations along the length of the suspended raceway rack. Rack shall not move more than 2 inches during these demonstrations.

END OF SECTION

SECTION 26 09 25 – OCCUPANCY SENSED LIGHTING CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. The Contractor shall provide all labor, materials, tools, appliances, control hardware, sensor, wire, junction boxes and equipment necessary for and incidental to the delivery, installation and furnishing of a completely operational occupancy sensor lighting control system, as described herein.

B. The Contractor shall examine all general specification provisions and drawings for related electrical work required as work under Division 26.

1.2 SUBMITTALS:

A. Submit complete and descriptive shop drawings including floor plans, layouts, catalog cuts and other descriptive data indicating compliance with the specifications herein. Submit data sheets on sensors, control units and all junction boxes and mounting accessories, including all wiring diagrams. Submit in accordance with Division 01.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. The Watt Stopper, Inc., Cooper Controls, Cooper Wavelinx, Douglas Lighting Controls, Hubbell Controls, Lutron, Nlight, Sensor Switch

B. Requests for substitution of other products will be considered if submitted in accordance with the general conditions and Division 1.

2.2 WALL SWITCH INFRARED TYPE

A. Wall switch sensors shall be capable of detection of motion at desk top level up to 500 square feet.

B. Wall switch sensors shall accommodate loads indicated on the plans.

C. Coverage of 180 degrees

D. Digital auto-OFF time delay adjustable from 30 seconds up to 30 minutes.

E. Adjustable unit sensitivity.

F. Integrated light level sensor - works from 2.4 to 300 footcandles

G. LED for sensitivity calibration

H. Transformer / latching relay design.

I. Works with electronic ballast and high power factor PL lamp ballasts.

J. No leakage current in off mode.

K. Voltage drop protection.

L. Watt Stopper Model WS 120 / 277

2.3 CEILING MOUNT DUAL-TECHNOLOGY TYPE

Low Profile, ceiling mount, 360 degree coverage: Watt Stopper Model DT-300
Adjustable arm, wall mount, 180 degree coverage: WattStopper Model DT-200

A. The Occupancy Sensors shall be capable of detecting presence in the floor area to be controlled, by detecting Doppler shifts in transmitted ultrasound and passive infrared heat changes (dual technology). Sensors that utilize microphonics are not approved.

B. Upon entering a space, motion from both technologies must be sensed before lighting will be turned on. After this has occurred, detection in either technology will hold lighting on for the set time period. Sensors will have a retrigger time delay where only one motion is necessary to turn on the lights within 5 seconds after turning off.

C. Ultrasonic sensors will be volumetric in coverage. Up to 10 different passive infrared patterns will be available by lens selection. Detection shall be maintained when a person of average size and weight moves only within or a maximum distance of twelve inches either in a horizontal or vertical manner at the approximate speed of 12 inches per second. The sum of this distance, volume and speed represent the average condition an Occupancy Sensor must meet in order that the lights will not go off when a person is reading or writing while seated at a desk.

D. Sensors will cover a minimum of 1500 square feet when mounted at 12 feet.

E. The sensors are designed to be ceiling mounted and not protrude more than 2 inches and should blend in aesthetically with the space.

F. Each sensing technology shall have independent sensitivity adjustments and LED display.

G. Time Delay range shall be adjustable from 15 seconds to 15 minutes.

H. Sensors shall operate on 24 volts, 25 milliamps DC.

I. Sensor shall have an additional single pole, double throw isolated relay with Normally Open, Normally Closed and Common outputs rated at 1 amp for 24 VDC. The isolated relay is for use with HVAC control, Data Logging, and other control options.

J. Ultrasonic circuit shall be solid state, crystal controlled with signal processing filtering.

K. Ultrasonic receivers shall be temperature and humidity resistant with less than a 6dB shift in the humidity range of 10% to 90% and less than a 6dB shift in the temperature range of -20o to 60o C.

L. The ultrasonic frequency shall be 40 kHz + .006%.

M. Ceiling mount sensors shall provide a minor motion coverage range of 250 to 1300 square feet with an overall 1/2 step coverage range from 500 to 2000 square feet.

N. All sensors shall be capable of operating normally with electronic ballast and PL lamp systems.

O. All sensors shall be self-contained, crystal controlled ultrasonic or infrared occupancy sensors located to provide coverage of 90 to 100% of the controlled area.

P. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.

Q. All sensors shall have readily accessible, user adjustable controls for time delay and sensitivity. Controls shall be recessed in the sensor to limit tampering.

R. In the event of failure, a bypass manual "override on" shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed in the sensor to prevent tampering.

S. Ultrasonic operating frequency shall be crystal controlled to within plus or minus 0.005% tolerance to assure reliable performance.

T. Ultrasonic microphone receiver frequency shall be 25 KHz or greater and shall be temperature and humidity resistant.

1. All sensors shall provide a red LED indication light to verify that motion is being detected and that the unit is working.

U. All ultrasonic sensors shall comply with the State of California Safety and Health Requirements. Decibel levels for ultrasonic sensors shall comply with the following California Energy Commission criteria:

Midfrequency of Sound Pressure Third Octave Band (KHz)	Minimum dB level within Third Octave Band (in dB reference 20 micropascals)
Less than 20	80
20 or more to less than 25	105
25 or more to less than 31.5	110
31.5 or more	115

The Contractor shall certify in writing that installed sensors comply with the specified California Energy Commission criteria for ultrasonic sound.

V. All sensors shall have no leakage current in OFF mode and shall have voltage drop protection.

W. Sensors shall be suitable for N.E.C. 725 Class 2 wiring and use plenum cable where approved. Where plenum cable is not approved, provide conduit to within 6 inches of sensor location.

2.4 POWER PACKS:

A. Power Packs shall be mounted on external J boxes and be an integrated self-contained unit consisting of a load switching relay and a transformer.

B. Relay Contacts shall have ratings of:

10A - 120 VAC Tungsten
20A - 120 VAC Ballast
15A - 277 VAC Ballast

C. Relay contacts shall be isolated.

D. Power Packs: Wattstopper BZ-50, BZ-150

E. Between sensors and controls units shall be three (3) conductors, 18 AWG, stranded U.L. Classified, PVC insulated or TEFLON jacketed cable approved for use in plenums. One sensor shall be capable of driving four Power Packs.

F. Enclosures for Power Packs shall be NEMA I construction with mounting and barriers to provide separation between line and low voltage wiring or a standard four (4") inch junction box with control unit mounting to cover plate with ½ inch knockout. Boxes not located above accessible ceilings shall be painted to match finish color of mounting surface.

G. Occupancy sensors shall have calibration at the occupancy sensor head, not at the power pack above the ceiling.

PART 3 - EXECUTION

3.1 PERFORMANCE:

A. The objective of this section is to ensure the proper design and installation of the occupancy sensor based fluorescent lighting control system in rooms designated on the drawings so that lighting is turned off automatically after reasonable time delay when a room or area is vacated by the last person to occupy said room or area.

B. The occupancy sensor based lighting control shall accommodate all conditions of space utilization and all irregular work hours and habits.

3.2 INSTALLATION:

A. It shall be the contractor's responsibility to contact the Manufacturers Representative and, with their assistance, aim and locate sensors correctly as required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas. Rooms shall have ninety (90) to one hundred (100) percent coverage to adequately cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the rooms(s). The sensor symbols shown on the drawings are diagrammatic and indicate only rooms which are to be provided with sensors. The contractor shall provide sensors as required to properly and completely cover the respective room. Proper judgment must be exercised in executing the work so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components. Sensors in small offices should be located to avoid false operation caused by persons walking by the door and outside the office.

B. Mount occupancy sensors a minimum of 8 feet away from HVAC diffusers. Ultrasonic sensors shall be mounted on vibration free, stable surfaces and shall not be used in areas of heavy air flow, moving objects, or on ceilings over 14 feet high.

C. Where "override-OFF" switch is required, switch is to be connected on the load side of the Power Pack Relay.

D. Contractor shall be responsible to make all required adjustments to the occupancy sensor system for a period of 3 months after Owner occupancy at no additional charge to the Owner to ensure the system is working properly after occupancy.

3.3 LABELING:

A. Provide self-adhesive labeling for all wall mounted occupancy sensors in compliance with Part 3.3 of Section 26 05 00.

B. Provide hand written permanent marker circuit number labeling on the power pack junction box in compliance with Part 3.3 of Section 26 05 00.

3.4 WARRANTY:

A. Contractor shall warrant the system including all equipment furnished in accordance to this specification to be undamaged, free of defects in materials and workmanship, and in conformance with the specifications. The suppliers obligation shall include repair or replacement, and testing without charge to the owner, all or any parts of equipment which are found to be damaged, defective or non-conforming and returned to the supplier. Warranty on sensors and controls units will be for a period of five (5) years. The warranty shall commence upon the owner's acceptance of the project. Warranty on labor shall be for a minimum period of one (1) year.

3.5 OWNER TRAINING:

A. Upon completion of the system fine tuning and required adjustments, the factory authorized technician shall provide the necessary training at the Owner’s facility to familiarize the owner’s personnel with the operation, use, adjustment, maintenance, and trouble shooting diagnosis of the occupancy sensing devices and system.

END OF SECTION

SECTION 26 22 00 - TRANSFORMERS

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Provide all transformers as herein specified and shown on the Drawings.

1.2 SUBMITTALS:

A. Submit complete and descriptive shop drawings indicating dimensions and compliance with the specifications herein. Submit in accordance with the General Conditions, Division 01, and Section 26 05 00.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. ACME, Cutler Hammer, Federal Pacific, General Electric, Hammond Power Solutions, MGM Transformer Company, Siemens, Square D.

B. Requests for substitution of other products will be considered if submitted in accordance with the General Conditions, Division 01, and Section 26 05 00.

2.2 TRANSFORMERS – BASIC REQUIREMENTS:

A. KVA and voltage ratings shall be as specified on the Drawings.

B. Transformers of the size and type covered by U.L. Specification 506 shall be so labeled and listed. All transformers must be constructed and rated in accordance with all applicable ANSI, NEMA, and U.L. standards. Minimum 4% impedance.

C. Transformers 37-1/2 KVA three phase and larger shall incorporate a U.L. recognized Class 220 degree C insulating system. Transformer temperature rise shall not exceed 115 degree C. in a 40 degree C. ambient unless shown otherwise on the drawings.

D. Transformers 5 KVA and larger shall be capable of meeting the overload requirements of ANSI Standard C57.12.

E. Transformers 15 KVA and larger shall have NEMA standard taps.

F. Dry Type Transformers 15 KVA and larger shall meet the NEMA TP-1-2002 energy efficient standards and/or be Energy Star rated.

G. Sound levels shall be equal or lower than those established in ANSI Standard C89.2.

H. Transformers shall have copper windings.

2.3 TRANSFORMERS FOR NON-LINEAR LOADS:

A. Transformers shown on the one line diagram with a "K= ___" designation shall be suitable for non-linear loads and shall be designed with the K factor stated on the drawings. Such transformers shall have a maximum hot spot temperature of 220 degrees centigrade. The transformer secondary neutral terminal shall be sized for 200% of the secondary phase current.

B. Transformers shall have a full width electrostatic shield between primary and secondary with a maximum effective coupling capacitance of 33 picofarads.

C. Common mode noise and transient attenuation shall be no less than 40db at 1 MHz. Transverse mode attenuation shall be no less than 30db at 1 Mhz.

D. Transformers less than 300 KVA shall have a maximum of 4 percent impedance.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Transformers shall be installed with special consideration given to the transmission of hum noise through structure or conduit system. Provide 1-1/2" neoprene vibration isolation dampers under each corner of transformer, equal to Mason Industries type “ND”.

B. Flexible conduit to be installed between the conduit system or panel and transformer. Provide slack in flex conduit to reduce noise transmission. This contractor shall be responsible for correction of excessive hum conditions.

C. Transformer taps are to be adjusted to the proper voltage after system is in operation.

D. Where transformers form part of a unit substation, the transformer shall have a minimum 0.5 inch separation from the other components of the substation. Flexible connections shall be made between the transformer and switchboard bus.

E. Measure clearance from venting openings to wall and ensure compliance with manufacturers published requirements. Where published requirements are not available, ensure typical clearance is 6 inches minimum for transformers 225 KVA and less, and 12 inches for transformers 300 KVA and higher.

F. Anchor transformers to housekeeping pad, or wall structure as calculated in section 26 05 48 Seismic Restraint for Electrical Work. Deferred submittals shall be approved prior to installing anchors.

G. Provide a minimum 4” high steel reinforced and steel doweled concrete housekeeping pad for all floor mounted transformers. Extend housekeeping pad at least 3 inches beyond the dimensions of the transformer. Where the drawings required housekeeping pads in excess of 4” the drawings shall take precedence.

H. Vacuum dirt and debris inside, around, and under the installed transformer. Do not used compressed air for cleaning. Wipe outside of transformer clean.

3.2 CONNECTIONS:

A. Ground equipment per NEC 250 and Division 26 section 26 05 26 Grounding and Bonding.

B. Tighten electrical connectors and terminals according to manufacturers published torque tightening values. If manufacturing torque values are not available, use the values specified in UL 468A and/or UL 468B.

3.3 LABELING:

A. Provide a permanent engraved label with a center white ply and outer black ply (black label with white lettering) for all transformers on the outside of the transformer enclosure including the following information:

1. Transformer Name
2. Source feeding the transformer and the load supplied equipment
3. Size (KVA), Primary Voltage, and Secondary voltage

3.4 TESTING:

A. Perform field tests and inspections and prepare testing reports. Engage a technician skilled in performance of transformer testing.

B. Perform visual and mechanical inspection and provide electrical test as stated in NETA Acceptance Testing Specification guidelines. Document compliance with test parameters.

C. Perform spot voltage measurement using typical building daytime running load of approximately 40-60% of transformer capacity. A combination of building load and load bank may be used for this test. Record actual load and output voltage for O&M manual. If voltage is below nominal value by at least 3%, adjust tap settings, and retest voltage. Note any adjustments made in O&M test report.

D. All current carrying devices and terminations within this section shall be inspected by performing a thermographic survey with normal load conditions applied to the system.

E. Inspect distribution systems with thermal imaging equipment capable of detecting a minimum temperature difference of 1° C at 30° C.

E. Equipment shall detect emitted radiation and convert it to a visual signal.

F. Perform thermographic survey during periods of maximum possible loading. Provide a load bank to load the transformer to the maximum recommended capacity.

G. Perform actions to correct any and all deficiencies.

H. Provide a certified report including the following:

1. Equipment to be tested
2. Any and all discrepancies
3. Temperature difference between concern area and reference area
4. Probable cause of temperature difference
5. Areas inspected, any areas and equipment which are unobservable
6. Actual load conditions at time of inspection
7. Provide photographs and thermograms of the deficient area
8. Action to correct deficiencies

END OF SECTION

SECTION 26 24 13 – SWITCHBOARDS 600 VOLTS & BELOW

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Furnish and install the service entrance switchboard and distribution switchboards as herein specified and shown on the associated electrical drawings.

1.2 SUBMITTALS:

A. Submit complete descriptive shop drawings indicating bus arrangement, overcurrent devices, labeling, dimensions, ratings and other pertinent data.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Square D, General Electric, Siemens, Cutler-Hammer/Westinghouse

B. Requests for substitution of other products will be considered if submitted in accordance with the General Conditions, Division 1, and Section 26 05 00.

2.2 EQUIPMENT:

A. Each distribution board section shall be free standing and have an open bottom. Top and bottom conduit area is to be clearly shown and dimensioned on the shop drawings. All front plates used for mounting meters, selector switches or other front mounted devices shall be hinged with all wiring installed and laced with flexibility at the hinged side. All closure plates shall be screw removable and small enough for easy handling by one man. The paint finish shall be gray enamel over a rust-inhibiting phosphate primer.

B. Overcurrent devices shall be of size and type as indicated on the drawings. Series rated equipment will not be permitted as a substitute for the interrupting capacities stated on the one line diagram.

C. Main lugs shall be tool applied compression type if aluminum wire is used. The bus bars shall be rigidly braced for 100,000 amps and sized as indicated on the drawings.

D. The bus bars shall be Copper or Aluminum.

E. The end section is to have bus bar provisions for future addition of a switchboard section. The provisions shall include the bus bars installed to the extreme side of the switchboard and prepunched to facilitate future bolted splice plates.

F. Where fusible switches are indicated, they shall have Class R or L fuse clips. Fusible switches shall be of the positive, quick-make, quick-break type and external operating handle shall be suitable for padlocking in the "OFF" position. All units shall be dead front. Provide a spare fuse cabinet.

G. Operating handles shall be mounted on the unit doors and interlocked with the overcurrent device to prevent opening of the door when the switch is "ON". A concealed "defeater" shall be provided so that authorized personnel may open door without interrupting power.

H. All extra space in distribution boards shall be bussed for future use.

I. Prior to bidding, confirm that equipment will fit within the physical space allocated on the drawings for switchgear. Do not attempt to use equipment which does not fit within the space allotted. Do not use space identified for future use.

J. Provide ground-fault protection integral with each circuit breaker rated 1000 amps or more and operating above 150 volts phase-to-ground but below 600 volts phase-to-phase regardless of what is shown on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Distribution boards shall be free from surface and finish defects, and cleaned of dust and construction debris.

B. All nameplates, labels, screws, bolts, or other hardware shall be in place prior to acceptance.

C. Prior to installation of switchgear and transformers, layout the electrical rooms and obtain approval of the layout from the code authority having jurisdiction.

D. Switchboards shall not be installed under piping or ductwork. Meet all requirements of NEC article 110 for Dedicated Electrical Space and Working space about equipment.

3.2 LABELING:

A. Where changes are made in existing switchboards, distribution boards, etc., provide new labeling and schedules to accurately reflect the changes; hand written revisions will not be acceptable.

B. Provide an engraved permanent master nameplate at the main distribution to identify the project, the Engineer and the date.

C. Provide engraved nameplate for all switchboards permanently mounted on the outside face of switchboard; include the following minimum information:

1. Text stating “Main Building Disconnect” (if applicable)
2. Switchboard name
3. Source feeding switchboard
4. Voltage, Size (amps), number of phases, number of wires, and AIC rating

D. Provide engraved nameplates to clearly label each switchboard breaker to identify each load served, each spare breaker, and each space (size in amps and phase).

E. Engraved nameplates shall be have a black back ply, an inner white ply with outer colored ply as follows: Black for normal power, Red for Emergency (Legally Required or Optional Standby) power, Orange for UPS power.

F. Provide a permanent engraved label indicating the conductor insulation color for: (1) all ungrounded conductors (2) grounded conductor (3) equipment grounding conductor. This shall be documented at each switchboard in a readily visible location; refer to Wires and Cables Section 26 05 19 for conductor color coding.

3.3 PERFORMANCE TESTING:

A. Provide ground-fault protection system testing prior to Owner’s acceptance and provide written record of testing and proper operation to the A/E team, Owner and Authority Having Jurisdiction (AHJ). Ground-fault protection system testing shall be done in accordance with the manufacturer’s instructions.

END OF SECTION

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Provide all branch circuit panelboards as herein specified and shown on the drawings.

1.2 SUBMITTALS:

A. Submit complete and descriptive shop drawings indicating dimensions and compliance with the specifications herein. Submit in accordance with the General Conditions, Division 01, and Section 26 05 00.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Breaker Panels: Square D, Siemens, General Electric, Cutler-Hammer/Westinghouse,

B. Requests for substitution of other products will be considered if submitted in accordance with the General Conditions, Division 01, and Section 26 05 00.

2.2 EQUIPMENT:

A. Panels shall be factory pre-assembled using bolt-on circuit breakers, equivalent to Square D NQOD series. Separate feeder lugs shall be provided for each feeder conductor.

B. Breakers in branch panelboards shall be not less than 3/4 inch on centers. Each breaker shall be securely fastened to prevent movement and trims shall fit neatly and tightly to the breaker assembly. Two and three pole breakers shall be single breaker assembly rather than two or three single pole breakers with the handles tied together externally.

C. Panel finish shall be a flat, light gray finish suitable for painting over or being left with factory finish. Flush mounted panels in finished walls shall be painted to match wall, paint and paint preparation to be as specified by Architect. Panel covers to be painted off wall, then installed over painted wall surface. Trims to be separately packed and protected from scratching and marring. Refer to labeling requirements in 26 05 00 Basic Materials and Methods.

D. Panelboard trims to have concealed trim screws and door hinges, and a flush stainless steel cylinder lock with catch and coil spring loaded door pull equivalent to Square D "Mono-Flat". All panels shall be keyed alike.

E. Where grounding conductors are shown or specified, provide each panel and distribution center with grounding bus to which the grounding conductors shall be connected, each having its own terminal or lug.

F. Where Isolated Grounding (IG) conductors are shown or specified, provide each panel and distribution center with an Isolated Grounding bus to which the IG conductors shall be connected, each having its own terminal or lug. The IG grounding system shall be fully separated and insulated from the IG receptacle to the System Grounding Electrode. Provide a second ground bus bonded to the panelboard can for termination of conduit and equipment bonding conductors.

G. Panelboards rated 400 amps or less shall not exceed 6" depth.

H. Provide Fully rated equipment greater than or equal to the interrupting capacities indicated on the drawings.

I. Aluminum bussing shall be allowed, provide 100% rated neutral bus, ground bus and isolated ground bus where indicated. CU-AL rated lugs shall be allowed.

J. Provide breaker tie handles in 2 pole and 3 pole configurations for all grouped multiwire branch circuits to allow grouped disconnecting means. Verify quantity with contractor.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Breaker handle guards shall be provided on each circuit supplying obviously constant loads to prevent accidental shutting off. Such loads are refrigeration, contactor controlled circuits, freeze protection, etc.

B. Furnish and install three spare one inch conduits from the top of each recessed panel, to an accessible point above the ceiling.

C. Care shall be taken to terminate ground conductors from isolated ground receptacles only on the isolated ground bus in a panel. Do not terminate bonding conductors on an isolated ground bus.

D. Each multiwire branch circuit shall be provided with breaker tie handles such that all ungrounded conductors will be simultaneously disconnected as per NEC 210.4 (B). Provide 2 pole and 3 pole breaker tie handles in sufficient quantity for all grouped circuits.

E. Group the ungrounded and grounded conductors for multiwire branch circuits in at least one location inside the panelboard with wire ties or similar means per NEC 210.4 (D).

3.2 LABELING:

A. No brand labels or other marking shall be on the outside of the panels. Where changes are made in existing panels, distribution boards, etc., provide new labeling and schedules to accurately reflect the changes; hand written revisions will not be acceptable.

B. Provide engraved nameplate for all panelboards permanently mounted inside door for flush panels and on the outside face of the door for surface panels; include the following minimum information:

1. Text stating “Main Building Disconnect” (if applicable)
2. Panelboard name
3. Source feeding panel
4. Voltage, Size (amps), number of phases, number of wires, and AIC rating

C. Engraved nameplates shall be have a black back ply, an inner white ply with outer colored ply as follows: Black for normal power, Red for Emergency (Legally Required or Optional Standby) power, Orange for UPS power.

D. Provide typewritten branch panel schedules with protective clear, transparent covers accounting for every breaker installed. Use actual room designations assigned by name or number near completion of the work, and not the designations shown on drawings.

E. Provide a permanent engraved label or include with the panel schedule information indicating the conductor insulation color for: (1) all ungrounded conductors (2) grounded conductor (3) equipment grounding conductor. This shall be documented at each panelboard in a readily visible location; refer to Wires and Cables Section 26 05 19 for conductor color coding.

END OF SECTION

SECTION 26 27 26 – WIRING DEVICES

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Provide all switches, receptacles, and other devices as herein specified and shown on the associated drawings.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Bryant, Arrow-Hart, Eagle, LeGrand, General Electric, Leviton, Hubbell are acceptable.

2.2 MATERIALS:

A. The following list of wiring devices covers the most commonly specified items and establishes the grade of device. Should the Drawings indicate a device other than those listed herein without reference to catalog number, such device shall be of the same grade and manufacturer as like devices.

Single Pole Switches	Hubbell #1221
Duplex Receptacles - 20 amp Where required by Code and/or indicated on drawings	Hubbell #5362
Hospital-grade Duplex Receptacle	Hubbell #8300
Safety Duplex Receptacle	Hubbell #HBLSG 63H
Duplex Receptacles-Isolated Ground	Hubbell #5362-IG, Orange
Switch with Pilot	LeGrand #20AC1
Dimmer	Lightolier, Sunrise Series Electronic 0-10V Part# SR1200ZTUNV (provide relay pack for 277 volt)

B. All wiring devices and plates to be specification grade. Receptacles shall be mounted vertically with the ground pin down unless otherwise noted.

C. Color of devices to be selected by Architect. Provide 302 stainless steel plates.

D. Wet location and/or weatherproof receptacles shall be in a weatherproof enclosure, the integrity of which is not affected when the receptacle is in use (attachment plug cap inserted), UL labeled and listed “Suitable For Wet Locations While In Use”. Provide enclosure with stainless steel screws, gasket between enclosure and mounting surface and between cover and base, clear impact resistant UV stabilized polycarbonate as manufactured by TayMac Corporation or accepted equivalent.

E. Receptacles installed outdoors in a wet/damp location shall be listed weather-resistant type.

PART 3 - EXECUTION

3.1 GENERAL:

A. Coordination with General Contractor and Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not damage boxes or mudrings while cutting holes for wall finish.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables. Clean before device and coverplate installation.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

B. Provide a separate GFI type receptacle for each receptacle noted on plans as GFI. Standard receptacles fed from an up-steam GFI type receptacle are not acceptable.

C. Install outlets and switches in a neat manner with plates covering all gaps between box and adjacent wall surface.

D. Extend mudrings to flush out with surrounding wood panels and walls. In sheetrock, the mudring shall not be less than 1/8 inch recessed from surrounding wall surface, and shall not protrude more the 1/16 inch.

E. Faceplates, devices, and boxes shall be square with floor, and door lines. Outlet plates of adjacent outlets shall be vertically aligned to within 1/16 inch.

F. Bond ground terminal of each receptacles to equipment ground conductor, and provide green bonding jumper to box grounding screw when used with metal boxes in dry wall type construction.

G. Devices to be installed flush with faceplate. Do not overtighten and crack or warp the coverplate

3.2 DEVICE INSTALLATION:

A. Replace all devices that have been in temporary use during construction or that show signs of where or damage, that they were installed before building finishing operations were complete.

B. Keep each wiring device in its package or otherwise protected until it is time to install and connect conductors.

C. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.

D. Provide pigtails to connect building branch circuits to devices using pigtails that are not less than 6 inches in length.

E. Side wiring to binding-head screw is the required method of termination when available. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw and torque as recommended by the manufacturer.

F. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.

G. Tighten unused terminal screws on the device to minimize risk of accidental shock.

H. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

I. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

J. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening

END OF SECTION

SECTION 26 51 00 - LIGHTING

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Provide light fixtures with lamps and accessories as herein specified and shown on the drawings.

1.2 QUALITY ASSURANCE:

A. If the catalog number of a specified fixture should conflict with the fixture description or the general lighting specifications, such conflicts shall be brought to the attention of the Architect prior to bidding.

B. The dimensions shown on the luminaire schedule are for general reference only. Refer to the manufacturer's shop drawings for exact dimensions prior to rough in.

1.3 SUBMITTALS:

A. Submit product data and shop drawings for fixtures, ballasts, and lamps in accordance with the General Conditions, Division 1, and Section 26 05 00.

B. Verify that fixture description matches that which is indicated by the specified catalog number.

C. All features mentioned in the fixture list shall be marked on the submitted items.

D. Submit written confirmation that dimming ballasts and dimming controls are compatible.

E. Submit Operation and Maintenance data in accordance with the General Conditions, Division 1, and Section 26 05 00.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. See Luminaire Schedule for acceptable manufacturers.

B. Requests for substitution of other products will be considered if submitted in accordance with the General Conditions, Division 1, and Section 26 05 00.

C. Substitution requests for fixtures equal to those specified shall include complete construction and photometric data including, if applicable, candlepower distribution

curve, spacing to mounting height ratio, table of coefficients of utilization, isofootcandle curve, ANSI beam spread classification, efficiency, etc.

D. Submittals and substitution requests for fixtures shall include the sheet metal gauge of the housing and the lens thickness, material, and pattern.

2.2 MATERIALS:

A. Polystyrene lenses and lenses less than 0.125 inches nominal thickness shall not be permitted unless otherwise noted.

B. Provide luminaires with Area Coverage, damp, or wet label if required for the application indicated.

C. All recessed luminaires shall be free of light leaks.

2.3 BALLASTS:

A. All ballasts shall be capable of providing reliable operation of the lamps at the lowest temperature normally encountered. The contractor shall confirm that the ballasts are appropriate for the ambient conditions.

B. The contractor shall verify the ballast voltage prior to submittal.

H. DIMMING DRIVER LED: Provide integral 0-10 volt dimming driver capable of continuous dimming that works with any standard 0-10V dimmer, unless noted otherwise on Luminaire Schedule:

1. UL listed and CSA certified.
2. Comply with IESNA LM-79 and LM-80 standards.
3. Recognized Testing Laboratory listed, thermally protected, resetting, Class P, For use in insulated ceilings.
4. Power factor equal to or greater than 90%.
5. Meet all current Federal, State and Power Co. efficiency and efficacy standards, and rebate program requirements.
6. Meet all current ANSI, IEEE, and FCC regulations for EMI/RFI, harmonic distortion, and transient protection.
7. Compatible with occupancy sensor switching.

Coordinate dimming with dimming controls specified in separate section.

Provide low voltage cable for 0-10 volt dimming per manufacturer instructions.

I. Provide emergency battery/inverter packs at fixtures indicated on plans.

1. Emergency battery/inverter pack shall be capable of operating lamp(s) at a minimum of 1100 lumens, or at the lumen rating listed on the Light Fixture Schedule (whichever is greater), for a minimum of 90 minutes.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Luminaires installed under this work shall be properly and adequately supported from the building structure except where ceiling construction or other provisions are specifically designed to support the fixture units. Fixture support systems shall provide a safety factor of four. This shall apply to chains, hangers, anchors, clamps, screws, and all other hardware and appurtenances associated with the support system.

B. Fixture supports shall provide proper alignment and leveling of fixtures, and shall be arranged to maintain the alignment at all times. The final decision as to adequacy of alignment shall be given by the Architect.

C. All light outlets shall be supplied with a fixture. Outlet symbols on the drawings without a type designation shall have a fixture the same as those used in similar or like locations.

D. Fixture stem or chain lengths for industrial reflector or bare lamp strip fixtures shall be appropriate for the space and for coordination with other work such as ducts and piping. Provide swivel hangers for stem-hung fixtures.

E. Fixtures shall be left clean at the time of acceptance of the work and every lamp shall be in operation. The responsibility for cleaning or protecting fixtures from dirt, dust, paint, debris, etc. shall rest with the Contractor performing this division of work.

F. Prior to the purchase of any luminaire, the finish shall be verified with the Architect and the voltage shall be verified based on the panelboard voltage.

G. Provide seismic support wires for all recessed fixtures where ceiling framing is not designed for fixture support.

3.3 WARRANTY:

A. Provide a 5-year complete parts and replacement labor by manufacturer.

END OF SECTION

DIVISION 31 – EARTHWORK

SECTION 31 05 13
COMMON FILL

PART 1 GENERAL

1.1. **SECTION INCLUDES**

A. Common fill material.

1.2 **REFERENCES**

A. **ASTM Standards**:

C136 Sieve Analysis of Fine and Coarse Aggregates.

D448 Classification for Sizes of Aggregate for Road and Bridge Construction.

D1883 CBR (California Bearing Ratio) of Laboratory-Compacted Soils.

D2487 Classification of Soils for Engineering Purposes.

D2844 Resistance R-Value and Expansion Pressure of Compacted Soils.

D3282 Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.

D3740 Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

F1647 Organic Matter Content of Putting Green and Sports Turf Root Zone Mixes.

1.3 **SUBMITTALS**

A. **General**. If a change in source of material is required, submit name of Supplier, source and gradation analysis of material before delivery to site.

B. **Topsoil**. Submit certification from topsoil Supplier assuring topsoil product meets requirements in this Section.

C. **Borrow, granular borrow, granular backfill borrow, recycled fill, sand, gravel.** Before delivering material to site, identify:

1. Name of Supplier and source.
2. Gradation, classification and CBR.
3. Percent composition of reclaimed bitumionous concrete or Portland cement concrete included in the mix.

D. **Slag, pumice, scoria**. Identify name of supplier, source, and density.

1.4 **QUALITY ASSURANCE**

A. Use a laboratory that complies with ASTM D3740 and Section 01 45 00 requirements.

B. Reject fill products that do not meet requirements of this section.

C. Remove product found defective after installation and install acceptable product at no additional cost to OWNER.

1.5 **ACCEPTANCE**

A. **General**:

1. Acceptance is by Lot. One (1) lot is one (1) day productionl

2. Dispute resolution, Section 01 35 10.

B. **Roadway Backfill**: Sub-lot size is 5,000 tons.

PART 2 PRODUCTS

2.1 **BORROW**

A. Classifications A-1-a through A-4, ASTM D3282.

2.2 **GRANULAR BORROW**

A. Classifications A-1-a, A-1-b, A-2-4, or A-3, ASTM D3282.

B. Material meets design CBR-value (ASTM D1883) or R value (ASTM D2844) for suitability of source, not for project control testing.

2.3 **GRANULAR BACKFILL BORROW**

A. Classification A-1, ASTM D3282.

B. Well graded.

C. Particle size, two (2) inch maximum.

D. Material meets design CBR-value (ASTM D1883) or R value (ASTM D2844) for suitability of source, not for project control testing.

2.4 **RECYCLED FILL**

A. Material: Pulverized Portland cement concrete, pulverized bitumionous concrete pavement or combination, either mixed with or not mixed with a new aggregate.

B. Gradation: Meet requirements of this section based upon use; e.g. borrow, granular borrow, granular backfill borrow, etc.

2.5 **NATIVE**

A. When allowed by ENGINEER, material obtained from Excavations may be used as fill, provided organic material, rubbish, debris, and other objectionable materials are removed and CONTRACTOR has submitted the appropriate proctor density data (see Section 31 23 26).

2.6 **CLAY**

A. Classification CL, CL-ML, or ML, ASTM D2487.

B. Free of organic matter, frozen material, debris, rocks, and deleterious

materials.

C. Homogeneous, relatively uniform.

2.7 **SAND**

A. Friable river or bank aggregate, free of loam and organic matter. Graded as follows.

Sieve	Percent Passing by Weight
3/8	100
100	1 – 10

2.8 **GRAVEL**

A. Material: Rock, stone, or other high quality mineral particle or combination.

Sewer Rock.

Nominal Size	ASTM Size No.
3.5 to 1.5”	1
2.5 to 1.5”	2
2 to 1”	3
1.5 to 3/4”	4
1 to 1/2"	5

Pea Gravel.

Nominal Size	ASTM Size No.
3/4 to 3/8”	6
1/2 to No. 4	7
3/8 to No. 8	8
No. 4 to No. 16	9
No. 4 (screenings)	10

2.9 **TOPSOIL**

A. Chemical Characteristics:

1. Acidity and alkalinity range: pH 5.5 to 7.7
2. Soluble Salts: Less than 2.0 mmhos/cm.
3. Sodium Absorption Ratio (SAR): less than 3.0
4. Nitrogen (NO_3N): 48 ppm minimum
5. Phosphorus (P): 11 ppm minimum
6. Potash (K): 130 ppm minimum
7. Iron (Fe): 5.0 ppm minimum

B. Physical Characteristics:

1. Fertile, loose, friable.
2. Free of weeds, subsoil, lumps or clods of hard earth, plants or their roots, sticks, toxic minerals, chemicals and stones greater than 1-1/2 inch diameter.

3. Composition, ASTM D2487:

Material	Percent
Sand	15 – 60
Silt	10 – 70
Clay	5 – 30
Organic matter	2 - 5

Humus determined by ASTM F1647. Peat may be used as an organic amendment to meet the humus requirements.

2.10 **SLAG, PUMICE, SCORIA**

A. Chemically inert, porous, durable, free draining.

Table 1 – Gradation and Density

Criteria		Slag	Pumice	Scoria
Gradation, US Sieve	3”	100	100	100
	1 1/2"	80 – 100	80 – 100	80 – 100
	3/4"	20 – 100	--	--
	3/8”	0 – 20	0 – 20	40 – 100
	No. 4	0 – 10	0 – 10	10 – 70
	No. 16	--	0 – 65	0 – 40
	No. 50	--	0 – 40	0 – 25
	No. 200	0 – 3	0 – 3	0 – 15
Density, pound per cubic foot		85 – 100	75 – 80	60 – 75

NOTES:
(a) Gradations are based upon percent of material passing sieve by weight, ASTM C136.
(b) Density measured as in-place target.

2.11 **SOURCE QUALITY CONTROL**

A. Verify gradation, ASTM C136.

B. Select samples on a random location and time basis.

C. If tests indicate materials do not meet specified requirements, change materials and retest at no additional cost to OWNER.

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 31 11 00
SITE CLEARING

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Removal of trees, stumps, roots, and tree debris.

B. Clearing site of plant life, root systems and shrubs.

C. Removal of fences, fence posts, mail box posts, and miscellany.

1.2 **REFERENCES**

A. **NAA Standards**:

Pruning Standards for Shade Trees.

B. **Utah Shade Tree Pruning Standards**.

1.3 **QUALITY ASSURANCE**

A. Provide at least one person, who is familiar with NAA pruning standards for the type of tree involved, to be present during tree pruning operations.

1.4 **SITE CONDITIONS**

A. Repair or replace damaged trees and shrubs at no additional cost to OWNER.

1.5 **PROTECTION**

A. Protect roots and branches of trees to remain.

B. Construct temporary barricading at tree's approximated drip line. Place continuous barricades at least three (3) feet high.

C. When setting posts, avoid damaging tree roots.

D. Do not permit heavy equipment or stockpiling of materials or debris within the barricaded area, or permit earth surface to be changed.

E. Provide water and fertilizer to maintain existing trees.

PART 2 PRODUCTS

2.1 **STUMP TREATMENT SOLUTION**

A. Formulated to kill existing vegetation.

PART 3 EXECUTION

3.1 EXAMINATION

A. The drawings do not purport to show all trees and shrubs existing on site.

B. Verify with ENGINEER which plantings are to be removed or to remain.

C. Tree root inspection:

1. Assist ENGINEER by removing and replacing existing surface improvements.
2. Cost of removals and replacements will be paid for using existing payment prices, or if none, then by using contract Modification prices.

3.2 PREPARATION

A. Locate utilities. Preserve utilities that are to remain in service, Section 31 23 16.

B. Review work procedures with ENGINEER.

C. Schedule work carefully with consideration for property owners and general public.

D. Before starting, arrange for disconnection of all utility services that are to be removed or which interfere with work.

3.3 SITE CLEARING

A. Remove all vegetation outside of excavation, fill slope lines, and limits of slope rounding.

B. Remove fences, posts, appurtenances, and miscellaneous objects.

3.4 TREE REMOVAL

A. Remove branches, limbs, and debris.

B. Remove stumps and roots to 18 inches below proposed grade.

C. For stumps larger than six (6) inches caliper remove and treat as follows:

1. Remove chips and debris from around remaining stump.
2. Apply stump treatment solution in accordance with manufacturer's recommendations.
3. Do not allow chemical solution to mist, drip, drift, or splash onto adjacent ground surfaces or desirable vegetation.
4. Replace any existing vegetation damaged or killed through improper use of chemical at no additional cost to OWNER.

END OF SECTION

SECTION 31 22 19 - FINISH GRADING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide all labor, materials, services and equipment indicated on the Drawings and/or herein specified to complete all Finish Grading Work.

B. Finish grading shall consist of the final grading and shaping of all areas, except those areas under pavements, slabs and structures, to conform to lines, elevations and shapes as indicated on the Drawings.

C. Re-vegetation of all cleared or stripped areas disturbed by construction activities

1.2 DEFINITIONS

A. Subgrade: Subgrade shall mean surfaces upon which additional specified materials are to be placed, prepared or constructed.

B. Rough Grading: Rough grading shall mean the act that includes the spreading or placement of specified materials to the tolerances defined as final rough grade.

C. Final Rough Grade: Final rough grade shall mean the establishment of grades to a 0.15 foot plus or minus tolerance of grades required to accomplish the work described in other sections of the specifications on the drawings (i.e. landscape work, finish grading, concrete work, asphalt work, etc.)

D. Finish Grading: Finish grading shall mean the act that includes the spreading or placement of specified materials to establish the tolerances defined as final finish grade.

E. Final Finish Grade: Final finish grade shall mean the establishment of grades to a plus or minus tolerance of final grades as indicated on drawings. Tolerances are specified in applicable sections of the specifications (i.e. concrete, asphalt, finish grading, etc.).

1.4 SUBMITTALS

A. Topsoil shall be subject to inspection and approval at the source of supply or upon delivery.

1.5 QUALITY ASSURANCE

A. All spot elevations to be staked for verification and approval by the Engineer.

B. Finish grade tolerance shall be within plus or minus 0.15 foot of final grades indicated on drawings.

C. Finished grades shall conform to shapes, spot elevations and contours, as indicated on drawings, with uniform levels or slopes between finished elevations or between finished elevations and existing elevations.

D. Testing and Inspection Service: Contractor will engage a soil testing service for quality control testing during finish grading operations. All testing will be coordinated with Engineer and his inspector.

PART 2 - PRODUCTS

2.1 IMPORTED FILL MATERIALS

A. As required in Section 312000 – Earth Moving

2.2 TOPSOIL

A. Topsoil shall be fertile, friable, natural loam and shall be capable of sustaining vigorous plant growth. Topsoil shall be approved native soils stripped from the site prior to excavation. It shall be free of stones, lumps, clods of hard earth, plants or their roots, sticks and other extraneous matter. The soil shall contain no noxious weeds or their seeds. It shall not be used for planting operation while in a frozen or muddy condition.

PART 3 - EXECUTION

3.1 GENERAL

A. Conduct work in an orderly manner and so as to not create a nuisance. Dirt shall not be permitted to accumulate on streets or sidewalks not to be washed into storm sewers.

B. Finished grades shall be established using materials as specified.

C. Finish grade tolerance shall be within plus or minus 0.15 foot of final grades indicated on drawings.

D. Finished grades shall conform to shapes, spot elevations and contours, as indicated on drawings, with uniform levels or slopes between finished elevations and existing elevations.

E. Finished grades shall be established to provide after settling, adequate drainage in a uniform way so no water pockets or ridges will be created.

3.2 FINISH GRADING

A. Fine grade all landscaped areas to a smooth, loose and uniform surface.

B. Finish grades of all landscaped areas shall be established with topsoil material, as specified, spread to a depth of two (2) inches.

C. Contractor is responsible to spread excess excavated soil material from plant pits in surrounding planting beds.

D. Finished grade of planting areas shall be one (1) inch below top of curb, walls, concrete slabs, and mow strips or redwood headers.

END OF SECTION

SECTION 31 23 16
EXCAVATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Excavation and disposal of excavated materials.

B. Protection of existing facilities such as utilities, vegetation, structures affected by excavation, etc.

1.2 PAYMENT PROCEDURES

A. No Contract Time extension shall be granted and no additional compensation shall be made if buried utilities or structures that conflict with the Work have not been found by Keyholing.

B. Perform Incidental Excavation at no additional cost to OWNER.

1.3 DEFINITIONS

A. **Authorized Over Excavation**: Upper limit of excavation is proposed excavation limit. Lower and lateral limits are as authorized by ENGINEER.

B. **Classified Excavation**: The excavation of specified materials.

C. **Incidental Excavation**: Excavation done for CONTRACTOR's benefit, excavation error, dewatering of excavation, slough, or over-break.

D. **Unclassified Excavation**: The excavation of all materials encountered regardless of the nature, size, or manner in which they are removed. Presence of isolated boulders or rock fragments will not be sufficient cause to change classification of surrounding materials.

E. **Keyholing**: The process of making a small, precisely controlled hole for "day-lighting", or uncovering and exposing underground utilities, in order to locate or inspect them.

1.4 STORAGE AND HANDLING

A. Stockpile excavated material to cause minimum inconvenience to public and provide for emergency services as necessary.

B. Provide free access to existing fire hydrants, water valves, gas valves, and meters.

C. Provide free flow of storm water in all gutters, conduits, and natural water courses.

D. Utilize traffic control signs, markers, and procedures in product storage and handling activities.

E. Promptly remove other material from site.

PART 2 PRODUCTS

2.1 BACKFILL MATERIALS

A. Common fill, Section 31 05 13.

B. Aggregate base course, Section 32 11 23.

C. Stabilization fill, aggregate base course or common fill with maximum rectilinear particle size of two (2) inches.

D. Stabilization fabric, Section 31 05 19.

PART 3 EXECUTION

3.1 PREPARATION

A. Photograph existing surfaces where work will take place to document conditions before excavation, Section 01 78 39.

B. Use white paint and mark the proposed excavation.

C. Call the one-call center and wait the required amount of time. Colors of one call center marks indicate the following:

White	Proposed excavation
Red	Electric power lines, cables, conduit and lighting cables
Yellow	Gas, oil, steam, petroleum or gaseous materials.
Orange	Communications, alarm, signal, cables or conduits.
Blue	Potable water.
Purple	Reclaimed water, irrigation and slurry lines.
Green	Sewer and storm drain lines.
Pink	Temporary survey markings.

D. Implement traffic control plan requirements, Section 01 55 26.

E. For temporary controls, refer to Section 01 57 00.

3.2 PROTECTION

A. Identify required lines, grades, contours, and benchmarks, Section 01 71 23.

B. Utilities:

1. Keyhole, expose or otherwise locate utilities as necessary to give utility agency at least one (1) day notice to protect, preserve, or relocate a utility that may interfere with or may be damaged by excavation work. Perserve utilities that remain in service.

2. Where utilities or structures conflict with design grades, report conflict to appropriate utility company and ENGINEER 14 days before initiating work within the conflict area.

C. Support and protect from damage any existing facility and structure that

exists in, passes through, or passes under the site.

D. Protect existing landscape sprinkler systems. When sprinkler system disturbance is required, interrupt and repair system so operation of system is maintained, Section 02 41 13.

E. Carefully remove soil around tree roots so ENGINEER can assess stability and health of tree.

3.3 **GENERAL EXCAVATION REQUIREMENTS**

A. Excavate topsoil from areas to be relandscaped or regraded and other marked areas.

B. Excavate site to line and grade indicated. Legally dispose of excavated material.

C. Carefully excavate soils in vicinity of buried utility marks placed by the one-call center.

D. Where soil has been softened or eroded by flooding or hardened by drying, rework all damaged areas or replace with approved material at no additional cost to OWNER.

E. Notify ENGINEER of unexpected subsurface conditions.

F. Underpin adjacent structure, service utilities and pipe chases that may be damaged by excavation work.

G. Protect excavation walls as required. If conditions permit, slope excavation sides to maintain a safe and clean working area. Remove loose materials.

H. Where ENGINEER deems subgrade material to be susceptible to frost heave or otherwise unsatisfactory, excavate additional depth.

3.4 **TOPSOIL**

A. Excavate topsoil only to depth that will preserve topsoil quality.

B. Do not mix topsoil with subsoil during stockpiling or spreading.

3.5 **SHORING**

A. Slope, shore, sheet, brace or otherwise support excavations over four (4) feet deep, Section 31 41 00.

B. When soil conditions are unstable, excavations shallower than four (4) feet deep must also be sloped, supported or shored.

3.6 **DEWATERING**

A. Keep excavation free from surface and ground water.

B. If ground water is in the intended construction operations, dewater excavations.

C. If there are no olfactory or visual indications of contamination in the water, discharge according to requirements of Federal, State or local agency having jurisdiction.

D. If any evidence of contamination in the water, based on olfactory or visual indications, cease excavation work until potential risks are evaluated. During evaluation, handle water as a contaminated material.

E. Pay for damages and costs resulting from dewatering operations.

3.7 ROADWAY EXCAVATION

A. In advance of setting line and grade stakes, clear and grub area of brush, weeds, vegetation, grass, and debris. Drain all depressions or ruts.

B. Roadway excavation is Unclassified Excavation. It includes Portland cement concrete or bituminous concrete pavement removal and removal of any aggregate base or sub-base material to line and grade established by Drawings or ENGINEER.

3.8 STRUCTURAL AND LANDSCAPE EXCAVATION

A. Provide shoring, cribs, cofferdams, caissons, pumping, bailing, draining, sheathing, bracing, and related items.

B. For piling work, coordinate special requirements for piling. Protect excavation walls.

C. If conditions permit, slope excavation sides as excavation progress. Maintain a safe and clean working area.

D. Support excavations. Do not interfere with the bearing of adjacent foundations, pipelines, etc.

3.9 TRENCH EXCAVATION

A. Grade bottom of trenches to provide uniform bearing surface.

B. If necessary, make bell holes and depressions required for laying and joining pipe or box.

C. Limit width of trench excavations to the dimensions suitable for worker access per pipe manufacturer's recommendation. Provide enough space for compaction equipment. Notify ENGINEER if excavation operations exceed any indicated line and grade limits.

D. In roadways and regardless of trench depth, limit length of open trenches to 200 lineal feet day or night. Provide barricading, Section 01 55 26. Protect trenches over night.

3.10 STABILIZATION EXCAVATION

A. Perform stabilization excavation as Incidental Excavation.

3.11 AUTHORIZED OVER EXCAVATION

A. Over excavation must be permited by ENGINEER to be classified as authorized over excavation. Volume will be determined by the method of average-end-areas in the original position.

3.12 TOLERANCE

A. Grading: Top surface of Subgrade = plus or minus 1 inch.

END OF SECTION

SECTION 31 23 17
ROCK REMOVAL

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Requirements for Rock removal and use of explosives to assist in Rock removal.

1.2 **REFERENCES**

A. **NFPA Standards**:

495 Manufacture, Transportation, Storage, and Use of Explosive Materials.

1.3 **DEFINITIONS**

A. **Rock**: Solid mineral material that cannot be removed with equipment reasonably expected to be used in the Work without cutting, drilling or blasting.

1.4 **SUBMITTALS**

A. Submit proposed method of blasting, delay pattern, explosive types, type of blasting mat cover, and intended Rock recovery method.

B. Submit photographs of existing site conditions and facilities in vicinity of Work before blasting. Refer to construction photographic requirements, Section 01 78 39.

1.5 **QUALITY ASSURANCE**

A. Seismic Survey Firm: Company specializing in seismic surveys with two (2) years documented experience.

B. Explosive Firm: Company specializing in explosives for disintegration of Rock with 2 years documented experience.

PART 2 PRODUCTS

2.1 **EXPLOSIVES**

A. Type recommended by explosives firm following seismic survey and required by authorities having jurisdiction.

2.2 **DELAY DEVICES**

A. Type recommended by explosives firm.

2.3 **BLASTING MAT MATERIALS**

A. Type recommended by explosives firm.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify site conditions and note irregularities affecting work of this Section.

B. Obtain permits from authorities having jurisdiction before explosives are brought to site or drilling is started.

C. Locate and preserve utilities, Section 31 23 16.

D. Beginning work of this Section constitutes acceptance of existing conditions.

E. Comply with NFPA 495.

3.2 STORAGE OF BLASTING MATERIALS

A. Securely store all explosives in compliance with Laws and Regulations.

B. Mark all storage places clearly.

C. Where no local Laws or Regulations apply, provide storage not closer than 1,000 feet from any road, building, camping area or place of human occupancy.

3.3 ROCK REMOVAL - NONEXPLOSIVE METHOD

A. Cut away Rock at excavation bottom to form level bearing.

B. Remove shaled layers to provide sound and unshattered base for foundations.

C. Remove and legally dispose of excess excavated material and debris off-site unless indicated otherwise.

D. Correct unauthorized Rock removal at no additional cost to OWNER.

3.4 ROCK REMOVAL - EXPLOSIVE METHOD

A. Provide a qualified explosives expert to act as an advisor and consultant during drilling and blasting operations.

B. Advise owners of adjacent buildings or structures and utility companies in writing before setting up seismographs. Describe blasting and seismic operations.

C. Obtain and pay for a seismic survey before Rock excavation to determine maximum charges that can be used at different locations in area of excavation without damaging adjacent properties and utilities.

D. Provide seismograph monitoring during progress of blasting operations.

E. Disintegrate and remove Rock from excavation operations.

END OF SECTION

SECTION 31 23 19 - DEWATERING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish and install all labor, equipment, material, and related services to dewater all applicable portions of the project.

B. Dewatering may be necessary for construction requiring deep excavations.

C. Provide all necessary dewatering during construction of the entire project.

1.2 SUBMITTALS

A. Submit dewatering plan for all applicable excavations.

1.3 SITE CONDITIONS

A. Protect the project site and adjacent property to avoid any damage caused by dewatering and pumping.

B. All dewatering discharge shall be the responsibility of the Contractor.

C. Ensure that no erosion occurs and that no contamination of the adjacent low areas occurs due to dewatering.

D. Soil borings made at the site are shown on the plans and complete soil boring reports are included in this specification document. Groundwater level readings at the time of the borings are included on the logs. Borings and groundwater levels are for informational purposes only and are not to be taken as wholly representative of all conditions throughout the project site.

E. The Contractor shall furnish all power, pumps and other apparatus necessary for the rapid and proper execution of the dewatering. All costs associated with dewatering during construction shall be included in the Lump Sum bid. The risk associated with correctly determining the appropriate dewatering cost shall be borne by the Contractor. Regardless of the bid value of dewatering, the Contractor shall complete any and all dewatering work necessary to construct this project in accordance with plans and specifications. No additional compensation will be paid by the Owner.

PART 2 - PRODUCTS

2.1 DEWATERING EQUIPMENT

A. The Contractor is advised to carefully view the site to determine to what extent dewatering will be necessary for construction of the various structures. The choice of dewatering equipment shall be the responsibility of the Contractor.

B. Dewatering by pumping from sump pits will be acceptable if this method is able to keep the excavation dry.

C. If pumping from sump pits is not able to maintain a dry excavation, dewatering shall be accomplished by means of well points, vacuum well points, deep wells, or a combination of these methods.

D. Contractor shall remove from the site, all sand, silt, and debris accumulated during dewatering operations.

PART 3 - EXECUTION

3.1 DEWATERING

A. All dewatering shall be carried out in accordance with an approved plan. Plan must be approved by the Engineer prior to any dewatering operations.

B. All dewatering shall be done to insure no erosion or pollution results.

C. Dewatering shall be of such magnitude necessary to ensure all excavations are acceptable for the construction requirements.

D. The Contractor shall insure that the dewatering is operated continuously, 24 hours per day, if necessary.

E. Upon completion of the operation, the areas shall be cleaned of all debris and equipment and shall be returned to original or better condition.

3.2 PERMITS

A. The Contractor shall obtain all permits and pay all fees required by the Department of Natural Resources and other regulatory agencies for dewatering wells or water appropriation.

END OF SECTION

SECTION 31 23 23

BACKFILLING FOR STRUCTURES

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Structural backfill materials.

B. Structural backfilling requirements.

1.2 **REFERENCES**

A. **ASTM Standards**:

D698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).

D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D4832 Preparation and Testing of Soil-Cement Slurry Test Cylinders.

1.3 **SUBMITTALS**

A. Submit maximum laboratory dry density and optimum laboratory moisture content for:

1. Subgrade material, and
2. Each type of fill to be used.

1.4 **QUALITY ASSURANCE**

A. Do not change material sources, or aggregate without ENGINEER's knowledge.

B. Reject backfill material that does not comply with requirements specified in this Section.

C. If requested, submit a written quality control inspections and testing report describing source and field quality control activities performed by CONTRACTOR and Suppliers.

1.5 **STORAGE**

A. Safely stockpile backfill materials.

B. Separate differing materials, prevent mixing, and maintain optimum moisture content of backfill materials.

1.6 **SITE CONDITIONS**

A. Do not place, spread, or roll any backfill material over material that is damaged by water. Remove and replace damaged material at no additional cost to OWNER.

B. Control erosion. Keep area free of trash and debris. Repair settled, eroded, and rutted areas.

C. Reshape and compact damaged structural section to required density.

1.7 **ACCEPTANCE**

A. **General**: Native material may be wasted if there is no additional cost to substitute material acceptable to ENGINEER.

B. **Material**: For material acceptance refer to:

1. Common fill, Section 31 05 13.
2. Aggregate base course, Section 32 11 23.
3. Cement treated fill, Section 31 05 15.

C. **Lift thickness**: One test per Lot.

D. **Compaction**: One test per Lot. Verify compaction using nuclear tests, ASTM D2922. Density and lot sizes as follows:

Table 1 – Density and Lot Sizes

Structure Type	Density	Proctor	Lot Size
Strip Footings	95	Standard	Subgrade: 200 linear feet
	98	Modified	Aggregate base course: 200 linear feet per lift.
Structure Footing excluding strip footings	95	Standard	Subgrade: 225 square feet.
	98	Modified	Aggregate base course: Each 225 square feet per lift
Embankments	95	Standard	Fill: 625 square feet per lift
Interior Slab on Grade	98	Modified	Aggregate base course: 625 square feet
Side of Foundation Walls and Retaining Walls	95	Standard	Exterior:
	98	Modified	Interior
Miscellaneous small structures (e.g. Manholes, drainage boxes, etc.)	95	Standard	Subgrade: Each footprint area Fill: Each lift
	98	Modified	Aggregate base course: Each lift

NOTES
(a) Standard proctor, ASTM D698.
(b) Modified proctor, ASTM D1557.

E. **Flowable Fill Strength**: Lot size is one day production with sub-lots of 250 cubic yards or part thereof. Verify strength using cylinders, ASTM D4832.

F. **Grade, Cross Slope**: Measured at random locations.

1.8 **WARRANTY**

A. Repair settlement damage at no additional cost to OWNER.

PART 2 PRODUCTS

2.1 **BACKFILL MATERIALS**

A. Common fill, Section 31 05 13. Granular material, CONTRACTOR's choice.

B. Aggregate base course, Section 32 11 23. Untreated base course.

C. Cement treated fill, Section 31 05 15. Use a flowable fill so vibration is not required.

2.2 **WATER**

A. Make arrangements for sources of water during construction and make arrangements for delivery of water to site.

B. Comply with local Laws and Regulations at no additional cost to OWNER when securing water from water utility company.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Implement traffic control plan requirements, Section 01 55 26.

B. Verify:

1. Backfill material meets gradation requirements.
2. Foundation walls are braced to support surcharge forces imposed by backfilling operations, areas to be backfilled are free of debris, snow, ice or water.
3. Ground surface is not frozen.

C If ground water is in the intended backfill zone, dewater.

3.2 **PROTECTION**

A. Protect existing trees, shrubs, lawns, structures, fences, roads, sidewalks, pavings, curb and gutter and other features.

B. Protect above or below grade utilities. Contact utility companies to repair utility damage. Pay all cost of repairs.

C. Avoid displacement of and damage to existing installations while compacting or operating equipment. Do not fill adjacent to structures until excavation is checked by ENGINEER.

D. Do not use compaction equipment adjacent to walls or retaining walls that may cause wall to become over-stressed or moved from alignment.

E. Do not disturb or damage foundation perimeter drainage, foundation, damp-proofing, foundation waterproofing and protective cover, or utilities in trenches. Movement of construction machinery over work at any stage of construction is solely at CONTRACTOR's risk.

F. Restore any damaged structure to its original strength and condition.

3.3 **LAYOUT**

A. Identify required line, levels, contours, and datum.

B. Stake and flag locations of underground utilities.

C. Upon discovery of unknown utility or concealed conditions, notify ENGINEER.

D. Maintain all benchmarks, control monuments and stakes, whether newly established by surveyor or previously existing. Protect from damage and dislocation.

E. If discrepancy is found between Contract Documents and site, ENGINEER shall make such minor adjustments in the Work as necessary to accomplish the intent of Contract Documents without increasing the Cost of the Work to CONTRACTOR or OWNER.

3.4 **SUBGRADE**

A. Protect Subgrade from desiccation, flooding, and freezing.

B. Before backfilling over Subgrade, get ENGINEER's inspection of subgrade surface preparations.

C. If Subgrade is not readily compactable get ENGINEER’s permission to stabilize the subgrade.

3.5 **FOUNDATIONS AND SLABS ON GRADE**

A. Lift thickness before compaction is eight (8) inches.

B. Do not backfill against walls until concrete has obtained 14 days strength. Backfill against foundation walls simultaneously on each side.

C. Fill unauthorized excavations with material acceptable to ENGINEER at no additional cost to OWNER.

D. Do not damage adjacent structures or service lines.

E. Where flowable fill is used, use fill that flows easily and vibration for compaction is not required.

3.6 **MODIFIED BACKFILL LAYER METHOD**

A. Section 33 05 20.

3.7 **TOLERANCES**

A. Compaction: Ninety-five (95) percent or ninety eight (98) percent minimum relative to a standard or modified proctor density, Section 31 23 26.

B. Lift Thickness (before compaction):

1. Eight (8) inches when using riding compaction equipment.
2. Six (6) inches when using hand held compaction equipment.
3. As proven in the modified backfill layer method, Section 33 05 20.

C. Cement Treated Fill: Compressive strength targets are 60 psi in 28 days and 90 psi maximum in 28 days.

3.8 **CLEANING**

A. Remove stockpiles from site. Grade site surface to prevent free standing surface water.

B. Leave borrow areas clean and neat.

END OF SECTION

SECTION 31 23 26
COMPACTION

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Compaction of granular fill materials.

1.2 **REFERENCES**

A. **ASTM Standards**:

D698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).

D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3))

D2216 Laboratory Determination of Water (Moisture) Content of Soil and Rock.

D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D3017 Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

D3282 Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.

D3740 Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

1.3 **DEFINITIONS**

A. **A-1 Soil**: Defined in ASTM D3282.

B. **Modified Proctor Density**: The maximum laboratory density, as defined in and determined by ASTM D1557 using procedure A, B or C as applicable.

C. **Relative Density (or Relative Compaction):** The ratio of field dry density to the maximum laboratory density expressed as a percentage.

D. **Standard Proctor Density**: The maximum laboratory density, as defined in and determined by ASTM D698 using procedure A, B or C as applicable.

1.4 **QUALITY ASSURANCE**

A. Use a soil and rock laboratory that complies with ASTM D3740.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 COMPACTION

A. Moisten or dewater backfill material to obtain optimum moisture for compaction.

B. When no density compactive effort is specified, compact the entire area to 95 percent and eliminate unstable zones.

C. Correct deficient compaction conditions. Replace or repair materials and damaged facilities.

3.2 FIELD QUALITY CONTROL

A. **Testing**: Perform control testing of materials. Perform additional testing at no additional cost to OWNER, for

1. Changes in source of materials or proportions requested by CONTRACTOR, or
2. Failure of materials to meet specification requirements, or
3. Other testing services needed or required by CONTRACTOR.

B. **Optimum Soil Density**: Use ASTM D2216 and the following industry standards.

1. For A-1 Soils: Method C of ASTM D1557 (Modified Proctor)
2. For All Other Soils: Method C of ASTM D698 (Standard Proctor).

C. **Field Density**:

1. Use ASTM D3017 and test method C of ASTM D2922 for shallow depth nuclear testing.
2. No density determinations are required on any material containing more than 65 percent material retained on the number 10 sieve or more than 60 percent material retained on the number 4 sieve. In lieu of reporting densities in such cases, report the sieve analysis to document the material type.

3.3 REPORT

A. For each material tested, document the following:

1. Vertical and horizontal location of the test.
2. Optimum laboratory moisture content.
3. Field moisture content.
4. Maximum laboratory dry density.
5. Field density.
6. Percent compaction results.
7. Certification of test results by Independent Testing Agency.

END OF SECTION

SECTION 31 25 00

EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Erosion control and slope protection facilities including blankets or mulches.

B. Construction of drainage facilities to protect work area.

1.2 SUBMITTALS

A. Submit before using:

1. Sample of blanket or geotextile materials.
2. Mulch formula.
3. Grass mixture listing.
4. Plant list.
5. Geotextile manufacturer's certification.

B. Application rate of fiber mulches recommended by tackifier manufacturer.

1.3 DELIVERY, STORAGE AND HANDLING

A. Deliver seed in original containers with certified germination test results showing analysis of seed mixture, percentage of pure seed, year of production, and date of packaging. Damaged packages are not acceptable. Store seed free of moisture.

B. Deliver fertilizer in waterproof bags showing weight, chemical composition and name of manufacturer.

C. Deliver blanket in original wrapping showing name of manufacturer and product weight.

D. Deliver plant materials immediately before placement.

E. Replace plant when original root protection system (burlap bag wrap of earth ball, plastic container with special plant bedder, etc.) has been broken or displaced before planting.

PART 2 PRODUCTS

2.1 MATERIALS

A. Riprap: Rock, Section 31 37 00.

B. Blankets: Uniform open weave jute, wood fiber, biodegradable or photodegradable synthetic fiber matting.

C. Geotextiles: Section 31 05 19.

D. Erosion Control Vegetation Mats: Permanent three dimensional mats that allow for revegetation where high water flows are expected.

E. Fiber Mulches: Straw, hay, wood or paper free from weeds and foreign matter detrimental to plant life.

F. Mulch Binder: Vegetable based gel tackifier with growth stimulant.

G. Topsoil and Fertilizer: Section 31 05 13 and Section 32 92 00.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove foreign materials, roots, rocks, debris.

B. Grade to eliminate rough spots, ponding areas.

C. Grade soil to drain perimeter water away from protected areas.

D. Temporary controls, Section 01 57 00 as applicable.

3.2 SLOPE PROTECTION BLANKET

A. Cover seeded slopes where grade is greater than one (1) vertical to three (3) horizontal with blanket. Roll down over slopes carefully and loosely without stretching or pulling.

B. Lay blanket smoothly on prepared soil surface. Bury top end of each section in a narrow trench. Leave 24 inches overlap from top roll over bottom roll. Leave 12 inches overlap over adjacent section.

C. Toe-wrap fabric at bottom of slope.

D. Staple loosely the outside edges and overlaps.

E. In ditches, lay matting in upstream direction. Overlap and staple ends six (6) inches with upstream section on top.

F. If natural drainage water traverses protected or controlled area; construct a channel or riprap Section 31 37 00.

G. Lightly dress slopes with topsoil to ensure close contact between cover and soil.

H. Present alternative methods of protection for approval before starting any work.

3.3 GEOTEXTILE

A. Placement, Section 31 05 19.

3.4 MULCHES

A. Apply mulches at the rate necessary.

B. When installed with a tackifier, apply at the rate recommended by the tackifier supplier.

3.5 SURFACE COVER

A. Grass, Section 32 92 00.

B. Ground cover, Section 32 93 13.

3.6 **MAINTENANCE**

A. Maintain surfaces and supply additional topsoil where necessary, including areas affected by erosion.

B. Protect and repair geotextiles, Section 31 05 19.

C. Keep surface of soil damp only as necessary for seed germination.

D. Apply water slowly so surface of soil will not puddle and crust.

E. Replant damaged grass areas showing root growth failure, deterioration, bare or thin spots, and eroded areas.

F. Re-fertilize 60 days after planting.

G. Remove weeds that are over three (3) inches high.

END OF SECTION

SECTION 31 31 19
VEGETATION CONTROL

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Application of soil treatment to remove weed and vegetation.

1.2 **SUBMITTALS**

A. Submit certificate identifying composition of non-selective control herbicide.

PART 2 PRODUCTS

2.1 **HERBICIDE**

A. Water soluble herbicide for non-selective control of annual and perennial weeds.

PART 3 EXECUTION

3.1 **MIXING**

A. Mix herbicide solution in strict accordance with manufacturer's instructions and applicable Laws and Regulations.

3.2 **APPLICATION**

A. Execute all work in an orderly and careful manner with due consideration for surrounding plantings that are to remain.

B. Apply herbicide solution with a shield applicator. Do not allow solution to mist, drip, drift, or splash onto desirable vegetation.

C. Apply solution according to manufacturer's recommendations seven (7) days before preparation of surface to receive additional cover material. Do not add cover material until ENGINEER reviews spraying results.

D. Do not spray under windy or adverse weather conditions.

E. Replace portions of surrounding vegetation damaged or killed through this operation.

END OF SECTION

SECTION 31 37 00

RIPRAP OR ROCK LINING

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Placement of loose riprap, hand-placed riprap, or grouted riprap.

1.2 **REFERENCES**

A. **ASTM Standards**:

C535 Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

1.3 **SUBMITTALS**

A. Submit before use in the Work product data showing riprap source, gradation, aggregate wear and placement technique.

PART 2 PRODUCTS

2.1 **AGGREGATE**

A. Durable, angular, hard stone free from seams and cracks.

B. Graded in size to produce a reasonably dense mass.

C. The greatest dimension of 25 percent of the stones shall be at least, equal to but not more than 1-1/2 times the thickness of riprap indicated.

D. The greatest dimension of 50 percent of the stone shall be at least 3/4, but not more than 1-1/2 times the thickness of riprap indicated.

E. Not more than 10 percent of the aggregate shall have a dimension less than 0.1 times the thickness of riprap.

F. At least 95 percent of the stones shall have at least two (2) fractured or clean angular faces.

2.2 **ACCESSORIES**

A. Portland cement grout, Section 03 61 00.

B. Geotextile fabric, Section 31 05 19.

C. Grout, Section 04 05 16.

2.3 **SOURCE QUALITY CONTROL**

A. Aggregate: Wear not greater than 40 percent when tested, ASTM C535.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove all brush, trees, stumps, and other objectionable materials and dress area to a smooth surface. Make Excavation to provide a firm foundation and protect against undercutting. Secure approval before backfilling.

B. Install required geotextile in accordance with Section 31 05 19.

3.2 LOOSE-PLACED RIPRAP

A. Place stones to secure a Rock mass with the minimum thickness and height indicated. Manipulate Rock to secure a regular surface of graded size and mass stability.

3.3 HAND-PLACED RIPRAP

A. Place and bed rocks, one against the other, and key together. Fill irregularities between stones with suitable size spalls.

B. Place so finished surface of riprap is even, tight, and true to line and grade. Extend riprap sufficiently below ground surface to secure a firm foundation.

3.4 GROUTED RIPRAP

A. After placement and wetting the stones, sweep sand or fine gravel into the interstices to fill to within four (4) inches of the outer surface of the riprap.

C. Fill the remaining volume of the interstices flush with a well-mixed grout.

D. Keep grout wet by sprinkling or covering with wet material for at least three (3) days. Protect grout from stream water or any other disturbance during this cure period.

E. Do not place grout in freezing weather.

END OF SECTION

SECTION 31 50 00 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes temporary excavation support and protection systems.

1.2 PREINSTALLATION MEETINGS

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

1.3 INFORMATIONAL SUBMITTALS

A. Contractor Calculations: For excavation support and protection system. Include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

B. Record Drawings: Identify locations and depths of capped utilities, abandoned-in-place support and protection systems, and other subsurface structural, electrical, or mechanical conditions.

1.4 FIELD CONDITIONS

A. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Provide, design, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting earth and hydrostatic pressures and superimposed and construction loads.

1. Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer.

PART 3 - EXECUTION

3.1 SOLDIER PILES AND LAGGING

A. Install steel soldier piles before starting excavation. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging. 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. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.

C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

3.2 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. Limit vertical offset of adjacent sheet piling to 60 inches. 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.

3.3 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.

3.4 BRACING

A. Bracing: 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 Engineer.
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.

3.5 FIELD QUALITY CONTROL

A. Survey-Work Benchmarks: Resurvey benchmarks regularly during installation of excavation support and protection systems, excavation progress, and for as long as excavation remains open. Maintain an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Engineer if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

3.6 REMOVAL AND REPAIRS

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and earth and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils and rock or damaging structures, pavements, facilities, and utilities.

1. Remove excavation support and protection systems to a minimum depth of 48 inches below overlying construction and abandon remainder.

B. Leave excavation support and protection systems permanently in place.

END OF SECTION

DIVISION 32 – EXTERIOR IMPROVEMENTS

SECTION 32 01 05

INFORMATION, REGULATORY, AND WARNING SIGNS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Information, regulatory, and warning signs but not street name signs or construction signs.

1.2 REFERENCES

A. **ASTM Standards**:

B209: Aluminum and Aluminum - Alloy Sheet and Plate.

B. **FS Standards**:

L-P 380: Plastic Molding Material Methacrylate.

L-S-300: Sheeting and Tape, Reflective: Nonexposed Lens.

C. **National Bureau of Standards**:

PS 1: Construction and Industrial Plywood.

D. **DOT Standards**:

MUTCD: Manual on Uniform Traffic Control Devices for Streets and Highways.

1.3 DEFINITIONS

A. For definition purposes, the various types of signs are identified by a combination of letter and number. The letter represents the type of sign panel construction and the number represents the type of lettering and symbols to be used as follows:

1. Panel Type:
   a. Type A: Reflectorized sheeting on sheet aluminum.
   b. Type B: Reflectorized sheeting on plywood.
2. Letter Type:
   a. Type 1: Reflectorized demountable cutout letters, symbols, and borders with prismatic reflectors.
   b. Type 2: Opaque legend and borders.
   c. Type 3: Reflectorized permanently attached cutout letters, symbols, and borders or reflectorized screen processed letters, symbols, and borders.

1.4 SUBMITTALS

A. Submit Shop Drawings of support structures before fabrication.

B. Submit sample of each color of reflective sheeting including manufacturer's name and product number.

PART 2 PRODUCTS

2.1 MATERIALS

A. Sign Blank:
   1. Aluminum Sheet: 0.1 inch thick ASTM B209 alloy 6061-T6.
   2. Aluminum Extrusion: 0.1 inch thick ASTM B209 alloy 6063-T5 and 6063-T6.
   3. Softwood Plywood: PS 1 Group 1 with each panel bearing initials DFPA Grade - Trademark of the American Plywood Association; painted to ENGINEER's choice of color unless indicated.

B. Posts: Galvanized structural steel, U-shaped, T-shaped, C-shaped, box-shaped, or round tube, Section 05 12 00, with 3/8 inch diameter mounting holes.

C. Fabricated Supports: Galvanized steel, Sections 05 05 10 and 05 12 00.

D. Sheeting:
   1. Reflective: FS L-S-300 with 2,200 hours minimum durability.
   2. Nonreflective: Nonchalking, weather resistant transparent plastic having a protected adhesive backing and a smooth flat outer surface with glass spheres embedded within.

E. Prismatic Reflectors: Methyl methacrylate lens meeting FS L-P-380 requirements with aluminum frame.

F. Bolts, Nuts, Accessories: Galvanized steel, Section 05 05 23.

G. Cast-in-place Concrete: Class 3000 minimum, Section 03 30 04.

2.2 COLORS AND FORMAT

A. Sign Colors and Format: MUTCD.

B. Provided colors of same reflectorized hue in daylight and night under artificial white illumination.

PART 3 EXECUTION

3.1 PREPARATION

A. Locate and preserve utilities, Section 31 23 16.

B. Excavation, Section 31 23 16.

3.2 INSTALLATION

A. Do not remove a sign that is being replaced until the new sign is placed and uncovered. Provide temporary covering. Maintain covering until removal.

B. Unless indicated otherwise use clearance and locations shown in MUTCD. Install posts plumb and in proper alignment. Construct sign

post foundations with concrete. Finish foundations flush with or below natural ground.

C. Establish proper elevation and orientation of all signs, structures, and determine proper sign post lengths as dictated by construction slopes.

D. Construct overhead support structures where indicated with signs horizontal and perpendicular to roadway. Minimum allowable vertical clearance from high point of pavement is 16.5 feet.

3.3 **WORKMANSHIP**

A. Carefully fabricate and erect signs. Damage signs will be rejected.

B. Make all vertical joints and cuts flat and true.

C. Elevator bolts may be used or bolt holes relocated where conflict exists with sign border, legend, or copy.

D. Lay out and properly balance on the sign face all Type 1 legend and copy before fastening. Plug holes left by shifting of copy or legend with the same type screw used to fasten the legend.

E. Wash all sign faces before final inspection, Section 01 74 13.

END OF SECTION

SECTION 32 05 10

BACKFILLING ROADWAYS

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Roadway backfill materials.

B. Roadway backfilling requirements.

1.2 **REFERENCES**

A. **APWA (Utah) Standards**:

Plan 245 Subgrade stabilization.

B. **ASTM Standards**:

D698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).

D1557 Laboratory Compaction Characteristics of Soil using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D4832 Preparation and Testing of Soil-Cement Slurry Test Cylinders.

1.3 **DEFINITIONS**

A. **Embankment**: A raised earthen structure.

B. **Pavement**: A surface or covering, as of Portland cement concrete, bituminous concrete, brick, concrete paver, etc., specifically a paved street, sidewalk, curb, gutter, curb cut assembly, ramp, apron, Driveway, etc.

C. **Subgrade**: A surface of native earth or Rock leveled off as to receive backfill materials.

1.4 **SUBMITTALS**

A. Submit maximum laboratory dry density and optimum laboratory moisture content for:

1. Subgrade material.
2. Each type of fill to be used.

B. Submit aggregate batch delivery tickets showing name of material source, serial number of ticket, date and truck number, name of Supplier, job name and location, volume or weight, and aggregate classification or Supplier's identification code.

1.5 **QUALITY ASSURANCE**

A. Do not change material sources, or aggregate without ENGINEER's knowledge.

B. Reject backfill material that does not comply with requirements specified in this section.

C. If requested, submit a quality control Inspection and testing report describing source and field quality control activities performed by CONTRACTOR and Suppliers.

1.6 **STORAGE**

A. Safely stockpile backfill materials.

B. Separate differing materials, prevent mixing, and maintain optimum moisture content of backfill materials.

1.7 **SITE CONDITIONS**

A. Do not place, spread, or roll any backfill material over material that is damaged by water. Remove and replace damaged material at no additional cost to OWNER.

B. Control traffic and erosion. Keep area free of trash and debris. Repair settled, eroded, and rutted areas.

C. Reshape and compact damaged structural roadway section to required density.

D. Soil Cement: Do not spread soil cement mixture when air temperature is less than 40 deg F in the shade.

E. Drainage: Immediately before suspension of construction operations for any reason, provide proper and necessary drainage of work area.

1.8 **ACCEPTANCE**

A. General: Native material may be wasted if there is no additional cost to substitute material acceptable to ENGINEER.

B. Material: For material acceptance refer to:

1. Common fill, Section 31 05 13.
2. Aggregate base course, Section 32 11 23.
3. Cement treated fill, Section 31 05 15.

C. Lift Thickness: One test per Lot.

D. Compaction: One test per Lot. Verify density using nuclear tests, ASTM D2922. Compaction standard and Lot size as follows:

Table 1 – Compaction Standard and Lot Sizes		
Material	**Proctor**	**Lot Size**
Subgrade	Standard	1000 square yards
Common Fill	Standard	PCC or AC Surface Course: 1,000 square yards per lift Driveway Approach: 400 square feet per lift Sidewalk: 400 linear feet per lift
Aggregate base course	Modified	PCC or AC Surface Course: 1,000 square yards per lift Driveway Approach: 400 square feet per lift Sidewalk: 400 linear feet per lift Curb, Gutter, and Waterways: 200 linear feet per lift
NOTES (a) Standard proctor, ASTM D698. (b) Modified proctor, ASTM D1557.		

E. Flowable Fill Strength: Lot size is one day production with sub-lots of 250 cubic yards or part thereof. Verify strength using cylinders, ASTM D4832.

F. Grade, Cross Slope: Measured at random locations.

1.9 **WARRANTY**

A. Repair incidental settlement or settlement damage at no additional cost to OWNER.

PART 2 PRODUCTS

2.1 **BACKFILL MATERIALS**

A. Common fill, Section 31 05 13: Granular material, CONTRACTOR's choice.

B. Aggregate base course, Section 32 11 23: Untreated base course.

C. Cement treated fill, Section 31 05 15: Use a flowable fill so vibration is not required.

2.2 **WATER**

A. Make arrangements for sources of water during construction and make arrangements for delivery of water to site.

B. Comply with local Laws and Regulations at no additional cost to OWNER when securing water from water utility company.

2.3 **GEOTEXTILE**

A. Stabilization separation fabric, Section 31 05 19: Woven, high MARV.

PART 3 EXECUTION

3.1 PREPARATION

A. Implement traffic control plan requirements, Section 01 55 26.

B. Verify:

1. Backfill material meets gradation requirements.
2. Areas to be backfilled are free of debris, snow, ice or water.
3. Bearing surfaces are not frozen.

C. If ground water is in the intended backfill zone, dewater.

3.2 PROTECTION

A. Protect existing trees, shrubs, lawns, structures, fences, roads, sidewalks, paving, curb and gutter and other features.

B. Protect above or below grade utilities. Contact utility companies to repair utility damage. Pay all cost of repairs.

C. Avoid displacement of and damage to existing installations while compacting or operating equipment. Do not fill adjacent to structures until excavation is checked by ENGINEER.

D. Do not use compaction equipment adjacent to walls or retaining walls that may cause wall to become over-stressed or moved from alignment.

E. Do not disturb or damage foundation perimeter drainage, foundation, damp-proofing, foundation waterproofing and protective cover, or utilities in trenches. Movement of construction machinery over work at any stage of construction is solely at CONTRACTOR's risk.

F. Restore any damaged structure to its original strength and condition.

3.3 LAYOUT

A. Identify required line, levels, contours, and datum.

B. Stake and flag locations of underground utilities.

C. Upon discovery of unknown utility or concealed conditions, notify ENGINEER.

D. Maintain all benchmarks, control monuments and stakes, whether newly established by surveyor or previously existing. Protect from damage and dislocation.

E. If discrepancy is found between Contract Documents and site, ENGINEER shall make such minor adjustments in the Work as necessary to accomplish the intent of Contract Documents without increasing the Cost of the Work to CONTRACTOR or OWNER.

3.4 SUBGRADE

A. Protect Subgrade from desiccation, flooding, and freezing.

B. Before backfilling over Subgrade, get ENGINEER's review of Subgrade surface preparations.

C. If Subgrade is not readily compactable, get ENGINEER's permission to stabilize the Subgrade:

1. Excavation for Subgrade stabilization is incidental work. Section 31 23 16.

2. Place geotextile fabric per APWA Plan 245. Place acceptable fill in lifts over the geotextile, compact and wrap.

3.5 EMBANKMENTS

A. Place backfill material in lifts not exceeding equipment compaction capability.

B. Build shoulders to a grade higher than that of adjacent fills. Provide surface runoff at all times.

C. Commence compaction along edge of area to be compacted and gradually advance toward center.

D. Operate compaction equipment along lines parallel or concentric with the center-line of the embankment being constructed.

E. Do not damage subsurface structures or utilities.

3.6 BASE COURSES

A. Place backfill material in lifts not exceeding eight (8) inches before compaction.

B. Maintain moisture content in compaction operations.

C. Avoid segregation when spreading backfill. Keep surfaces free from pockets of coarse and fine aggregate.

D. Rework fills that do not conform to compaction requirements until requirements are met.

E. Protect cement treated fill against freezing and traffic for seven (7) days.

3.7 MODIFIED BACKFILL LAYER METHOD

A. Section 33 05 20.

3.8 TOLERANCES

A. Compaction: Ninety-five (95) percent or greater relative to a standard or modified proctor density, Section 31 23 26.

B. Lift Thickness (before compaction):

1. Eight (8) inches when using riding compaction equipment.

2. Six (6) inches when using handheld compaction equipment.

3. As proven in the modified backfill layer method, Section 33 05 20.

C. Cement Treated Fill: Compressive strength targets are 60 psi in 28 days. Maximum is 90 psi in 28 days.

3.9 FIELD QUALITY CONTROL

A. Test roadway backfilling until a compaction pattern acceptable to CONTRACTOR and ENGINEER is achieved. Continue random quality control compaction testing.

B. Proof Rolling Test:

1. Before placing fill material for roadbed backfills, proof roll subgrade using gross weight of 18,000 pounds/tandem axle, with a tire pressure at least 90 psi.
2. All proof roll passes will traverse the subgrade parallel to the roadbed centerline. All subsequent passes will be offset 1/2 the vehicle width until the entire subgrade is tested.
3. ENGINEER will analyze, determine, designate and measure the areas, if any, requiring additional compaction or reconstruction.
4. Once subgrade passes the proof rolling test, protect the surface from construction operations and traffic damage. Repair all cuts, ruts, and breaks. Keep surface in a satisfactory condition until geotextile fabric or base course has been placed.

3.10 CLEANING

A. Remove stockpiles from site when work is complete. Grade site to prevent free standing surface water.

B. Leave borrow areas clean and neat.

END OF SECTION

SECTION 32 11 23

AGGREGATE BASE COURSES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Treated and untreated base course production and placement.

1.2 REFERENCES

A. **AASHTO Standards**:

R9 Acceptance Sampling Plans for Highway Construction.

B. **ASTM Standards**:

C29 Unit Weight and Voids in Aggregate.

C131 Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

C117 Materials Finer Than 0.075mm (No. 200) Sieve in Mineral Agtgregates by Washing.

C136 Sieve Analysis of Fine and Coarse Aggregates.

D75 Sampling Aggregates.

D448 Sizes of Aggregate for Road and Bridge Construction.

D1557 Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

D1883 CBR (California Bearing Ratio) of Laboratory-Compacted Soils.

D2216 Laboratory Determinations of Water (Moisture) Content of Soil and Rock.

D2419 Sand Equivalent Value of Soils and Fine Aggregate.

D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D3017 Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

D3665 Random Sampling of Construction Materials.

D3740 Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

D4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

D5821 Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate.

1.3 DEFINITIONS

A. **Master Grading Band**: A graphical area defined by gradation limits allowed for various sieve sizes ranging from the maximum sieve size to the No. 200 sieve.

B. **Target Grading Curve**: A smooth locus of points within the limits of the Master Grading Band.

C. **Target Grading Band**: Gradation limits defined by the allowable variance from the Target Grading Curve. It is possible that these limits may lie outside of the Master Grading Band.

D. **Mean of Deviations**: The sum of the absolute values of the variance between each screen target value and each measured value divided by the number of tests in the Lot.

E. **RAP**: Acronym for reclaimed asphalt pavement. See Section 32 12 16.18.

F. **Lot**: (a) Quantity of aggregate delivered to a site when considering gradation, (b) area of aggregate placed at a site when considering density.

1.4 SUBMITTALS

A. **Mix Design**: Provide the following. Allow ENGINEER 10 days to evaluate the submittal.

1. Date of mix design. If older than 365 days from date of submission, recertify mix design.
2. Name of supplier and aggregate source.
3. Target gradation for each sieve size,
4. Percent composition of reclaimed asphalt or concrete included in the mix.
5. Unit weight, CBR, relative density, and relative moisture content.
6. Aggregate physical properties (this section article 2.1). The information is for suitability of source and not for project control. A new report may be required if aggregate source is changed. Test results shall not be older than 455 days from date of submission.

B. **At Delivery**: Submit batch delivery ticket identifying serial number of ticket, date and truck number, job name, weight of aggregate, mix identification, and description.

1.5 QUALITY ASSURANCE

A. Do not change aggregate source until ENGINEER accepts new source and new mix design.

B. Use a laboratory that follows and complies with ASTM D3740 and Section 01 45 00 requirements.

C. If requested, submit a quality control and testing report describing source and field quality assurance activities performed by CONTRACTOR and Suppliers.

1.6 ACCEPTANCE

A. **General:**

1. Acceptance is by Lot.
2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring complying material as part of its installation, Section 01 29 00.
3. ENGINEER is not obligated to accept changes in gradation target after any material is delivered to site.
4. Observation of CONTRACTOR's field quality control testing does not constitute acceptance. Such testing; however, may be used by ENGINEER for acceptance if requirements in Section 01 35 10 are met.
5. Dispute resolution, Section 01 35 10.

B. **Gradation**: Lot size is one (1) day production. Sub-lot size is 500 tons. Collect samples from grade before compaction. Conduct at least one (1) gradation analysis for each lot. Lot is acceptable if gradation test deviations are within pay factor 1.00 limits. At ENGINEER's discretion, a lot with a sub-lot deviation greater than pay factor 0.70 limits may stay in place at 50 percent pay.

Table 1- Gradation Pay Factors

Criteria	Pay Factor	Mean of Deviations of Acceptance Tests From the Target Grading Curve Expressed in Percentage Points				
		1 Sample	2 Samples	3 Sample	4 Sample	5 or More Samples
1/2" and Larger Sieves	1.00	0 – 15	0.0 – 12.1	0.0 – 10.8	0.0 – 10.0	0.0 – 9.5
	0.95	16 – 17	12.2 – 13.9	10.9 – 12.4	10.1 – 11.5	9.6 – 11.
	0.90	18 – 19	14.0 – 15.1	12.5 – 13.5	11.6 – 12.5	11.1 – 11.9
	0.80	20 – 21	15.2 – 17.2	13.6 – 15.3	12.6 – 14.2	12. – 13.5
	0.70	22 – 23	17.3 – 18.8	15.4 – 16.7	14.3 – 15.5	13.6 – 14.7
3/8" Sieve	1.00	0 – 15	0.0 – 11.5	0.0 – 9.8	0.0 – 8.8	0.0 – 8.0
	0.95	16 – 17	11.6 – 13.2	9.9 – 11.3	8.9 – 10.1	8.1 – 9.2
	0.90	18 – 19	13.3 – 14.4	11.4 – 12.3	10.2 – 11	9.3 – 10.0
	0.80	20 – 21	14.5 – 16.3	12.4 – 13.9	11.1 – 12.5	10.1 – 22.4
	0.70	22 – 23	16.4 – 17.9	14.0 – 15.2	12.6 – 13.6	11.5 – 12.4
No. 4 Sieve	1.00	0 – 14	0.0 – 10.5	0.0 – 8.8	0.0 – 7.8	0.0 – 7.0
	0.95	15 – 17	10.6 – 12.1	8.9 – 10.1	7.9 – 9.0	7.1 – 8.0
	0.90	18	12.2 – 13.1	10.2 – 11	9.1 – 9.8	8.1 – 8.7
	0.80	19 – 20	13.2 – 14.9	11.1 – 12.5	9.9 – 11.1	8.8 – 10.0
	0.70	21 – 22	15.0 – 16.3	12.6 – 13.6	11.2 – 12.1	10.1 – 10.8
No. 16 Sieve	1.00	0 – 11	0.0 – 8.2	0.0 – 6.9	0.0 – 6.2	0.0 – 5.6
	0.95	12 – 13	8.3 – 9.4	7.0 – 7.9	6.3 – 7.1	5.7 – 6.4
	0.90	14	9.5 – 10.3	8.0 – 8.6	7.2 – 7.8	6.5 – 7.0
	0.80	15 – 16	10.4 – 11.6	8.7 – 9.8	7.9 – 8.8	7.1 – 8.0
	0.70	17	11.7 – 12.7	9.9 - 10.7	8.9 – 9.6	8.1 – 8.7

No. 200 Sieve	1.00	0 – 4.5	0.0 – 3.4	0.0 – 2.9	0.0 – 2.5	0.0 – 2.3
	0.95	4.6 – 5.2	3.5 – 3.9	3.0 – 3.3	2.6 – 2.9	2.4 – 2.6
	0.90	5.3 – 5.6	4.0 – 4.3	3.4 – 3.6	3.0 – 3.1	2.7 – 2.9
	0.80	5.7 – 6.4	4.4 – 4.9	3.7 – 4.1	3.2 – 3.6	3.0 – 3.3
	0.70	6.5 – 7.0	4.9 – 5.3	4.2 – 4.5	3.7 – 3.9	3.5 – 3.6

NOTES
(a) ENGINEER has 36 hours after Lot placement to accept aggregate gradation. CONTRACTOR may place material over the crushed aggregate base material during the 36 hours interval at its own risk. Pay factors for the Lot will NOT be applicable if ENGINEER performs tests after the 36 hours interval.

C. **Relative Density**: Lot size 10,000 cubic yards. Conduct at least one laboratory determination to be used as a standard for field density and field moisture content determinations.

D. **Field Density**: Lot size is one (1) day placement. Number of density tests varies according to placement type, location and sub-lot size (Table 2). Conduct at least one (1) field density test in the lot. Select each test location randomly.

Table 2 - Placement Type, Location, Sub-lot Size

Type	Location	Sub-lot Size
I	Pavement (includes curb, gutter and water way when in conjunction with pavement placement).	1,000 square yards
II	Curb, gutter, waterway	200 linear feet
	Sidewalk	400 linear feet
	Driveway approach, curb cut assembly, waterway transition structure, flat work	400 square feet
III	Landscaping and other non-structural, non- load bearing areas	--

PART 2 PRODUCTS

2.1 UNTREATED BASE COURSE

A. **Material**: Crushed rock, gravel, sand, or other high quality mineral particle, or combination that is free of organic matter, free of chemical or petroleum contamination, and meets the following physical properties.

Table 3 – Untreated Base Course Physical Properties				
	ASTMs	Aggregate Class		
		A	B	C
Coarse aggregate				
Angularity (2 fractured faces), min., percent	D5821	50	–	–
Wear (toughness or hardness), max., percent	C131	50		
Fine aggregate				
Liquid Limit, max.	D4318	25		
Plastic Index, max.	D4318	0	0	6
Sand Equivalent, min., percent	D24 19	35		
Blended aggregate				
Dry Rodded Unit Weight, min., percent	C29	75		
CBR, min., percent	D1883	70	55	--

NOTES
(a) Faces: Retained on No. 4 sieve.
(b) Wear: Retained on No. 12 sieve after 500 revolutions.
(c) Liquid limit and plastic index: Passing No. 40 sieve.
(d) Sand equivalent (clay content or cleanliness): Passing No. 4 sieve.
(e) CBR: Use a surcharge of 10 pounds measured at 0.20 inch penetration at 95 percent relative to a modified proctor density. A reduction in aggregate class may be accepted providing any costs for difference in excavation, backfill, and alternate design for CBR does not increase Concrete Price.

B. **Gradation**: Analyzed according to ASTM C136 on a dry weight and percent passing basis. Target Grading Curve must lie within the selected aggregate grade in table 4. Field gradation shall not vary from target by more than the target tolerance.

Table 4 – Master Grading Bands				
Sieve	Aggregate Grade			Target Tolerance
	Grade 1-1/2	Grade 1	Grade 3/4	
1-1/2"	100	–	–	(Pay factor 1.00 in Table 1)
1 "	–	100	–	
3/4 "	70 – 85	–	100	
1/2 "	–	79 – 91	–	
3/8 "	55 – 75	–	78 – 92	
No. 4	40 – 65	49 – 61	55 – 67	
No. 16	25 – 40	27 – 35	28 – 38	
No. 200	7 – 11	7 – 11	7 – 11	

NOTES
(a) It is assumed fine and course aggregate have same bulk specific gravity.
(b) Target tolerance for 3/4 sieve in Grade 3/4, and 1" sieve in Grade 1 is not applicable.
(c) Percentage of fines passing No. 200 sieve determined by washing, ASTM C117.

C. **Changing Source**: A new material properties report is required.

2.2 **TREATED BASE COURSE**

A. Treatment includes addition of lime, cement slurry, asphalt emulsion, RAP, crushed concrete, or any combination, or other material acceptable to ENGINEER.

B. Base course containing RAP:

1. Meet requirements of this section article 2.1 and the following:
   a. Sand equivalent and fractured face measured after asphalt residue is burned off.
   b. Plasticity and wear requirements apply to virgin aggregate portion only.
   c. Allowable asphalt content is controlled by allowable CBR.
2. Remove debris from crushed RAP aggregate by screening.
3. Mechanically blend virgin and RAP aggregates. Do not use windrows for blending.

C. Base course containing crushed concrete.

1. Meet requirements of this section article 2.1 and the following:
   a. Cement with its chemical components is allowed.
   b. Wear test and fractured face test not required.

2.3 **SOURCE QUALITY CONTROL**

A. Reject crushed aggregate base products that do not meet requirements of this Section.

B. Sampling Protocol: Random location selection, ASTM D3665. Sample collection, ASTM D75.

C. Testing Protocol: Gradation, ASTM C136. Maximum density, ASTM D1557. Optimum moisture content, ASTM D2216.

PART 3 EXECUTION

3.1 **SUB-BASE PREPARATION**

A. Trenches, Section 33 05 20.

B. Structures, Section 31 23 23.

C. Landscaping, Section 32 91 19.

D. Pavements, Section 32 05 10.

3.2 **PLACEMENT**

A. General:

1. Place uniform lifts not exceeding eight (8) inches before compaction.
2. Maintain optimum moisture content plus or minus two (2) percent.

3. Use appropriate compaction equipment.
4. Do not place additional material on any unaccepted layer or on any frozen surface.

B. Provide aggregate suitable for the following locations.

Table 5 - Placement Type, Location, Aggregate Class

Type	Location	Aggregate Class		
		A	B	C
I	Pavement (includes curb, gutter and waterway when in conjunction with pavement placement)	**X**		
II	Concrete flat work (includes driveway approach, curb cut assembly, curb, gutter, sidewalk, waterway, etc.	**X**	**X**	
III	Landscape (includes non-structural, non-load bearing areas.	**X**	**X**	**X**

NOTES:
(a) **X** indicates where placement is allowed.

C. Compaction:
1. Type I and Type II Placement: 95 percent minimum.
2. Type III Placement: Suitable to overlying surface, or installation, or use. Verify compactive effort with ENGINEER.

D. Finish: Uniform with surface deviation no more than 3/8 of an inch from line and grade in 10 feet in any direction.

3.3 FIELD QUALITY CONTROL

A. Sampling Protocol: Random location selection, ASTM D3665. Sample collection, ASTM D75.

B. Testing Protocol: Gradation, ASTM C136. Field density, ASTM D2922. Moisture content, ASTM D3017.

3.4 REPAIR OR REMOVAL

A. If product is correctable and at no additional cost to OWNER, provide laboratory data showing design CBR has not been reduced and material in-place has been compacted to 97 percent minimum.

B. Remove any product that cannot be corrected and install acceptable product at no additional cost to OWNER.

END OF SECTION

SECTION 32 12 03
ASPHALT BINDERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. An asphalt-based cement that is produced from petroleum residue either with or without the addition of non-particulate, non-fibrous organic modifiers.

B. Requirements for accepting non-complying Asphalt Binders.

1.2 REFERENCES

A. **ASTM Standards**:

D113 Ductility of Bituminous Materials.

D977 Emulsified Asphalt.

D2026 Cutback Asphalt (Slow-Curing Type).

D2027 Cutback Asphalt (Medium-Curing Type).

D2028 Cutback Asphalt (Rapid-Curing Type).

D2397 Cationic Emulsified Asphalt.

D3381 Viscosity-Graded Asphalt Cement for Use in Pavement Construction.

D4552 Classifying Hot-Mix Recycling Agents.

D5710 Trinidad Lake Modified Asphalt.

D6373 Performance Graded Asphalt Binder.

1.3 SUBMITTALS

A. Submit bill of lading for each shipment of Asphalt Binder from vendor. Identify the following:

1. Source of product (manufacturer);
2. Type and grade of asphalt, and
3. Type and amount of additives in the product.

1.4 QUALITY ASSURANCE

A. Reject Asphalt Binders that are not uniform in appearance and consistency or foams at hot mixing temperature.

B. Do not use storage containers contaminated with other types or grades of petroleum products.

C. Do not use petroleum product that does not comply with contract requirements.

1.5 **ACCEPTANCE**

A. **General**:

1. Acceptance is by Lot. One (1) Lot is one (1) day production.
2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring material as part of its installation. Section 01 29 00
3. Dispute resolution, Section 01 35 10.

B. **Performance Graded Asphalt Binder (PGAB):** Sub-lot size is 20,000 gallons. Collect sub-lot Samples randomly from oil storage unit.

1. Meet limits published in Section 209 of UDOT's "Manual of Instruction, Part 8 Materials". Pay reductions are as follows:
   a. If none of the critical properties are outside rejection limit a composite pay adjustment of 25 percent or less is allowed.
   b. If one or more of the critical properties falls outside the rejection limit or if a composite pay adjustment is more than 25 percent, Asphalt Binder will be rejected.

C. **Asphalt Cement (AC) Binder**: Sub-lot size is 20,000 gallons. Collect sub-lot Samples randomly from oil storage unit.

1. Ductility: Meet this section's requirements, or
2. Viscosity or Penetration: Meet graphics published in Section 955 of UDOT's "Manual of Instructions, Part 8 Materials":
   a. Lot may be accepted using the published graphics. If pay adjustment exceeds 30 percent, reject Asphalt Binder, or
   b. If allowed to remain after placement, pay adjustment will be 50 percent.

D. **Cut-back Binder**: Meet this section's requirements for ductility.

E. **Trinidad Lake Modified Asphalt**: Supplier's certificate for ASTM compliance.

F. **Emulsified Asphalt**: Supplier's certificate for ASTM compliance.

G. **Recycle Asphalt**: Identity of source (asphalt cement or tar products).

H. **Crack Patch**: Meet material requirements in Section 32 01 17.

PART 2 PRODUCTS

2.1 **PERFORMANCE GRADE ASPHALT BINDER (PGAB)**

A. Petroleum asphalt that complies with ASTM D6373. Blending binder with polymers, crumb rubber, or natural bitumens is CONTRACTOR's choice.

2.2 **ASPHALT CEMENT (AC)**

A. Petroleum asphalt that complies with Table 2 of ASTM D3381 except as follows:

1. Replace ductility, ASTM D113, at 77 deg F (25 deg. C) with ductility at 39.2 deg F (4 deg. C). Use the following values.
   - AC-5: greater than 25.
   - AC-10: greater than 15.
   - AC-20: greater than 5.
2. Delete the loss on heating requirement on residue from "Thin-Film Oven Test".

B. AC-5 Latex Additive: Anionic emulsion of butadiene-styrene low-temperature copolymer consisting of two (2) percent by weight (solids basis), stabilized with fatty-acid soap for storage stability.

2.3 TRINIDAD LAKE MODIFIED ASPHALT (TLA)

A. Petroleum asphalt that complies with ASTM D5710 (a blend of natural bitumens).

2.4 SLOW CURE CUT-BACK ASPHALT (SC)

A. Petroleum asphalt that complies with ASTM D2026 (fluxed with a light oil) except if penetration of residue is more than 200 and its ductility at 77 deg. F (25 deg. C) is less than 100 cm., the material will be acceptable if the ductility at 59 deg F (15 deg. C) is greater than 100.

2.5 MEDIUM CURE CUT-BACK ASPHALT (MC)

A. Petroleum asphalt that complies with ASTM D2027 (fluxed or blended with a kerosene type solvent, non-foaming when heated to application temperature) except if penetration of residue is more than 200 and its ductility at 77 deg F (25 deg. C) is less than 100 cm., the material will be acceptable if the ductility at 59 deg F (15 deg. C) is greater than 100.

2.6 RAPID CURE CUT-BACK ASPHALT (RC)

A. Petroleum that complies with ASTM D2028 asphalt (fluxed or blended with a naphtha solvent, non-foaming when heated to application temperature).

2.7 EMULSIFIED ASPHALT

A. Petroleum asphalt uniformly emulsified with water, homogeneous throughout, and when stored, shows no separation within 30 days after delivery. Frozen emulsions not accepted:
   1. Anionic, ASTM D977 (breaks by evaporation).
   2. Cationic, ASTM D2397 (breaks chemically).

2.8 RECYCLE ASPHALT (RA)

A. Petroleum asphalt that complies with ASTM D4552 (homogeneous, free-flowing at pumping temperature made from maltene fractions of asphalt cement for surface revitalization or from tar products to make Pavements resistant to fuel spillage:
   1. RA-1, RA-5, RA-25 or RA-75 for recycling RAP aggregate when less than 30 percent virgin aggregate is added.
   2. RA-250 or RA-500 when more than 30 percent virgin aggregate is added to RAP.

2.9 **WARM-MIX ASPHALT (WMA)**

A. Performance grade Asphalt Binder or asphalt cement binder blended with a wax, foam, chemical, or organic additive.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Prime coat, Section 32 12 13.19.

B. Tack coat, Section 32 12 13.13.

C. Plant mix paving, Section 32 12 16.13.

D. Road mix paving, Section 32 12 16.19.

E. Slurry seal coating, Section 32 01 13.61.

F. Crack sealing, Section 32 01 17.

END OF SECTION

SECTION 32 12 05
BITUMINOUS CONCRETE

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Composition of a bituminous concrete mix.

1.2 **REFERENCES**

A. **AASHTO Standards**:

- M323 Superpave Volumetric Mix Design, Single User Digital Publication
- R30 Mixture Conditioning of Hot-Mix Asphalt (HMA)
- T324 Hamburg Wheel-Track Testing of Compacted Hot-Mix Asphalt (HMA)

B. **AI Standards**:

- MS-2 Asphalt Mix Design Methods.

C. **ASTM Standards**:

- C29 Unit Weight and Voids in Aggregate.
- C88 Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
- C117 Materials Finer Than 0.075mm (No. 200) Sieve in Mineral Aggregates by Washing.
- C131 Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- C136 Standard Method for Sieve Analysis of Fine and Coarse Aggregate.
- C142 Clay Lumps and Friable Particles in Aggregates.
- D75 Sampling Aggregates.
- D140 Sampling Bituminous Materials.
- D242 Mineral Filler for Bituminous Paving Mixtures.
- D979 Sampling Bituminous Paving Mixtures.
- D995 Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
- D2041 Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures.
- D2419 Sand Equivalent Value of Soils and Fine Aggregate.
- D3203 Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures.
- D3515 Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.

D3665 Random Sampling of Construction Materials.

D3666 Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials.

D4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

D4552 Classifying Hot-Mix Recycling Agents.

D4791 Flat or Elongated Particles in Coarse Aggregate.

D4867 Effect of Moisture on Asphalt Concrete Paving Mixtures.

D5444 Mechanical Size Analysis of Extracted Aggregate.

D5821 Determining the Percentage of Fractured Particles in Coarse Aggregate.

D6307 Determining Asphalt Content of Hot-Mix Asphalt by Ignition Method.

D6373 Performance Graded Asphalt Binder.

D6927 Marshall Stability and Flow of Bituminous Mixtures.

1.3 **DEFINITIONS**

A. **Mix Designator**: An alphanumeric code that identifies binder grade, aggregate grade, and compaction level for a bituminous concrete mix. For example.

- *PG70-28, SP-1, 75Nd***:** PG70-28 is a Performance Graded Asphalt Binder. SP-1 is the aggregate grade. 75Nd is the compaction level at Superpave mix design.
- *OS/PG, SP-3/4, 75Nd*: OS/PG is a Blended Binder. SP-3/4 is the aggregate grade. 75ND is the compaction level at Superpave mix design.
- *PG64-22, DM-1/2, 50 blow*: PG64-22 is a Performance Graded Asphalt Binder. DM-1/2 is the aggregate grade. 50 blow is the compaction level at Marshall mix design.
- *OS/PG, DM-3/4, 50 blow*: OS/PG is a Blended Binder. DM-3/4 is the aggregate grade. 50 blow is the compaction level at Marshall mix design.

B. **Bituminous Binder**: A cement composed of any of several viscous or solid mixtures of hydrocarbons and their nitrogen and sulfur derivatives.

1. Asphalt Binder: A refined or manufactured bituminous cement known as performance graded asphalt binder (PG or PGAB) whether virgin or contained in RAP.
2. Bitumen Binder: A natural bituminous cement contained in an Oil Sand (OS) or contained in a ROSP.
3. Blended Binder: A Mixture of Asphalt Binder and Bitumen Binder.

C. **Mean of Deviations**: Defined in Section 32 11 23.

D. **Nominal Maximum Size**: One sieve size larger than first sieve size retaining more than 10 percent of the Sample. One hundred percent of the aggregate might be able to pass through the nominal maximum size sieve but not more than 10 percent will be retained on that sieve. The maximum size sieve will be one (1) sieve size larger than the nominal

maximum size.

E. **Oil Sand (OS):** Naturally occurring sediments or sedimentary rock containing gravel, sand, clay, water and bituminous cement.

F. **RAP**: Acronym for reclaimed asphalt pavement. A granular product recovered from a bituminous pavement containing aggregate and an Asphalt Binder.

G. **ROSP**: Acronym for reclaimed Oil Sand pavement. A granular product recovered from a bituminous pavement containing aggregate and a Bitumen Binder.

1.4 **SUBMITTALS**

A. **General**:

1. Pre-approved Mix Design: Submit name and address of Supplier.
2. Allow ENGINEER 10 days to evaluate mixing equipment and mix design submittals.
3. Once a mix design is accepted, a new mix design submittal is required if the following occurs.
   a. Asphalt Binder grade is changed.
   b. Aggregate source is changed. When this occurs, submit a physical properties report on the proposed aggregates.

B. **Quality Assurance**:

1. Independent Laboratory: Submit names, certification levels, and years of experience of testing agency's field technicians that are assigned to the Work. Verify laboratory complies with ASTM D3666. and follows Section 01 45 00 requirements.
2. Mix Production Equipment: Submit verification by an individual acceptable to ENGINEER, that plant equipment complies with requirements of ASTM D995.
3. Testing Report: If requested by ENGINEER, submit a report of source and field quality control testing performed by CONTRACTOR and Suppliers.

C. **Mix Design**: Submit the following.

1. Date of mix design. If the date exceeds the following times, the mix design is invalid and must be redesigned.
   a. One (1) year for non-commercial plants.
   b. Two (2) years for commercial plants if there is no change in the aggregate source. A new mix design will be required if aggregate source is changed.
2. Binder source, type, and grade. Disclose if RAP or ROSP is used in the mix.
3. Optimum compaction temperature at the project site.
4. Theoretical maximum specific gravity.
5. Compaction density at design target air voids.
6. Target Grading Curve for aggregate.

7. Binder target percentage, dust to binder ratio, and the following as applicable.
   a. For Superpave mix design provide 1) voids in the mineral aggregate (VMA), and 2) voids filled with Bituminous Binder also known as VFA, and 3) Hamburg Wheel Tracker results.
   b. For Marshall mix design provide 1) tensile strength ratio (moisture sensitivity), 2) voids in the mineral aggregate (VMA), 3) stability, 4) flow and 5) voids in the bituminous mix, and 6) voids filled with Bituminous Binder also known as VFA.
8. Percentages of 1) mineral filler, 2) anti-strip, 3) reclaimed bituminous pavement (RAP or ROSP), 4) recycle agent in the mix, and 5) virgin aggregate.
9. Aggregate physical properties (this section article 2.2). The information is for suitability of source and not for project control. A new report may be required if aggregate source is changed. Test results shall not be older than two (2) calendar years from the date of submission.

1.5 **QUALITY ASSURANCE**

A. Do not change aggregate source or binder source until ENGINEER accepts new sources and mix design.

1.6 **ACCEPTANCE**

A. **General**:
   1. Acceptance is by Lot. One (1) Lot is one (1) days' production.
   2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring material as part of its installation, Section 01 29 00.
   3. If test results are not within this section's limits, options include correction of production procedures or production of an alternate mix design acceptable to ENGINEER.
   4. Observation of CONTRACTOR's field quality control testing does not constitute acceptance. Such testing; however, may be used by ENGINEER for acceptance if requirements in Section 01 35 10 are met.
   5. Dispute resolution, Section 01 35 10.

B. **Mix Sampling and Testing**:
   1. Sub-lot size is 500 tons or part thereof.
   2. Sampling Protocol: ASTM D3665 and ASTM D979. Collect at least one (1) random Sample per sub-lot from behind paver and before compaction. Any sample collected because of non-uniform appearance shall not be used in determining a pay factor for the Lot.
   3. Testing Protocol: Field samples will be compacted in the laboratory and tested for:
      a. Air voids, ASTM D3203.
      b. Voids in the mineral aggregate, AI MS 2.

c. Binder content, ASTM D6307.

d. Aggregate gradation, ASTM D5444.

C. **Pay Reduction**: Lot is acceptable if binder content and aggregate gradation test deviations are within pay factor 1.00 limits in Table 1 or Table 2 as applicable. At ENGINEER's discretion a Lot with a sub-lot test deviation greater than pay factor 0.85 limits may stay in place at 50 percent pay.

Table 1 – Pay Factors – Superpave Mix Design

Criteria	Pay Factor	Range of Mean of Deviations of Tests Results in Percentage Points from Binder and Gradation Targets			
		500 Tons	1,000 Tons	1,500 Tons	≥ 2,000 Tons
Binder Content	1.00	0.0 – 0.7	0.0 – 0.54	0.0 – 0.46	0.0 – 0.41
	0.975	0.71 – 0.8	0.55 – 0.61	0.47 – 0.52	0.42 – 0.46
	0.95	0.81 – 0.9	0.62 – 0.68	0.53 – 0.58	0.47 – 0.52
	0.90	0.9 – 1.0	0.69 – 0.75	0.59 – 0.64	0.53 – 0.56
	0.85	1.01 – 1.1	0.76 – 0.82	0.65 – 0.69	0.57 – 0.61
1/2" and larger Sieve	1.00	0.0 – 10.0	0.0 – 7.3	0.0 – 6.3	0.0 – 5.6
	0.975	11.0 – 12.0	7.4 – 8.3	6.4 – 7.1	5.7 – 6.3
	0.95	13.0 – 13.9	8.4 – 9.3	7.2 – 7.9	6.4 – 7.0
	0.90	14.0 – 14.9	9.4 – 10.3	8.0 – 8.7	7.1 – 7.7
	0.85	15.0 – 16.0	10.4 – 11.3	8.8 – 9.5	7.8 – 8.4
3/8" Sieve	1.00	0.0 – 9.9	0.0 – 6.9	0.0 – 5.9	0.0 – 5.3
	0.975	10.0 – 10.9	7.0 – 7.8	6.0 – 6.6	5.4 – 5.9
	0.95	11.0 – 11.9	7.9 – 8.7	6.7 – 7.3	6.0 – 6.6
	0.90	12.0 – 13.9	8.8 – 9.6	7.4 – 8.0	6.7 – 7.2
	0.85	14.0 – 15.0	9.7 – 10.5	8.1 – 8.9	7.3 – 7.9
No. 4 Sieve	1.00	0.0 – 9.9	0.0 – 6.7	0.0 – 5.7	0.0 – 5.2
	0.975	10.0 – 10.9	6.8 – 7.6	5.8 – 6.3	5.3 – 5.8
	0.95	11.0 – 11.9	7.7 – 8.5	6.4 – 6.9	5.9 – 6.4
	0.90	12.0 – 12.9	8.6 – 9.4	7.0 – 7.5	6.5 – 7.0
	0.85	13.0 – 14.0	9.5 – 10.2	7.6 – 8.0	7.1 – 7.6
No. 8 Sieve	1.00	0.0 – 7.9	0.0 – 5.6	0.0 – 4.8	0.0 – 4.3
	0.975	8.0 – 8.9	5.7 – 6.3	4.9 – 5.4	4.4 – 4.8
	0.95	9.0 – 9.9	6.4 – 7.0	5.5 – 6.0	4.9 – 5.3
	0.90	10.0 – 10.9	7.1 – 7.7	6.1 – 6.6	5.4 – 5.8
	0.85	11.0 – 12.0	7.8 – 8.5	6.7 – 7.2	5.9 – 6.4
No. 200 Sieve	1.00	0.0 – 3.0	0.0-2.4	0.0 – 2.0	0.0 – 1.8
	0.975	3.1 – 3.5	2.5 – 2.7	2.1 – 2.2	1.9 – 2.0
	0.95	3.6 – 4.0	2.8 – 3.0	2.3 – 2.4	2.1 – 2.2
	0.90	4.1 – 4.5	3.1 – 3.3	2.5 – 2.7	2.3 – 2.4
	0.85	4.6 – 5.0	3.4 – 3.6	2.8 – 3.0	2.5 – 2.6

NOTES
(a) Test binder content using a burn-off oven, ASTM D6307.
(b) Determine aggregate gradation by extraction, ASTM D5444.

Table 2 – Pay Factors - Marshall Mix Design						
Criteria	**Pay Factor**	**Range of Mean of Deviations of Tests Results from the Binder and Gradation Targets in Percentage Points**				
		500 Tons	**1,000 Tons**	**1,500 Tons**	**2,000 Tons**	**≥2,500 Tons**
Binder Content	1.00	0.00–0.70	0.00–0.54	0.00–0.46	0.00–0.41	0.00–0.38
	0.975	0.71–0.80	0.55–0.61	0.47–0.52	0.42–0.46	0.39–0.43
	0.95	0.81–0.90	0.62–0.68	0.53–0.58	0.47–0.52	0.44–0.47
	0.90	0.91–1.00	0.69–0.75	0.59–0.64	0.53–0.56	0.48–0.52
	0.85	1.01–1.10	0.76–0.82	0.65–0.69	0.57–0.61	0.53–0.56
1/2"and larger Sieve	1.00	0.0–10.9	0.0–7.3	0.0–6.5	0.0–5.6	0.0–5.2
	0.975	11.0–12.9	7.4–8.3	6.4–7.1	5.7–6.3	5.3–5.8
	0.95	13.0–13.9	8.4–9.3	7.2–7.9	6.4–7.0	5.9–6.4
	0.90	14.0–14.9	9.4– 10.3	8.0–8.7	7.1–7.7	6.5–7.1
	0.85	15.0–16.0	10.4–11.3	8.8–9.5	7.8–8.4	7.2–7.7
3/8" Sieve	1.00	0.0–9.9	0.0–6.9	0.0–5.9	0.0–5.3	0.0–4.9
	0.975	10.0–10.9	7.0–7.8	6.0–6.6	5.4–6.9	5.0–5.5
	0.95	11.0–11.9	7.9–8.7	6.7–7.3	6.0–6.6	5.6–6.1
	0.90	12.0–13.9	8.8–9.6	7.4–8.0	6.7–7.2	6.2–6.6
	0.85	14.0–15.0	9.7–10.5	8.1–8.9	7.3–7.9	6.7–7.2
No. 4 Sieve	1.00	0.0–9.9	0.0–6.7	0.0–5.7	0.0–5.2	0.0–4.8
	0.975	10.0–11.0	6.8–7.6	5.8–6.3	5.3–5.8	4.9–5.4
	0.95	11.1–11.9	7.7–8.5	6.4–6.9	5.9–6.4	5.5–5.9
	0.90	12.0–12.9	8.6–9.4	7.0–7.5	6.5–7.0	6.0–6.5
	0.85	13.0-14.0	9.5–10.2	7.6–8.0	7.1–7.6	6.6–7.0
No. 8 Sieve	1.00	0.0–7.9	0.0–5.6	0.0–4.8	0.0–4.3	0.0–4.0
	0.975	8.0–8.9	5.7–6.3	4.9–5.4	4.4–4.8	4.1–4.5
	0.95	9.0–9.9	6.4–7.0	5.5–6.0	4.9–5.3	4.6–4.9
	0.90	10.0–10.9	7.1–7.7	6.1–6.6	5.4–5.8	5.0–5.4
	0.85	11.0–12.0	7.8–8.5	6.7–7.2	5.9–6.4	5.5–5.8
No. 16 Sieve	1.00	0.0–7.9	0.0–5.2	0.0–4.6	0.0–4.2	0.0–3.9
	0.975	8.0–8.9	5.3–5.8	4.7–5.1	4.3–4.6	4.0–4.3
	0.95	9.0–9.9	5.9–6.4	5.2–5.6	4.7–5.1	4.4–4.7
	0.90	10.0–10.9	6.5–7.0	5.7–6.1	5.2–5.5	4.8–5.1
	0.85	11.0–12.0	7.1–7.6	6.2–6.6	5.6–5.9	5.2–5.4
No. 50 Sieve	1.00	0.0–6.9	0.0–4.3	0.0–3.8	0.0–3.4	0.0–3.2
	0.975	7.0–7.9	4.4–4.8	3.9–4.1	3.5–3.8	3.3–3.5
	0.95	8.0–8.9	4.9–5.3	4.2–4.5	3.9–4.1	3.6–3.8
	0.90	9.0–9.9	5.4–5.8	4.6–4.9	4.2–4.4	3.9–4.1
	0.85	10.0–11.0	5.9–6.4	5.0–5.5	4.5–4.9	4.2–4.5
No. 200 Sieve	1.00	0.0–3.0	0.0–2.4	0.0–2.0	0.0–1.8	0.0–1.7
	0.975	3.1–3.5	2.5–2.7	2.1–2.2	1.9–2.0	1.8–1.9
	0.95	3.6–4.0	2.8–3.0	2.3–2.4	2.1–2.2	2.0–2.1
	0.90	4.1–4.5	3.1–3.3	2.5–2.7	2.3–2.4	2.2–2.3
	0.85	4.6–5.0	3.4–3.6	2.8–3.0	2.5–2.6	2.4–2.5
NOTES (a) Test binder content using a burn-off oven, ASTM D6307. (b) Determine aggregate gradation by extraction, ASTM D5444.						

D. **Installation**: See Section 32 12 16.13 acceptance requirements.

PART 2 PRODUCTS

2.1 BINDER

A. **Performance Graded Asphalt Binder (PGAB)**: See ASTM D6373.

1. Blending with polymers is allowed.
2. Do not use acid blends without documentation supporting need.
3. Adjust binder grade according to AASHTO M323 to account for any binder stiffness caused by adding RAP or ROSP to the mix.

B. **Bitumen Binder**: Oil Sand (OS) source is CONTRACTOR's choice.

C. **Blended Binder**: CONTRACTOR's choice. A blended ratio of Asphalt Binder to Bitumen Binder in the range of about 1:4 to about 4:1 may require patent licensure (Reference: US RE39, 289 E). CONTRACTOR to verify.

2.2 AGGREGATE

A. Crushed stone, crushed gravel,slag, sand, or combination.

B. Use Table 3 to determine suitability of aggregate source.

Table 3 – Aggregate Physical Properties

		Standard	Road Class	
			I & II	III
Coarse Aggregate				
Angularity, percent, minimum	One Fractured face	D5821	90	95
	Two Fractured faces		90	90
Wear (hardness or toughness), percent, maximum		C131	35	35
Flats or elongates (3:1 length to width), percent, maximum		D4791	--	20
Fine Aggregate				
Angularity (uncompacted void content), percent, minimum		T304	40	45
Sand equivalent, percent, minimum		D2419	45	60
Plastic limit, maximum		D4318	0	0
Blended Physical Properties				
Dry-rodded Unit Weight, lb/ft^3, minimum		C29	75	75
Weight Loss (Soundness), percent, maximum		C88	16	16
Friable particles, percent, maximum		C142	2	2

NOTES

(a) Road Class is defined in Section 32 01 31.

(b) Course aggregate does not pass No. 4 sieve. Fine aggregate does pass.

(c) Angularity is determined by weight.

(d) Wear of aggregate may have higher values if aggregate source is known to have higher values.

(e) Sand equivalent is waived for RAP or ROSP aggregate but applies to the

remainder of the aggregate blend.

(f) Plastic limit, passing No. 40 sieve. Aggregate is non-plastic even when filler material is added to the aggregate.

(g) Weight loss, using sodium sulfate.

(g) Friable particles are clay lumps, shale, wood, mica, coal passing the No. 4 sieve, and other deleterious materials.

2.3 **ADDITIVES**

A. Mineral Filler: ASTM D242.

B. Recycle Agent: ASTM D4552.

C. Anti-strip Agent: Heat stable cement slurry, lime slurry, or chemical liquid.

D. RAP or ROSP: Free of detrimental quantities of deleterious materials.

1. Allowed up to 15 percent by weight of RAP or binder, whichever is lesser, with no change in specified binder grade.
2. Allowed from 15 to 30 percent by weight of RAP or binder, whichever is lesser, if the binder grade is adjusted according to AASHTO M323 to meet the specified binder grade.
3. Determine RAP binder content by chemical extraction.

2.4 **MIX DESIGN**

A. **Preparation**:

1. Get the Mix Designator and the Road Class from the OWNER, ENGINEER, or bid documents.
2. Use paragraph 1.4C to determine submittal requirements.

B. **Aggregate Gradation – Superpave Mix Design:** See Table 4. The Target Gradation Curve for the specified aggregate grade must lie within the Master Grading Band limits. The target grading band limits for the Target Grading Curve are the appropriate grading limits for pay factor 1.00 in Table 1. The target grading band limits are allowed to extend outside of the Master Grading Band limits.

Table 4 - Master Grading Bnds - Superpave Mix Design

Sieve	Grade			
	SP-1	**SP-3/4**	**SP-1/2**	**SP-3/8**
1.5 inch	100.0	–	–	--
1 inch	90.0 – 100.0	100.0	–	--
3/4 inch	< 90	90.0 – 100.0	100.0	–
1/2 inch	–	< 90	90.0 – 100.0	100.0
3/8 inch	–	–	< 90	90.0 – 100.0
No. 4	–	–	–	< 90
No. 8	19.0 – 45.0	23.0 – 49.0	28.0 – 58.0	32.0 – 67.0
No. 200	1.0 – 7.0	2.0 – 8.0	2.0 – 10.0	2.0 – 10.0

NOTES

(a) Gradation is expressed in percent passing by weight per ASTM C136. Percentage of fines passing No. 200 sieve determined by washing per

ASTM C117.

(b) The alpha portion of the grade designator (SP) represents Superpave mix. The numerical portion (1, 3/4, 1/2, 3/8) represents the ***nominal maximum*** sieve size.

C. **Aggregate Gradation – Marshall Mix Design**: See Table 5. The Target Gradation Curve for the specified aggregate grade must lie within the Master Grading Band limits. The target grading band limits for the Target Grading Curve are the appropriate grading limits for pay factor 1.00 in Table 2. The target grading band limits are allowed to extend outside of the Master Grading Band limits.

Table 5 - Master Grading Band Limits - Marshal Mix Deisgn

Sieve	Aggregate Grades					
	DM-1	**DM-3/4**	**DM-/2**	**OM-1/2**	**FM-1**	**FM-1/2**
1 inch	100					
3/4 inch		100			100	
1/2 inch	75 - 91		100	100	90 - 100	100
3/8 inch		75 - 91		93 - 100	60 - 100	90 - 100
No. 4	47 - 61	46 - 62	60 - 80	36 - 44	15 - 40	30 - 50
No. 8				14 - 21	4 - 12	5 - 15
No. 16	23 - 33	22 - 34	28 - 42			
No. 50	12 - 22	11 - 23	11 - 23			
No. 200	3 - 7	3 - 7	3 - 7	2 - 4	2 -5	2 - 5

NOTES

(a) Gradation is expressed in percent passing by weight, ASTM C136. Percentage of fines passing No. 200 sieve determined by washing, ASTM C117.

(b) Friction Mixture, ASTM D3515.

(c) The alpha portion of the grade designator (DM, OM, FM) represents dense mix, open mix and friction mix. The numerical portion (1, 3/4, 1/2) represents the ***maximum*** sieve size.

D. Design Parameters: Determined by AI MS-2.

Table 6 - Mix Design Parameters

	SuperPave			Marshall	
Compaction Level (b)	50Nd	75Nd	100Nd	50 blow	75 blow
Stability, lbs, minimum (c)	--			1200	1800
Flow, in 0.01 inch units (c)	--			10 - 18	
Design Air Void Target, percent (d)	3.5			3.5	
Voids in Mineral Aggregate (VMA) relative to maximum or nominal sieve size grading and calculated using Gsb(dry), percent, minimm	ASTM D3203			ASTM D6927	
	Nominal Grading			Maximum Grading	
	1	12.0		1	13.0
	3/4	13.0		3/4	14.0
	1/2	14.0		1/2	15.0
	3/8	15.0		3/8	16.0
RAP or ROSP specific gravity for calculations	Gsb (dry) by chemical extraction				
Dust to Binder Ratio, maximum	1.4			1.6	
Tensile Strength Ratio (moisture sensitivity), minimum (e)	-			0.80	
Rutting (Hamburg rut test) (f)	AASHTO T324				
Road Class I	--			--	--
Road Class II	15 mm/10,000 passes			--	--
Road Class III	10 mm/20,000 passes			--	--

NOTES

(a) Road Class is defined in Section 32 01 31.

(b) 100Nd mix is for very high traffic applications only as defined by ENGINEER. 100Nd mix is intended for lower lift applications or surface applications with proactive seal coat program.

(c) Design Density Target: See ASTM D2041. Percent of maximum theoretical specific gravity.

(d) Stability, Flow, Voids: See ASTM D6927.

(e) Tensile Strength Ratio (moisture sensitivity): See ASTM D4867. Use freeze thaw conditioning. Compact test specimen to seven (7) percent plus or minus one (1) percent air voids.

(f) With testing performed at temperatures representing the specified binder grade in the Hamburg rut test, the average rut depth of two (2) mix design test Samples is less than the amount shown for the respective Road Classes.

2.5 **SOURCE QUALITY CONTROL**

A. Collect Samples randomly, ASTM D3665. Do not change sampling points:
   1. Sampling aggregate, ASTM D75. Collect samples before the drum mixer.
   2. Sampling binder, ASTM D140.
   3. Sampling bituminous paving mixture, ASTM D979.

B. Validate binder grade received from Supplier, Section 32 12 03.

C. Test mix every production day for the following:
   1. Combined aggregate gradation in the mix, ASTM D5444.
   2. Binder content in the mix, ASTM D6307.
   3. Temperature of mix placed in the transport vehicle at the production plant.
      a. Asphalt Binder mixes.
         1) Hot Mix: 325 deg F maximum.
         2) Warm Mix: 325 deg F maximum.
      b. Bitumen Binder mixes or Blended Binder mixes.
         1) Hot Mix: NOT ALLOWED.
         2) Warm Mix: 230 degrees maximum.

D. Warm Mix Testing: When rutting or moisture susceptibility tests are required on plant produced warm mix, condition the warm mix material before testing for two (2) hours at 275 plus or minus five (5) deg F per AASHTO R30 (short term aging). The material may be cooled to room temperature before conditioning.

PART 3 EXECUTION

3.1 **CONSTRUCTION EQUIPMENT**

A. Mixing Plant: ASTM D995. Provide.
   1. Positive means to determine the moisture content of aggregate.
   2. Positive means to sample all material components.
   3. Sensors to measure the temperature of the mix at discharge.
   4. Ability to maintain discharge temperature of mix.
   5. Capability of maintaining plus or minus five (5) percent tolerance on component percentages in final mix.
   6. Oil Sand Introduction System: **Do not burn off the light oils in Bitumen Binder (oil sand).**

3.2 **INSTALLATION**

A. Pavement placement, Section 32 12 16.13.

B. Pavement restoration, Section 33 05 25

END OF SECTION

SECTION 32 12 16.13

PLANT-MIX BITUMINOUS PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Place a bituminous concrete pavement base course, leveling course, surface course, overlay course, or an inlay course.

1.2 REFERENCES

A. **AASHTO Standards**:

- R9 Acceptance Sampling Plans for Highway Construction.
- TP68 Bulk Specific Gravity and Density of Compacted Asphalt Mixtures Using Automatic Vacuum Sealing Method.
- T324 Hamburg Wheel-Track Testing of Compacted Hot-Mix Asphalt (HMA).

B. **ASTM Standards**:

- D979 Sampling Bituminous Paving Mixtures.
- D1188 Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples.
- D2041 Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures.
- D2725 Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures.
- D2950 Density of Bituminous Concrete In Place by Nuclear Method.
- D3549 Thickness or Height of Compacted Bituminous Paving Mixture Specimens.
- D3665 Random Sampling of Construction Materials.
- D5361 Sampling Compacted Bituminous Mixtures for Laboratory Testing.
- D6927 Marshall Stability and flow of Bituminous Mixtures.

1.3 DEFINITIONS

A. Must Grind: Defined in Section 32 01 31.

B. Road Class: Defined in Section 32 01 31

1.4 SUBMITTALS

A. **Before Delivery**: Submit 48 hours before delivery:

1. Location and name of bituminous concrete production facility.
2. Mix design method.
3. Mix identification number or code.

4. Type, grade, and weight of binder.
5. Type, grade, and weight of aggregate.
6. Traffic control plan, Section 01 55 26.
7. Type and number of rollers.
8. Manufacturer's certificate of compliance for paving geotextiles. (Refer to Section 31 05 19).
9. Certification of profilograph and profilograph operator.
10. Cold weather paving plan.

B. **At Delivery**: For each batch delivered to site identify:

1. Date and project description.
2. Producer and plant.
3. Name of contractor.
4. Serial number of ticket.
5. Mix identification number or code.
6. Truck number and time dispatched.
7. Volume of mix delivered.

C. **After Placement**: Before final payment submit summary report describing profile deviation and profile roughness. See Section 32 01 31.

1.5 .**QUALITY ASSURANCE**

A. Do not change aggregate source or binder grade until ENGINEER accepts new source and new mix design.

B. Reject product and work that does not meet requirements of this Section.

C. Remove product found defective after installation and install acceptable product at no additional cost to OWNER.

D. Foreman of paving crew has completed at least three (3) projects of similar size and nature.

E. If requested, submit a quality control and testing report describing source and field quality assurance activities performed by CONTRACTOR and Suppliers.

F. For all equipment and hand tools used to mix, haul, and place the bituminous concrete, use a release agent that does not dissolve asphalt and is acceptable to ENGINEER.

1.6 **WEATHER**

A. Temperature:

1. April 15 to October 15: Place pavement when air temperature in the shade and the roadway surface temperature are above 50 deg F. The ENGINEER determines may provide written approval if it is acceptable to place outside of this temperature limit.
2. Before April 15 and After October 15: Provide a Cold Weather Paving Plan. ENGINEER must accept the plan before proceding.

Include the following details.

a. Haul details.

b. Placement details.

c. Compaction aids used in production.

d. Coordination procedure for acceptance testing.

B. Moisture: Do not place on frozen base, during adverse climatic conditions such as precipitation, or when roadway surface is wet or icy.

1.7 **NOTICE**

A. Follow Laws and Regulations concerning when and to whom notices are to be given. Send written notice at least three (3) days before start of paving.

B. Indicate paving time and when new surface can be used.

C. Warn of potential vehicle tow away and other construction issues affecting neighborhood.

D. Should work not occur on specified day, send a new notice.

1.8 **ACCEPTANCE**

A. **General**:

1. Acceptance is by Lot.
2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring complying material as part of its installation, Section 01 29 00.
3. Dispute resolution, Section 01 35 10.
4. Opening a paved surface to traffic does not constitute acceptance.
5. Observation of CONTRACTOR's field quality control testing does not constitute acceptance. Such testing; however, may be used by ENGINEER for acceptance if requirements of Section 01 35 10 are met.

B. **Mix Material**: Accepted as specified for bituminous concrete , Section 32 12 05, or rubberized asphalt concrete, Section 32 12 08.

C. **Mix Temperature at Site:**

1. Reject mixes in the transport material exceeding the following temperatures.
   a. Hot mix, 425 deg F.
   b. Warm mix, 300 deg F.
   c. Oil sand bituminous concrete, 230 deg F.
2. Dispose of cold mix in paver hopper as thin spread underlay.

D. **Grade, Cross Slope**: Verify tolerances are not exceeded.

E. **Compaction**: Options for acceptance are 1) core density, 2) non-destructive test density, or 3) control strip density with visual observation. Use core density unless specified elsewhere. A Lot is acceptable if density tests are within pay factor 1.00 limits. At ENGINEER's discretion, a Lot with deficient sub-lot density tests may be accepted if pay is adjusted using an applicable pay factor in the following table, or accepted at 50 percent pay if a sub-lot is in Reject.

Table 1 – Compaction Pay Factors

Pay Factor	Density, in Percent Relative to ASTM D2041	
	Average	Lowest Test
0.70	More than 96	–
1.00	**92 to 96**	**89 or greater**
0.90	92 to 96	Less than 89
0.80	Less than 92	89 or greater
Reject	Less than 92	Less than 89

1. **Core Density**: This method compares the average density of cores extracted from a pavement surface to maximum theoretical density:
   a. Lot Size: One (1) day production with 1,000 square yard sub-lots or part thereof.
   b. Sampling Protocol: Use ASTM D3665 to randomly select in each sub-lot at least one (1) surface test location and one (1) longitudinal joint test location. Collect at least two (2) test samples at each test location, ASTM D5361. Samples are full depth or overlay depth in overlay construction.
   c. Testing Protocol: ASTM D2725 for core density and ASTM D2041 (Rice) for maximum theoretical density.
2. **Non-Destructive Density Testing by Gage**:
   a. Lot Size: One (1) day production with 1,000 square yard sub-lots or part thereof.
   b. Sampling Protocol: Use ASTM D3665 to randomly select in each sub-lot at least one (1) surface test location and one (1) longitudinal joint test location.
   c. Testing Protocol: ASTM D2950 (nuclear gage) or AASHTO TP68 (non-nuclear gage) and ASTM D2041 (Rice) for maximum theoretical density.
3. **Control Strip Density with Visual Observation**:
   a. Lot: One (1) day production.
   b. Sampling Protocol: Not required after rolling pattern is determined.
   c. Testing Protocol: ASTM D6927 (Marshall) and D2041 (Rice method) to determine rolling pattern for 94 percent compaction, thereafter visual examination.
4. **Compaction Dispute Resolution**:

a. CONTRACTOR:
   1) Provide an Independent Testing Agency, Section 01 45 00.
   2) Take two (2) supplement cores midway between deficient acceptance test locations, and midway between a deficient test location and an adjacent acceptable test location.
   3) Patch core holes.
   4) Conduct testing at no additional cost to OWNER.

b. ENGINEER:
   1) Accept Lot at full pay if new information shows compliance, or
   2) Accept Lot at pay reduction using new test information, or
   3) Reject Lot.

F. **Thickness**: A Lot is acceptable if test deficiencies are within pay factor 1.00 limits. At ENGINEER's discretion, a Lot with sub-lot deficiencies greater than allowed for pay factor 1 in the following table may be accepted if pay is adjusted using one of the following applicable pay factors, or accepted at 50 percent pay if a sub-lot is in Reject.

Table 2 – Thickness Pay Factor

Pay Factors	Deficiency Limits, in Inches
1.00	0.00 to 0.375
0.90	0.376 to 0.50
0.70	0.51 to 0.75
Reject	0.76 to 1.00

1. **Lot Size**: One (1) day production with 1,000 square yard sub-lots or part thereof.
2. **Sampling Protocol**: Use ASTM D3665 to randomly select at least one surface test location and one longitudinal joint test location in each sub-lot. Collect at least two (2) core samples at each test location, ASTM D5361. Samples are full depth. Overlay construction measured only on overlay portion of core sample.
3. **Testing Protocol**: ASTM D3549:
   a. Minimum Specified Thickness: A Lot specified to have minimum thickness will be accepted if all sub-lot measurements meet or exceed minimum. If thickness is deficient, additional material may be placed over the deficient thickness if there is no pavement feathering; placement matches this section's thickness tolerance; surface continues to drain; and roughness tolerance is met.
   b. Actual Specified Thickness: A Lot specified to have actual thickness is acceptable if any sub-lot measurement does not exceed deficiency limits for thickness pay factor 1.00.

4. **Thickness Dispute Resolution**:
   a. CONTRACTOR:
      1) Hire an Independent Testing Agency, Section 01 45 00.
      2) Take two (2) additional cores midway between deficient acceptance test locations, and midway between a deficient test location and the next adjacent acceptable test location.
      3) Patch core holes.
      4) Conduct testing at no additional cost to OWNER.
   b. ENGINEER:
      1) Graph deficient areas by plotting new cores and original cores to define deficient areas assuming the following.
         a) The graph represents the thickness of the pavement.
         b) Thicknesses vary linearly along the pavement length from core depth to core depth.
         c) The pavement is a constant depth in the transverse direction.
      2) Accept Lot at full pay if new information shows compliance, or
      3) Accept Lot at pay reduction using new test information, or
      4) Reject Lot.

G. **Profile Roughness and Profile Deviation**: Section 32 01 31.

1.9 **WARRANTY**

A. Joints at Street Fixtures and Portland Cement Concrete Flat Work: If wider than 1/2 inch before end of the correction period seal joints with asphalt rubber or rubberized asphalt; Section 32 01 17.

PART 2 PRODUCTS

2.1 **MATERIALS**

A. Bituminous concrete, Section 32 12 05.
B. Rubberized asphalt concrete, Section 32 12 08.
C. Tack coat, Section 32 12 13.13.
D. Prime coat, Section 32 12 13.19.
E. Paving geotextile, Section 31 05 19.
F. Paving geogrid, Section 31 05 21.

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. Paver Machine: Use track equipment when operating on fabrics, geogrids or pavement mats hotter than 180 deg F

B. Compactors: Steel wheel static or vibratory. Use pneumatic tire roller for intermediate rolling only.

3.2 PREPARATION

A. General:

1. Locate and preserve utilities Section 01 31 13. Contact utility companies and other agencies, for dangerous concentration of combustible, flammable, or explosive matter.
2. Lower Street Fixtures if paving machine is not capable of passing over the fixtures.
3. Remove vegetation from cracks, edges and joints. Sweep surface clean. Blow cracks clean. Remove leaves.
4. Fill cracks and fix Potholes, Section 32 01 17.
5. Stabilize Portland cement concrete subgrade slabs.

B. Traffic Control:

1. Implement notification and traffic control plan requirements, Section 01 55 26. Do not proceed without certified flaggers.
2. Apply temporary lane marking tape or paint after layout has been verified with ENGINEER.

C. Aggregate Base Course:

1. Verify base course is placed to grade, compacted and dampened.
2. If indicated, follow Section 31 31 19 requirements for herbicide treatment or Section 32 12 13.19 for prime coat applications.

3.3 PROTECTION

A. Trees, Plants, Ground Cover:

1. Protect trees, plants and other ground cover from damage.
2. Prune trees to allow equipment passage underneath, Section 32 01 93. Repair tree damage at no additional cost to OWNER.

B. Protect all structures, including curb, gutter, sidewalks, guard rails and guide posts from physical damage. Remove spatter, over-coat, or mar.

C. Do not discharge bituminous materials into borrow pits or gutters.

D. Protect hot pavement from traffic until cool enough not to become marred.

E. Remove saw-cut dust immediately. Protect neighborhood, storm drains and down-stream fish habitat.

3.4 TEMPORARY SURFACING

A. Place, roll, maintain, remove and dispose of temporary Pavement surfaces.

B. In sidewalk areas construct temporary pavements at least 1 inch thick and in all other areas at least two (2) inches thick. At major intersections and other critical locations a greater thickness may be required.

3.5 LINE AND GRADE CONTROL

A. Provide necessary survey stakes for horizontal and vertical control.

B. Furnish, place, and maintain supports, wire devices, and materials as required to provide continuous line and grade reference controls for placing pavement, matching existing pavement surfaces, etc.

3.6 FABRIC PLACEMENT

A. Section 31 05 19.

3.7 PAVEMENT PLACEMENT

A. General:

1. Barricade off or eliminate fall off edges.
2. Provide continuous forward paver movement so temperature 10 feet behind paver is as follows:
   a. Warm Mix Placement: 200 deg F minimum.
   b. Hot Mix Placement:

Table 3 – Minimum Pavement Temperature in Degrees F.

Air Temperature Deg F	Compacted Mat Thickness					
	3/4"	1"	1-1/2"	2"	3"	4"+
45 – 50	–	–	–	–	280	265
50 - 59	–	–	–	280	270	255
60 - 69	–	–	285	275	265	250
70 - 79	285	285	280	270	265	250
80 - 89	280	275	270	265	260	250
90 +	275	270	265	260	250	250

B. Overlays or Subsequent Lifts:

1. Allow new base pavement or new inlay pavement to cure (harden) before placing overlays.
2. Apply tack coat per Section 32 12 13.13 if inlay or sub-base Pavement surface is dirty or older than 24 hours.

C. Irregular Areas: Handwork is acceptable if specified grade, slope, compaction and smoothness are achieved.

D. Compaction:

1. Test mix placement until a compaction pattern is acceptable to CONTRACTOR. Continue random quality control testing.
2. Do not over compact or under compact.

3. Complete compaction before the following temperature are reached:
   a. 180 deg F for hot mixes.
   b. 140 deg F for warm mixes.

E. Joints:
1. Construct joints to industry standards for texture, density and smoothness.
2. Clean contact surfaces and apply tack coat. Ensure continuous bond between old and new pavements, or between successive day's work.
3. Offset longitudinal joints a minimum of 12 inches in succeeding courses and at least six (6) feet transversely to avoid a vertical joint through more than one course. In the top course restrict longitudinal joint to 1 foot either side of lane lines.
4. Prevent traffic, including construction traffic, from crossing vertical edges. Apply tack coat to vertical edges before making another pass with paver if mix has cooled to 90 deg F

3.8 TOLERANCES

A. Compaction: Target is 94 percent of ASTM D2041 (Rice density) plus or minus two (2) percent.

B. Lift Thickness: If not indicated, meet the following tolerances.

Table 4 – Lift Thickness Tolerance

Mix Design Method	Minimum	Maximum
Marshall	2 times maximum aggregate size	Not more than limits established by manufacturer of compactor equipment
Performance Grade (Superpave)	4 times *nominal* aggregate size	
NOTES (a) Thickness is measured after compaction.		

C. Smoothness:
1. Parallel to Centerline: Section 32 01 31.
2. Cross Slope: 1/4 inch in 10 feet except at cross section grade breaks.

3.9 REPAIR

A. Repair ride disturbing or unsafe butt joints. Repair expense is at no additional cost to OWNER.

B. If pavement smoothness is deficient, follow Section 32 01 31 repair requirements.

C. Corrective Action for Profile Deviations ("Must Grinds"): Grinding is acceptable. See Section 32 01 26. Apply a fog seal over grind areas. See Section 32 01 13.50. If depressions cannot be corrected by grinding, remove and replace.

D. Corrective Action for Profile Roughness Index: Grinding is acceptable. Re-profile corrected segments to verify ride index meets tolerance. Apply a fog seal over grind areas. See Section 32 01 13.50.

E. When thickness is deficient, place additional material over deficient areas. DO NOT skin patch. Mill for inlay if necessary.

F. Defective Joints, Seams, Edges: Repair.

G. Unacceptable Paving: Remove and replace.

3.10 **OPENING TO TRAFFIC**

A. Temperature of pavement surface is not more than 180 deg F

END OF SECTION

SECTION 32 12 16.18

RECYCLE BITUMINOUS PAVEMENT

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Make a base, leveling, or surface course using an existing bituminous concrete that is in-place.

B. Mix design requirements.

1.2 **REFERENCES**

A. **ASTM Standards**:

D2950 Density of Bituminous Concrete In Place by Nuclear Method.

D3549 Thickness or Height of Compacted Bituminous Paving Mixture Specimens.

1.3 **DEFINITIONS**

A. **RAP**: Acronym for reclaimed asphalt pavement. Refer to Section 32 12 05.

B. **RAC**: Acronym for recycled asphalt concrete. A bituminous mix product consisting of RAP or ROSP, new aggregates and Binder or Binder with a recycle rejuvenating agent, the mixture of which creates a new bituminous concrete.

C. **ROSP**: Acronym for reclaimed Oil Sand pavement. Refer to Section 32 12 05.

1.4 **SUBMITTALS**

A. Before commencing work of this Section, submit:

1. Traffic control plan, Section 01 55 26.
2. A list of equipment to be used.
3. Type of Binder to be used, Section 32 12 03.

B. RAC Mix Design: Determine conditions and properties of existing materials. Identify recycling agent and submit the following data as applicable:

1. If RAP or ROSP is 15 percent or less of the RAC, submit a mix design formula if Supplier does not have a mix design formula at the plant. The formula shall be based on current test data.
2. If RAP or ROSP added to the RAC is over 15 percent, submit a mix design formula.

C. RAC Delivery Tickets, Section 32 12 16.19.

1.5 **QUALITY ASSURANCE**

A. Section 32 12 16.13.

1.6 **WEATHER**

A. Section 32 12 16.13.

1.7 **NOTICE**

A. Section 32 12 16.13.

1.8 **ACCEPTANCE**

A. Section 32 12 16.13.

PART 2 PRODUCTS

2.1 **MATERIAL**

A. Recycle asphalt (RA), Section 32 12 03.

B. Tack coat, Section 32 12 13.13.

C. Paving geotextile, Section 31 05 19.

D. Paving geogrid, Section 31 05 21.

E. RAP OR ROSP: Free of detrimental quantities of deleterious materials. Graded (on a non-dried basis) as follows.

Sieve	Percent Passing by Weight
1–1/2"	100
1"	90

PART 3 EXECUTION

3.1 **CONSTRUCTION EQUIPMENT**

A. Laydown Machine: Provide track equipment when operating on fabrics or geogrid, otherwise type of equipment is CONTRACTOR's choice.

B. Compactors: Steel wheeled static or vibratory.

3.2 **PREPARATION**

A. General:

1. Locate and preserve utilities, Section 31 23 16. **Contact utility companies and other agencies, for dangerous concentration of combustible, flammable, or explosive matter.**
2. Lower Street Fixtures if pavement recycler machine is not capable of releasing pavement-cutting mechanism to protect fixtures.
3. Remove plant materials from cracks, edges and joints. Sweep surface clean. Blow cracks clean.
4. Stabilize concrete subgrade slabs.
5. Apply tack coat, Section 32 12 13.13.
6. Verify surfaces are dry.

B. Trees, Plants, Ground Cover:

1. Protect trees, plants and other ground cover from damage.
2. Prune trees, Section 32 01 93 to allow equipment passage underneath. Repair tree damage at no additional cost to OWNER.

C. Traffic Control:

1. Control pedestrian and vehicular traffic, Section 01 55 26.
2. Protect pavement from traffic until mixture has cooled enough not to become marked.
3. Apply temporary lane marking tape or paint after layout has been verified with ENGINEER.

D. Milling, Section 32 01 16.71

3.3 **PLACING RAC**

A. Hot-laid RAC, Section 32 12 16.13

B. Cold-laid RAC, Section 32 12 16.19

C. Mix and blend milled aggregate, recycling asphalt, virgin asphalt and virgin aggregate per mix design.

3.4 **TOLERANCES**

A. Compaction, lift thickness, grade, cross slope, Section 32 12 16.19

B. Complete compaction of RAC within five (5) minutes of placing RAC and before its temperature drops below 200 deg F

3.5 **PROTECTION AND REPAIR**

A. Section 32 12 16.19.

END OF SECTION

SECTION 32 13 13
CONCRETE PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Place Portland cement concrete in a base course, surface course, overlay course, or an inlay course.

B. This specification does not apply to concrete flat work.

1.2 REFERENCES

A. **ACI Standards**:

- 305 Hot Weather Concreting.
- 306 Cold Weather Concreting.
- 318 Building Code Requirements for Reinforced Concrete.

B. **APWA (Utah) Standards**:

- Plan 261 Concrete pavement joints.

C. **ASTM Standards**:

- A307 Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
- C39 Compressive Strength of Cylindrical Concrete Specimens.
- C78 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).
- C94 Ready-Mixed Concrete.
- C174 Measuring Thickness of Concrete Elements Using Drilled Concrete Cores.
- C231 Air Content of Freshly Mixed Concrete by the Pressure Method.
- C1315 Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
- D3665 Random Sampling of Construction Materials.
- D5249 Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement and Asphalt Joints.
- E950 Measuring the Longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference.
- E1274 Measuring Pavement Roughness Using a Profilograph.

D. **DOT Standards**:

1. Publication No. HIF-07-004: Integrated Materials and Construction Practices for Concrete Pavement.

1.3 **DEFINITIONS**

A. Must Grind: Defined in Section 32 01 31.

B. Road Class: Defined in Section 32 01 31

1.4 **SUBMITTALS**

A. **Before delivery**: Submit 48 hours before delivery:

1. Traffic control plan, Section 01 55 26.
2. Joint layout plan.
3. Concrete placement plan. Identify items such as but not limited to grade control system, placement start and stop timing, hydration control during cold conditions (ACI 306), hot and windy conditions (ACI 305), timing for evaporation retarder application, timing for curing agent application, floating restrictions, concrete saw-cut timing, header joints.
4. Curing plan. Describe method to prevent excessive concrete temperatures and water evaporation that could impair strength or serviceability of concrete. Refer to ACI 305.
5. Evaporation Retarder Data Sheet. Identify product components, application, and manufacturer's recommendations.
6. Proof of finisher's ACI certification.
7. Make and model name of paving machine, grade trimmer, and gang drill mechanism.
8. Pre-approved concrete mix design or supplier's mix number, Section 03 30 04.
9. Certification of profilograph calibration and profilograph operator.
10. Manufacturer's recommended installation procedures for joint sealing material which, when accepted by ENGINEER, will become the basis for accepting or rejecting actual installation procedures used in the Work.

B. **At Delivery**: Submit batch ticket, Section 03 30 10.

C. **After Placement**: Before final payment submit summary report describing profile deviation and profile roughness. See Section 32 01 31 requirements.

1.5 **QUALITY ASSURANCE**

A. Do not change concrete supplier until ENGINEER accepts new source and new mix design.

B. Reject product that does not meet requirements of Section 03 30 04.

C. Remove product found defective after installation and install acceptable product at no additional cost to OWNER.

D. Foreman of paving crew has completed at least three (3) projects of similar size and nature.

E. Lead finishing mechanic is ACI certified.

F. Follow state of practice for quality assurance as published in FHWA Publication No. HIF-07-004.

G. If requested, submit a quality control and testing report describing source and field quality assurance activities performed by CONTRACTOR its Suppliers.

1.6 **WEATHER**

A. Hot weather, ACI 305. Set retarding admixture may be used if allowed in mix design. Discontinue placement if ambient air temperature exceeds 100 deg F in the shade.

B. Cold weather, ACI 306 Accelerating admixtures may be used if allowed in mix design. Provide weather protection until 90 percent of design compressive strength is achieved. When removing heat, limit temperature change next to concrete surface to 20 deg F per 12 hours until the concrete surface temperature reaches ambient:

1. Use of admixtures or curing agent will not relax cold weather placement and cure requirements.
2. Do not use chemical additives to prevent freezing.
3 Prevent loss of moisture during protection.

1.7 **NOTICE**

A. Follow Laws and Regulations concerning when and to whom notices are to be given. Send written notice at least three (3) days before start of paving.

B. Indicate paving time and when new surface can be used.

C. Warn of potential vehicle tow away and other construction issues affecting neighborhood.

D. Should work not occur on specified day, send a new notice.

1.8 **ACCEPTANCE**

A. **General**:

1. Acceptance is by Lot. Lot size is one day production and as listed below.
2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring material as part of its installation, Section 01 29 00.
3. Dispute resolution, Section 01 35 10 and Section 03 30 05.
4. Opening a paved surface to traffic does not constitute acceptance.
5. Observation of CONTRACTOR's field quality control testing does not constitute acceptance. Such testing; however, may be used by ENGINEER for acceptance if requirements in Section 01 35 10 are met.

B. **Temperature, Slump, Air**:

1. Lot size is one (1) random batch.
2. Testing Frequency: Section 03 30 05.
3. Reject non-complying batches until two (2) consecutive batches are compliant then continue in random batch testing for acceptance.

C. **Strength**: At ENGINEER's discretion, a Lot with deficient sub-lot strength may be accepted if pay is adjusted using one of the following applicable pay factors, or accepted at 50 percent pay if a sub-lot is in Reject.

Table 1 – Strength Pay Factor			
Criteria	**Pay Factor**	**PSI Below 28 day Compressive Strength**	**Lot Size, in Square Yards**
Compression (ASTM C39)	0.98	1 to 100	500
	0.94	101 to 200	
	0.88	201 to 300	
	0.80	301 to 400	
	Reject	Greater than 400	
Flexure (ASTM C78)	0.95	1 to 29	750
	0.85	30 to 60	
	Reject	Greater than 60	

1. Strength Dispute Resolution:
   a) CONTRACTOR:
      1) Hire an Independent Testing Agency, Section 01 45 00.
      2) Follow Section 03 30 05 requirements.
      3) Conduct testing at no additional cost to OWNER. Retesting must be completed within 40 calendar days after placement.
   b) ENGINEER:
      1) Accept lot at full pay if average strength of three (3) cores from the defective lot is greater than or equal to 85 percent of compressive strength (f_c'), and if no single strength retest is less than 75 percent of f_c'.
      2) Use original cylinder compressive strengths for pay factor determination if any of above criteria are not met.

D. **Placement**: Section 03 30 10.
   1. Verify grade, cross slope, finish and dimensions.
   2. No standing water in curb and gutter.
   3. Curing membrane applied at twice coverage rate recommended by curing membrane Supplier.

E. **Thickness**: A Lot is acceptable if test deficiencies are within pay factor 1.00 limits. At ENGINEER's discretion, a lot with greater sub-lot deficiencies may be accepted if pay is adjusted using one of the following applicable pay factors, or accepted at 50 percent pay if a sub-lot is in Reject.

Table 2 – Thickness Pay Factor		
Pay Factors	**Deficiency Limits, in Inches**	
	Residential street	**Non-residential street**
1.00	0.00 to 0.25	0 to 1/8
0.90	0.26 to 0.50	1/8 to 1/4
0.75	--	1/4 to 1/2
0.70	0.51 to 0.75	--
0.60	--	1/2 to 3/4
0.50	0.76 to 1.00	--
Reject	Greater than 1.00	Greater than 3/4

1. Lot Size: 1,000 square yards or part thereof.
2 Sampling Protocol: Use ASTM D3665 to randomly select at least one (1) test location in each lot. Collect two (2) samples at each test location. Samples are full depth. Patch core holes.
3. Testing Protocol: ASTM C174.
4. Thickness Dispute Resolution:
   a. CONTRACTOR:
      1) Hire an Independent Testing Agency, Section 01 45 00.
      2) Take two (2) additional cores midway between deficient acceptance test locations, and midway between a deficient test location and the next adjacent acceptable test location.
      3) Patch core holes.
      4) Conduct testing at no additional cost to OWNER.
   b. ENGINEER:
      1) Graph deficient areas by plotting new cores and original cores to define deficient areas assuming the following.
         a) The graph represents the thickness of the pavement.
         b) Thicknesses vary linearly along the pavement length from core depth to core depth.
         c) The pavement is a constant depth in the transverse direction.
      2) Pay Factor: The pay factor will be calculated over the Lot's deficient area or over areas extending into adjacent Lots.
      3) Accept lot at full pay if new information shows compliance, or
      4) Accept Lot at pay reduction using new test information, or
      5) Reject Lot.

F. **Profile Roughness and Profile Deviation**: Verify tolerances required in Section 32 01 31.

PART 2 PRODUCTS

2.1 CONCRETE

A. Compression Design: Class 4000, Section 03 30 04. Slump per mix design.

B. Flexure Design:

1. Strength: 650 psi, ASTM C78.
2. Cement Content: 6.5 bags.
3. Water cement Ratio: 0.44 maximum by weight (before pozzolan exchange), ACI 318.
4. Entrained Air: Five (5) to seven (7) percent, ASTM C231 (pressure).
5. Slump per accepted mix design.

2.2 EVAPORATION RETARDER

A. Water based spray-on liquid that forms a mono-molecular film over the plastic concrete surface.

2.3 CONCRETE CURING COMPOUND

A. Type II Class A or B (white pigmented) liquid membrane forming compound, ASTM C1315.

2.4 JOINT MATERIALS

A. Section 32 13 73.

1. Expansion Joint Filler: F1 sheet.
2. Contraction Joint Filler (Backer Rod): Type 1 round, ASTM D5249.
3. Contraction Joint Sealer: HAS1, HAS4, or CAS6.

2.5 STEEL REINFORCEMENT

A. Section 03 20 00.

B. Tie Bar: Grade 60 or higher deformed billet steel bars galvanized or epoxy coated.

C. Dowel Bar: Grade 60 or higher billet steel bar, galvainzed or epoxy coated with plastic expansion cap on one (1) end.

D. Chair and Basket Assemblies: Plastic chairs. Galvanized or epoxy coated grade 60 billet steel bar basket assemblies.

E. Hook Bolts: Galvanized ASTM A307, grade A steel, nuts and shaft internall and externally threaded.

2.6 BOND BREAKER

A. Wax based compound.

2.7 **EPOXY ADHESIVE GROUT**

A. Two component, Section 03 61 00.

2.8 **EVAPORATIVE REDUCER**

A. Water-based mono-molecular polymer liquid at application rates recommended by manufacturer. **DO NOT use as a finishing aid**.

PART 3 EXECUTION

3.1 **CONSTRUCTION EQUIPMENT**

A. **Mixing plant**: ASTM C94, Option C:

1. Use scales certified by the State of Utah. Do not use volume measurement except for water and liquid admixtures.
2. Mixing time must exceed 80 seconds after adding air entrainment admixture.

B. **Cylinder Storage Device**: A container at the work site that maintains an interior temperature of 60 to 80 deg F. equipped with an automatic seven (7) days temperature recorder, accurate within two (2) degrees and having a permanent recording feature. A 24 hours test run may be required. Cease concrete operation when storage capacity of storage device is reached.

C **Concrete Hauling Vehicle**:

1. Truck mixer: Not allowed if ready mix product can be provided. If allowed:
   a. Fill drum no more than 63 percent of the gross drum volume and no less than two (2) cubic yards is occupied.
   b. Use drum manufacturer's recommended mixing speed (between 12 – 18 rpm)
   c. Driver of vehicle has and follows Supplier's manual of standard operational procedures.
2. Truck Agitator: Do not fill drum greater than 80 percent of the gross drum volume. Use drum manufacturer's recommended agitating speed (between 2 – 6 rpm).
3. Dump truck. End dump or side dump is acceptable. Air content must be controlled at the mixing plant.

D. **Trimmer**: A self propelled unit to strike off and shape surface of road base material so future placement of concrete pavement meets specified thickness. The trimmer uses the same line and grade control assembly or system that the paving machine uses.

E. **Slip Form Paving Machine**:

1. Capable of providing one pass between crown line and back of curb unless specified otherwise.
2. Self Propelled with two or four tracks

3. Steering and elevation controlled from reference string lines.
4. Paving width up to 50 feet (depending upon model and attachments).
5. Weight 2,000 pounds per foot of paving lane width.
6. Continuous auger, hydraulic plow-pans, or conveyor system to distribute concrete in front of the screed.
7. Variable speed internal vibrators.
8. Capable of consolidating mats up to 15 inches thick.
9. Various finishing attachments.

F. **Fixed Form Paving Machine:**

1. Capable of providing one pass between crown line and lip of gutter.
2. Ride on forms or on self-propelled wheels.
3. Steering and elevation controlled by fixed forms.
4. Various paving width.
5. Weight about 1,000 pounds per foot of paving width.
6. Suspended screw auger to spread concrete in front of screed or roller.
7. Has one or two vibrators that move transversely in front of the screed. May also use fixed vibrators near the form edges.
8. Capable of consolidating amts up to 10 inches thick.

G. **Vibrating Screed**:

1. Capable of providing one pass between crown line and lip of gutter.
2. Various paving width.
3. Elevation controlled by fixed forms or string-line.

H. **Finishing and Texturing Equipment**.

1. Machine float may be attached to paver.
2. Texturing equipment acceptable to ENGINEER.
3. Curing compound application device with a fully atomizing type power spray and a wind protection hood.

I. **Straight Edge**: 10 to 20 feet long hand-operated. Successive straightedge checks should overlap by one-half the length of the straightedge.

J. **Profilograph**:

1. Capable of producing results required by ASTM E950 and ASTM E1274.
2. Set profilograph readings with corresponding project survey stationing, or as a minimum, correlate equipment station 0+00 with a specific project station number. ENGINEER to select.

3.2 PREPARATION

A. **General**:

1. Locate and preserve utilities, Section 01 31 13. Contact utility companies and other agencies, for dangerous concentration of combustible, flammable, or explosive matter.
2. Lower Street Fixtures if paving machine is not capable of passing over fixtures.
3. Coat surface of Street Fixtures with oil to prevent bond with concrete pavement.
4. Remove sand, leaves and other objectionable materials before placing paving course.
5. Notify ENGINEER at least 24 hours before commencement of concreting operations.

B. **Traffic Control**:

1. Implement notification and traffic control plan requirements, Section 01 55 26. Do not proceed without certified flaggers.
2. Apply temporary lane marking tape or paint after layout has been verified with ENGINEER.

C. **Aggregate Base Course**:

1. Verify base course is placed to grade, compacted and dampened.
2. If indicated, follow Section 31 31 19 requirements for herbicide treatment or Section 32 12 13.19 for prime coat requirement.

D. **Cement Treated or Lean Concrete Base**:

1. Aggregate Subgrade: Moisten surface but do not place concrete over standing water.
2. Concrete Subgrade:
   a. Remove loose material from surface of cement treated or lean concrete base course immediately before placing concrete surface course.
   b. Apply a double coat of bond breaker before placing surface concrete.

3.3 PROTECTION

A. Protect placed concrete, Section 03 30 10 and as follows:

1. Do not allow steel wheel rollers or steel wheel vehicles on the concrete Pavement. Keep traffic and construction equipment off at least 10 days after concrete placement or until 100 percent of the design strength has been achieved and verified by either:
   a) Maturity meter.
   b) Concrete cylinders.
2. If construction traffic is permitted, keep Pavement clean. Remove surface stains and spillage of materials as they occur.
3. Remove saw-cut dust immediately. Protect neighborhood, storm

drains and down-stream fish habitat.

B. Trees, Plants, Ground Cover:

1. Protect trees, plants and other ground cover from damage.
2. Prune trees to allow equipment passage underneath, Section 32 01 93. Repair tree damage at no additional cost to OWNER.

3.4 LINE AND GRADE CONTROL

A. **General**:

1. Furnish, place, and maintain forms, supports, wire devices, and materials as required for providing continuous line and grade control.
2. Use survey staking. Distances between line and grade control points are as follows:
   a. 25 feet maximum on tangent sections.
   b. 10 feet maximum on vertical curve high points and low points, and on horizontal curves from PC to PT points.
3. Provide additional grade control at high points, low points,
4. Check line and grade control immediately before paving operation.
5. Use the same grade control system to control the paver and the grade trimmer.

B. **Slip Form Paving**. Equip machinery with a control system that automatically controls concrete placement to the specified longitudinal grades and transverse cross slopes.

C. **Formed Paving.** Section 03 11 00. Keep forms free from warps, bends, kinks, and equal in depth to the specified pavement edge. Tightly join formed sections and stop paving operation if the side forms to not meet or hold the following line and grade:

1. Top of forms not more than 1/4 inch from true grade.
2. Vertical face on longitudinal axis not more than 1/4 inch from true line.

3.5 REINFORCEMENT PLACEMENT

A. Section 03 20 00.

B. Use smooth dowel in expansion joints.

C. Interrupt reinforcement placement at expansion joints.

D. Keep load transfer bars and dowels in vertical center of concrete and perpendicular to the joint during concrete placement.

E. Position mats on bar chair supports and properly tie before concrete is poured. Keep mats clean, free from rust, flat, and free of distortions. Straighten bends, kinks, and other irregularities or replace units before concrete placement. Provide at least two (2) inch overlap to adjacent mats.

F. DO NOT place the end of a dowel or tie bar within 18 inches of any joint

3.6 **JOINTS**

A. **General**:

1. Review joint layout with ENGINEER.
2. See APWA Plan 261 for joint types.
3. Do not allow edge slump when placing tie-bars or by over-working edge of slab.
4. If CONTRACTOR chooses to open the roadway to construction or public traffic before final sawing and sealing, install backer rod in the initial (green) cut to prevent entrance of incompressibles.

B. **Contraction Joints (Crack Control Joint):**

1. Joint spacing measured in feet not to exceed twice the slab thickness measured in inches or 15 feet maximum.
2. Joint depth = T/3. T is depth of concrete slab in inches.
3. Use of a mechanical control joint-void former in lieu of saw cutting or tooling is acceptable.
4. Make transverse joints align with end at curb and gutter joints.
5. Leave forms in place until paving operations are resumed on the other side of the joint.
6. Keep a minimum of three (3) working power saws on site when concrete operations are underway. Saw all joints before uncontrolled shrinkage cracking takes place. Do not tear or ravel concrete during sawing.

C. **Expansion Joints**:

1. Joint Filler Type:
   a. Place joint filler vertical in position, in straight lines. Secure fillers to formwork or other to prevent movement. When butted together, do not leave voids or gaps between filler units.
   b. Set joint fillers full depth if no joint sealant is specified. Recess joint fillers if backer rods and joint sealant are specified.
2. Dowel Bar Type:
   a. Provide expansion cap on end of dowel bar.
   b. If a deformed bar is used in an expansion joint, provide sleeve for movement.

D. **Header Joints (Transverse Construction Joints) in Slip Form Paving:** Extend concrete paving placement an addition five (5) feet at the end of a day of work or at an interruption for a bridge, intersection, or leave-out. When hardened, saw cut and remove the five feet to create the header. Install dowels into the hardened concrete and continue concrete placement.

E. **Volunteer Crack Joint**:

1. If a volunteer crack joint falls within five (5) feet of the location of proposed contraction joint, omit the contraction joint.
2. Rout volunteer crack joints to a depth of 1/4 slab thickness per detail 1 of APWA Plan 261. Clean and fill crack joint with backer rod and joint sealant.
3. If a volunteer crack joint develops within two (2) feet of expansion or construction joints, replace panel. Use saw cuts and tie-bars or dowels in cut planes.

F. **Joint Sealing**: Section 32 13 73.

3.7 PLACEMENT

A. Section 03 30 10.

B. Do not place concrete until concrete sub base and surface course forms have been checked for line and grade. Moisten sub base if required to provide a uniform dampened condition at time of concrete placement. Do not place concrete around manholes or other structures until they are at required finish elevation and cross slope.

C. At the beginning of concrete placement:

1. Test slump and air. If corrections are necessary, placement may proceed after two (2) subsequent and consecutive batches pass testing.
2. Tempering, not allowed unless Section 03 30 10 requirements are followed or mix design makes allowance for water addition.
3. Admixtures (such as for air entrainment) not allowed unless specified elsewhere.

D. **Any delay in excess of 15 minutes from placing to start of finishing operations is cause for stopping placement work**.

E. Prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with 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 dislocation of reinforcing, dowels, and joint devices.

F. Do not place concrete in a longitudinal section until test specimens from the adjacent lane have attained a compressive strength of 2,500 psi as determined by maturity meter or cast cylinders.

G. Deposit and spread concrete in a continuous operation between transverse joints. If interrupted for more than 1/2 hour, place a construction joint.

H. Place the concrete to the full width of the pavement in a single construction operation unless indicated otherwise.

3.8 SCREEDING AND FLOATING

A. Strike-off , consolidate, and provide a smooth surface by screeding

B. After screeding, test slab for trueness with a straight edge. Distribute concrete as required to remove surface irregularities.

C. Apply an evaporation retarder immediately after screeding (or after floating if floating is required). Apply retarder BEFORE bleed water has vanished. **Do not use the retarder as a finishing aid**.

D. Use floating hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture. Refloat repaired areas to provide a continuous smooth finish.

3.9 **FINISHING**

A. Section 03 35 00.

B. DO NOT use steel finishing equipment (floats, trowels, etc.).

C. **Any delay in excess of 30 minutes for completing the finishing operation is cause for stopping concrete placing to correct difficulties**.

D. Round edges of slabs, gutters, back top edge of curb, and formed joints with an edging tool. Eliminate tool marks.

E. Surface Texture: After floating when excess moisture or surface sheen has disappeared:

1. For speed less than 45 mph: 1/16 inch deep burlap drag, turf drag, or broom.

2. For speeds 45 mph and greater: 1/8 inch deep groove placed 80 degrees to center line and randomly spaced between 3/8 and 1-1/2 inches.

F. Do not remove forms for at least 24 hours after concrete has been placed. After form removal, clean ends of joints and patch any minor honeycombed areas. Remove and replace areas or sections with major defects.

3.10 **CURE**

A. Section 03 39 00.

B. Immediately after floating and texturing as the water sheen of the surface is disappearing, apply curing agent in two directions for total white coverage on all exposed surfaces.

C. Apply agent at twice the rate recommended by the compound manufacturer. Applying curing agent too late (after concrete dampness has disappeared) may cause work rejection by ENGINEER.

D. Eliminate thermal shock of concrete by keeping cure temperature close to ground and air temperature.

3.11 **TOLERANCES**

A. **Slab Thickness**: Not more than 1/4 inch deficient.

B. **Smoothness**:

1. Parallel to Centerline: Section 32 01 31.

2. Cross Slope: 1/4 inch in 10 feet except at cross section grade breaks.

C. **Dowel Bar**:

1. Maximum allowable skew is 0.375 inches per 12 inches (3 percent) in the horizontal and vertical planes.
2. Embedment is six (6) inches minimum.
3. Position in slab is center plus or minus 1/2 inch.

3.12 **REPAIR**

A. General: Section 03 30 10. All expenses are at no additional cost to OWNER.

B. Corrective Action for Profile Deviations ("Must Grinds"): Grinding per Section 32 01 26 is acceptable after concrete cure. Apply a water repelling product, Section 07 19 00 over grind surfaces. If depressions cannot be corrected by grinding, remove and replace.

C. Corrective Action for Profile Roughness Index: Grinding is acceptable. Re-profile corrected segments to verify ride index meets tolerance. Apply a water repelling product, Section 07 19 00 over grind areas.

D. Corrective Action for Cracks: Consider repair options published in guidelines by the American Concrete Pavement Association (ACPA). Do not begin corrective work until ENGINEER agrees with repair option. Drill test cores when necessary to determine magnitude. Fill holes with Portland cement concrete bonded to pavement with epoxy adhesive.

3.13 **OPENING TO TRAFFIC**

A. Not less than 3,000 psi compressive or 400 psi flexure strength.

END OF SECTION

SECTION 32 13 73

CONCRETE PAVING JOINT SEALANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Joints and joint sealants in horizontal concrete sidewalks, curb, gutter and roadway Pavement surfaces.

1.2 REFERENCES

A. **ASTM Standards**:

C920 Elastomeric Joint Sealants.

D545 Preformed Expansion Joint Fillers for Concrete Construction (Nonextruding and Resilient Types).

D994 Preformed Expansion Joint Filler for Concrete (Bituminous Type).

D1190 Concrete Joint Sealer, Hot-Poured Elastic Type.

D1191 Testing Concrete Joint Sealers.

D1751 Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

D1752 Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

D1851 Concrete Joint Sealers, Cold-Application Type.

D2240 Rubber Property - Durometer Hardness.

D2628 Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.

D3405 Joint Sealants, Hot-Poured, For Concrete and Asphalt Pavements.

D3406 Joint Sealant, Hot-Applied, Elastomeric-Type, for Portland Cement Concrete Pavements.

D3407 Testing Joint Sealants, Hot-Poured, For Concrete and Asphalt Pavements.

D3408 Joint Sealants, Hot-Poured, Elastomeric-Type, for Portland Cement Concrete Pavements.

D3542 Preformed Polychloroprene Elastomeric Joint Seals for Bridges.

D3569 Joint Sealant, Hot-Applied, Elastomeric, Jet-Fuel-Resistant-Type for Portland Cement Concrete Pavements.

D3575 Flexible Cellular Materials Made from Olefin Polymers.

D3581 Joint Sealant, Hot-Poured, Jet-Fuel-Resistant Type, for Portland Cement Concrete and Tar-Concrete Pavements.

D3582 Testing Joint Sealant, Hot-Poured, Jet-Fuel-Resistant Type, for Portland Cement Concrete and Tar-Concrete Pavements.

D3583 Joint Sealant, Hot-Applied, Elastomeric Type, for Portland Cement Concrete Pavements, or Joint Sealant, Hot Applied, Elastomeric, Jet Fuel Resistant Type, for Portland Cement Concrete Pavements.

D5249 Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement and Asphalt Joints.

D5893 Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.

B. **FS Standards**:

SS-S-200 Sealants, Joint, Two Component, Jet-Fuel Resistant, Cold-Applied, for Portland Cement Concrete Pavement.

1.3 SYSTEM PERFORMANCES

A. Pavement joints include longitudinal and transverse expansion joints, contraction joints, construction joints, and crack control joints.

B. Provide joint sealants that maintain watertight and airtight continuous seals.

1.4 SUBMITTALS

A. Manufacturer's certification that product was manufactured, tested and supplied meeting source quality control requirements specified herein, together with a report of the test results and the date each test was completed.

B. Manufacturer's instruction for joint preparation, type of cleaning and installation.

C. Manufacturer's product data and samples for each joint sealant product required.

D. Safety data sheets.

1.5 QUALITY ASSURANCE

A. Installation of joint systems are to follow manufacturer’s published directions.

B. For cold applied joint sealant installation, use installers approved by joint sealant supplier.

C. Obtain joint sealing materials from a single manufacturer for each different product required.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in original unopened containers or bundles with labels identifying manufacturer, product name and designation, color, expiration period for use, pot life, cure time, and mixing instructions for

multi-component materials.

B. Store and handle materials in compliance with manufacturer's recommendations to prevent deterioration; or damage due to moisture, high or low temperatures, contaminants, or other causes.

PART 2 PRODUCTS

2.1 GENERAL

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

2.2 JOINT VOID - FORMER

A. Plastic with a water stop.

B. 1/4 depth of concrete structural section.

2.3 JOINT FILLER - SHEET TYPE

A. **F-1**: Bituminous (asphalt or tar) mastic, ASTM D994. Formed and encased between two (2) layers of bituminous saturated felt or two (2) layers of glass-fiber felt.

B. **F-2**: Cane or other cellulosic fiber, ASTM D1751. Saturated with asphalt.

C. **F-3**: Granulated cork, ASTM D1751. In an Asphalt Binder; encased between two (2) layers of asphalt saturated felt or two (2) layers of glass-fiber felt.

D. **F-4**: Sponge rubber fully compressible, ASTM C1752. With resiliency recovery rate of 90 percent minimum.

E. **F-5**: Cork, ASTM C1752. Impregnated and bound with asphalt, compressible with resiliency recovery rate of 90 percent if not compressed more than 50 percent of original thickness.

F. **F-6**: Plastic foam (for cold-applied sealants only). Preformed, compressible, resilient, non-waxing, non-extruding strips of flexible, non-gassing plastic foam; non-absorbent to water and gas; 30 pounds per cubic foot density maximum, And of size and shape to control sealant depth and performance.

2.4 JOINT FILLER - BACKER ROD, TAPE, POURED FILL TYPE

A. Backer material, ASTM D5249 for cold-applied and hot-applied joint sealant in Portland cement concrete or bituminous concrete pavements joints:

1. Type 1: Round rods.
2. Type 2: Sheets or strips, laminated or skived.
3. Type 3: Poured fills that completely fills pavement joint.

2.5 **JOINT SEALANT - GENERAL**

A. Color of exposed joint sealant indicated, or if not, as selected from manufacturer's standard colors.

2.6 **JOINT SEALANT – HOT APPLIED**

A. **HAS-1**: Asphalt base type, ASTM D3405.

B. **HAS-2**: Thermoplastic type, ASTM D3581. Jet-fuel resistant without rubber unless indicated otherwise.

C. **HAS-3**: Elastic type, ASTM D1190.

D. **HAS-4**: Elastomeric type, ASTM D3406. One component, for Portland cement concrete pavements.

E. **HAS-5**: Elastomeric type, ASTM D3569. One component, jet-fuel resistant, for Portland cement concrete pavements.

2.7 **JOINT SEALANT – COLD APPLIED**

A. **CAS-1**: Elastomeric type, ASTM C920. Chemically curing, for vehicular or pedestrian use, and types of construction other than highway and airfield pavements and bridges and joint substrates indicated; Type S or M; Grade P or NS; Class 25; Use T, NT, M and O:

1. Self leveling.
2. Shore A Hardness, ASTM D2240: 40 plus or minus 5.
3. Final cure: Four (4) days maximum.
4. Service range: -10 to 150 deg F

B. **CAS-2**: Mastic type, ASTM D1851. Single or multiple component; for joints having a minimum width of 1/2 inch.

C. **CAS-3**: Coal-tar modified urethane, FS SS-S-200. One part, jet fuel resistant; Type H.

D. **CAS-4**: Elastomeric preformed polychloroprene type with lubricant adhesive and indicated movement ratio:

1. For concrete pavement seal, ASTM D2628.
2. For concrete bridge seals, ASTM D3542.

E **CAS-5**: Silicone type, ASTM D5893. Single component, non-sag or self leveling, chemically curing sealant based on polymers of polysiloxane structure intended for use in Portland cement concrete pavements.

F. **CAS-6**: Asphalt base meeting ASTM D3405.

G. **CAS-7**: Olefin polymer, ASTM D3575 as follows:

1. Tensile elongation 255 percent plus or minus 20 percent, Suffix T.
2. Tensile strength 115 psi minimum, Suffix T
3. Density 2.9 plus or minus three (3) lbs/cubic foot, Suffix W, Method A
4. Water absorption 0.025 lbs/square foot maximum, Suffix L.

2.8 **SOURCE QUALITY CONTROL**

A. Preformed Expansion Joint Fillers: Non-extruding and resilient types, ASTM D545.

B. Hot-Applied Joint Sealants:

1. Elastic type used in concrete pavements, bridges, other structures, ASTM D1191.

2. Bituminous type for Portland cement concrete and bituminous concrete pavements, ASTM D3407.

3. Elastomeric type for hydraulic concrete pavement, ASTM D3408.

C. Jet-Fuel-Resistant Joint Sealant: Hot applied, ASTM D3582 and ASTM D3583.

D. Cold-Applied Mastic Joint Sealant: Cold applied, ASTM D1851.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Remove oil, grease, wax, form-release-agents, curing compounds, bitumens, laitance and old chalking material by sandblast, or water blast as recommended by manufacturer of sealant. Maximum sand blast angle, 25 degrees plus or minus five (5) degrees.

B. Clean and dry with air blast. Do not contaminate air blast with oils or lubricants.

C. Remove frost and moisture in concrete joint substrates before commencing sealing.

D. Install bond breaker tape where needed or required by manufacturer's recommendations to ensure that elastomeric sealants will perform properly.

3.2 **JOINT SEALING**

A. General:

1. Install sealants in uniform, continuous ribbons without gaps or air pockets, with complete bonding of joint surfaces on opposite sides.

2. Except as otherwise indicated, fill sealant rabbet flush with surface.

3. Where horizontal joints are between a horizontal surface and vertical surface, fill joint to form a slight cove so that joint will not trap moisture and dirt.

B. Depths: Saw cut joints if necessary to provide the required sealant thickness and depth. Install sealant to depths indicated or, if not indicated, as recommended by sealant manufacturer, but within the following general limitations measured at center (thin) section of bead:

1. For sidewalks, pavements, and similar joints sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to a depth equal to 75 percent of joint width,

but not more than 5/8 inch deep nor less than 3/8 inch deep.

2. For normal moving joints sealed with elastomeric sealants but not subject to traffic, fill joints to a depth equal to 50 percent of joint width, but not more than 1/2 inch deep nor less than 1/4 inch deep.
3. For joints sealed with non-elastomeric sealants and caulking compounds, fill joints full depth.

C. Spillage: Do not allow poured sealant compound to overflow or spill onto adjoining surfaces or to migrate into voids of adjoining surfaces. Clean adjoining surfaces to eliminate evidence of spillage.

D. Heating: Do not use overheated hot-applied sealants.

E. Edges: Unless indicated otherwise, recess exposed edges of gasket and exposed joint fillers slightly behind adjoining surfaces so compressed units will not protrude from joints.

3.3 CURING AND CLEANING

A. Cure sealants and caulking compounds per manufacturer's instructions and recommendations to obtain high early bond strength, internal cohesive strength and surface durability.

B. Clean off excess sealants or sealant smears adjacent to joints as work progresses. Use methods and cleaning materials approved by manufacturers of joint sealant and of products in which joints occur.

C. Remove protective coating and oil from metals with solvent recommended by the sealant manufacturer.

3.4 PROTECTION

A. Protect joint sealant during and after curing period from contact with contaminating substances or from damage resulting from deterioration or damage at time of substantial completion.

B. If damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealant immediately and reseal joints with new materials to produce joint sealer installations with repaired areas indistinguishable from original work at no additional cost to OWNER.

END OF SECTION

SECTION 32 15 40 - CRUSHED STONE SURFACING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes constructing universally accessible crushed stone walks on a prepared subgrade.

1.2 SUBMITTALS

A. Submit sieve analysis of proposed material to ensure it meets grading requirements.

B. Submit 1-gallon sample of crushed aggregate screenings for approval. Sample must clearly illustrate the functional characteristics, and full range of color and texture of the material.

C. Sieve analysis and color of crushed aggregate screenings shall be approved in writing by the Contracting Officer before any material is delivered to the project site.

D. Prepare a sample finished section using all specified materials and edging. Sample section shall be 5'x5'. Sample section shall be approved in writing by the Contracting Officer before the project stabilized crushed stone area is constructed.

E. Submit product data sheet and sample of non-woven geotechnical fabric

F. Submit product data sheet and sample of soil stabilizer

PART 2 - PRODUCTS

2.1 CRUSHED AGGREGATE SCREENINGS

A. Clean, hard, durable particles or fragments of ¼-inch minus select gray crushed river rock or basalt. Fines shall be evenly mixed throughout the aggregate. When produced from gravel 50 percent by weight of the material retained on a No. 4 sieve shall have one fractured face. Color to be approved by Contracting Officer.

B. The portion retained on the No. 4 sieve shall have a maximum percentage of wear of 50 at 500 revolutions as determined by AASHTO T96-77.

C. The portion passing a No. 4 sieve shall have a maximum liquid limit of 25 and a maximum plasticity index of 7, as determined by AASHTO T89-81 and AASHTO T90-81, respectively.

D. The crushed aggregate screenings shall be free from clay lumps, vegetable matter and deleterious material.

2.2 GRADING REQUIREMENTS

Percentage of Weight Passing a Square Mesh Sieve
AASHTO T11-82 and T27-82

Sieve Designation	Percent Passing	Sieve Designation	Passing
1/4 Inch	100	No. 30	40-50
No. 4	90-100	No. 50	25-35
No. 8	75-80	No. 100	15-20
No. 16	55-65	No. 200	10-15

2.3 SOIL STABILIZER

A. Stabilizer, a non-toxic, colorless, odorless, non-staining, concentrated organic powder that binds soil and crushed aggregate screenings together, creating a natural-appearing, firm trail surface. Stabilizers manufactured by Stabilizer Solutions, Inc. 33 South 28th Street. Phoenix, AZ 85034. Tel: 800-336-2468. Fax: 602-225-5902 or approved equal.

2.4 FORMS

A. Steel edging as detailed in plans shall be used in lieu of forms.

2.5 GEOTEXTILE FABRIC

A. Typar 3401 thermally spunbonded polypropylene, non-woven, thin geotextile weed control fabric. 4.0 oz/lineal yard weight Needle punched material is not acceptable.

1. Acceptable distributors include, but are not limited to:

a. GSM International 801-455-3369 , or approved equal

PART 3 - EXECUTION

3.1 GROUND SURFACE PREPARATION

A. Clear and grub site. Strip the top 4 inches of topsoil within the designated trail corridor and exhibit areas. Stockpile at onsite location designated by the Contracting Officer.

3.2 SUBGRADE PREPARATION

A. Prior to placing base course, shape, fill, grade, and compact the subgrade.

3.3 GEOTEXTILE FABRIC

A. Fabric shall be installed between the compacted base course and crushed aggregate screenings to prevent weeds from growing up through the crushed stone trail; pre-emergent chemicals may not be used. Place fabric across the entire width of trail surface to receive aggregate; overlap ends of rolls a minimum of 6 inches.

3.4 SOIL STABILIZER

A. Thoroughly pre-blend Stabilizer with the ¼-inch minus crushed aggregate screenings, at the rate of 10 lbs. Of Stabilizer per ton of aggregate screenings prior to placing of Stabilized mix. It is essential that Stabilizer be mixed thoroughly and uniformly through the crushed aggregate screenings to achieve a successful result. The Stabilizer locks the fines together, trapping the larger crushed aggregate screenings; Stabilizer does not act directly on the larger aggregate screenings. Blending is best accomplished with a truck-mounted mixer; a portable mechanical mixer may be used. Blend for minimum of 15 minutes prior to placing on subgrade.

B. Drop spreading of Stabilizer over raked crushed aggregate screenings and mixing Stabilizer by rototilling is not acceptable.

C. Soil stabilizer shall not be applied during, just prior to, or immediately following rainfall.

3.5 PLACING CRUSHED AGGREGATE SCREENINGS

A. After pre-blending, place the Stabilized crushed aggregate screenings (CAS) on prepared subgrade, and rake smooth using a steel tine rake to desired grade and cross section. Place to avoid segregation in one layer of 3 inches minimum thickness. Do not apply CAS deeper than 3 inches in one lift. Ex: For a 4-inch thickness, apply CAS in two 2-inch lifts.

3.6 WATERING

A. Water heavily to achieve full depth moisture penetration of the aggregate mix. Watering is best accomplished using a spray nozzle set to a coarse spray; pressure should not disturb leveled trail surface. A one-hour application at a rate of 20 gpm per 1,000 sq. ft of trail mix surface will achieve the desired full depth moisture penetration. Water activates Stabilizer; consequently, it is essential that the full depth of Stabilized trail material is saturated. Test for depth of water penetration by random inspection of trail cores. After inspection, fill core holes with material removed, smooth and hand tamp to match the adjoining trail surface grade. (Let watered trail mix stand 6-24 hours until surface water is no longer present; the trail mix should then be moist but not wet.)

3.7 COMPACTION

A. While the aggregate mix is still thoroughly moist, roll with a heavily lawn roller (minimum 225 ponds and maximum 30-inch width (, to achieve finish grade and initial compaction. Hand tamp edges around benches, signposts, interpretative exhibits, etc. Use a heavy (1 ton minimum) small rider, after having initially used the lawn roller, to obtain the desired final dense, smooth, uniform texture. DO NOT USE plate compactor or vibratory rollers as the trail mix will not harden for weeks if this method is used.

3.8 INSPECTION

A. Finished surface of trail shall be smooth, uniform and solid, with no evidence of chipping or cracking. Dried, compacted trail material shall be firm all the way through with no spongy areas. Loose material shall not be present on the surface initially. After the first year of use, a minor amount of loose material is expected on the surface.

B. Loose gravel on the surface, or unconsolidated crushed aggregate screenings below the surface, is evidence of improper bonding due to poor mixing or insufficient watering. Test the loose material for adequate Stabilizer by wetting, then tamping, and allowing it to dry. If the material still is unconsolidated, Stabilizer did not get mixed adequately throughout the crushed aggregate screenings. If the material now is solid, initial watering was insufficient. Cracking or sponginess is evidence of excessive Stabilizer in the mix.

C. Unconsolidated areas shall be dug out and be replaced with new crushed aggregate screenings with a high proportion of fines meeting the grading requirements of Section 2.2 above, pre-blended with Stabilizer per the procedures listed under Section 3.7A above. Patched areas then shall be wetted thoroughly and rolled smooth. Patching shall be completed prior to any trail smoothing required.

D. Any significant irregularities shall be smoothed out prior to final acceptance of work. Smoothing shall be accomplished by rewetting/saturated rough areas thoroughly, and then rolling the trail again with a heavy roller (1000-1500 lbs. powered walk-behind or small rider). Plate compactor are not recommended.

E. Final thickness of completed trail shall not vary more than ½ inch from dimension indicated. Measurements may be taken by means of test holes taken at random in finished trail surface. Correct any variations in the thickness beyond the allowable ½ inch by repeating the procedures listed under Sections 3.7-3.11 above.

F. Final width of completed trail shall not vary more than ½ inch from typical dimension indicated. Measurements may be taken at random cross sections in the finished trail surface.

G. No edges of geotextle fabric shall be exposed.

END OF SECTION

SECTION 32 16 13

DRIVEWAY, SIDEWALK, CURB, GUTTER

PART 1 GENERAL

1.1. **SECTION INCLUDES**

A. Concrete flat work such as waterways, waterway transition structures, sidewalks, curb, gutters, Driveway Approaches, etc.

1.2 **REFERENCES**

A. **APWA (Utah) Standards**:

Plan 205 Curb and gutter.
Plan 206 Curb and gutter dowel tie-in.
Plan 209 Curbs.
Plan 211 Waterway.
Plan 213 Waterway transition structure.
Plan 215 Dip driveway approach.
Plan 216 Mountable curb driveway approach.
Plan 221 Flare driveway approach.
Plan 225 Open driveway approach.
Plan 229 Pipe driveway approach.
Plan 231 Concrete sidewalk.

B. **ASTM Standards**:

A36 Structural Steel.
C39 Compressive Strength of Cylindrical Concrete Specimens.
C172 Sampling Freshly Mixed Concrete.

1.3 **DEFINITIONS**

A. **Driveway**: A paved or unpaved vehicular thoroughfare outside of, but connected to a public road right-of-way or highway right-of-way.

B. **Driveway Approach**: A paved or unpaved vehicular thoroughfare connecting a public road or highway to a Driveway.

1.4 **SUBMITTALS**

A. Traffic control plan, Section 01 55 26.

B. Concrete mix design, Section 03 30 04.

C. Batch ticket, Section 03 30 10.

1.5 **QUALITY ASSURANCE**

A. If requested, submit a quality control and testing report describing source and field quality assurance activities performed by CONTRACTOR and Suppliers.

1.6 **NOTICE**

A. Follow Laws and Regulations concerning when and to whom notices are to be given at least two (2) days before work starts.

B. Indicate when concrete work will take place and when driveway approach can be used.

C. Warn of potential vehicle tow away and other construction issues affecting neighborhood.

D. Should work not occur on specified day, send a new notice.

1.7 **ACCEPTANCE**

A. **General**:

1. Acceptance is by lot. One lot is one day production.
2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring material as part of its installation, Section 01 29 00.
3. Dispute resolution, Section 01 35 10 and Section 03 30 05.

B. **Concrete Mix**:

1. Testing Frequency: Section 03 30 05. Sample per ASTM C172.
2. Temperature, Slump, Air: Lot size is 1 random batch. Reject non-complying batches until two (2) consecutive batches are compliant then proceed in random batch testing for acceptance.
3. Strength: Lot size is 50 cubic yards. At ENGINEER's discretion and ASTM C39, a lot with deficient sub-lot strength may be accepted if pay is adjusted using one of the following applicable pay factors, or accepted at 50 percent pay if a sub-lot is in Reject.

Pay Factor	**PSI Below 28 days Compressive Strength**
0.98	1 to 100
0.94	101 to 200
0.88	201 to 300
0.80	301 to 400
Reject	Greater than 400

C. **Placement**, Section 03 30 10:

1. Verify line, grade, cross slope, finish and dimensions.
2. No standing water in curb and gutter.
3. Membrane curing compound applied for total coverage at two (2) times manufacturer's recommended rate in two (2) directions after finishing and texturing.

PART 2 PRODUCTS

2.1 MATERIALS

A. Concrete Mix:
   1. Class 4000 cast-in-place, Section 03 30 04.
   2. Slump range per mix design.

B. Reinforcement: Grade 60 ksi galvanized or epoxy coated steel, Section 03 20 00, deformed.

C. Expansion Joint Filler: F1 sheet 1/2 inch thick, Section 32 13 73.

D. Contraction Joint Filler (Backer Rod): Closed cell, Type 1 round, Section 32 13 73.

E. Contraction Joint Sealer: HAS1 or HAS4 hot applied, Section 32 13 73.

F. Curing Compound: Membrane forming compound, Section 03 39 00.

G. Plate Steel: Galvanized Steel, ASTM A36, Section 05 05 10.

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. Slip Form Machines:
   1. Placement must produce required cross-section, line, grade, finish, and jointing as specified for formed concrete.
   2. If results are not acceptable, remove and replace work with formed concrete.

3.2 PREPARATION

A. Implement notification and traffic control plan requirements, Section 01 55 26.

B. Examine surfaces scheduled to receive concrete formwork for defects.

C. Do not start work until defects are corrected.

D. Check slopes on each side of the work to ensure drainage. Failure to check and verify will result in CONTRACTOR repairing any drainage deficiencies at no additional cost to OWNER.

3.3 CONCRETE PLACEMENT

A. Section 03 30 10.

B. Make sure base course is uniformly damp at time of concrete placement.

C. Obtain ENGINEER's review of base course and forms before placing concrete.

D. Do not use methods that segregate the mix.

E. Place concrete so time between end of placement and beginning of finishing is less than 15 minutes.

F. Consolidate concrete with vibrator or other acceptable method. Do not use mechanical vibrators. Prevent dislocation of inserts.

3.4 CONTRACTION JOINTS

A. Section 32 13 73.

B. Geometrics:

1. Tooled Joints (Score Lines):
   a. Depth = T/4. T is the depth of the concrete slab in inches.
   b. Top radius = 1/2 inch.
2. Saw Cut Joints: Saw joints before uncontrolled shrinkage cracking occurs. Do not tear or ravel concrete during sawing.
3. Template Joints: 1/8 to 3/16 inch wide 1/4-depth of slab.

C. Sidewalks.

1. At intervals equal to the width of the sidewalk and transverse to the line of walk.
2. Radial at curbs and walk returns.
3. Place longitudinal joints in walks when width of walk in feet is greater than two (2) times the walk thickness in inches. (e.g. maximum width of a four (4) inch thick walk before placement of a longitudinal contraction joint is eight (8) feet). Make longitudinal joints parallel to, or concentric with, the lines of the walk.
4. In walk returns make at least one (1) radial joint midway between beginning of curb returns (BCR) and end of curb returns (ECR). Match longitudinal and traverse joints with joints in adjacent walks.

D. Curb, Gutter, Waterway:

1. Place joints at intervals not exceeding 12 feet.
2. At curb radius and walk returns make joints radial.
3. Where integral curb and gutter is adjacent to concrete pavement, align joints with pavement joints where practical.

3.5 EXPANSION JOINTS

A. General: Section 32 13 73:

1. 1/2 inch wide full depth filler that is flush with concrete surface. Do not place seal over top of joint filler.

B. Sidewalks:

1. Place expansion joints to separate sidewalk from utility poles, hydrants, manhole frames, buildings and abutting sidewalks.
2. Place expansion joints between sidewalk and back of curb returns and between sidewalk and sidewalk ramps.
3. Do not place expansion joints in sidewalk ramp surfaces.

4. Expansion joints are not required when using slip form method to place concrete except where sidewalk changes direction or where it joins foundation walls or structures.

C. Curb, Gutter, Waterway:
   1. Do not place longitudinal joint in drain gutter flow-line.
   2. Where drain gutter transitions extend beyond curb return, place expansion joints at ends of drain gutter transition.
   3. Place expansion joints at beginning of curb radius (BCR) and at end of curb radius (ECR).

D. Curb and Gutter Dowel Te-in: Follow APWA Plan 206 requirements. Tie-in occurs between new and existing curb and gutter.

E. Slip Form Work: Expansion joints are not required except at BCR or ECR.

F. Driveway Approach: Do not place expansion joints in curb returns.

G. Street Intersection Corner: Place expansion joints at BCR and ECR.

3.6 **FINISH**

A. Section 03 35 00.

B. Round edges exposed to public view to a 1/2 inch radius.

C. Apply broom finish longitudinal to curb and gutter flow-line.

D. Apply broom finish transverse to sidewalk centerline as follows:
   1. Fine hair finish where grades are less than six (6) percent.
   2. Rough hair finish where grades exceed six (6) percent.

E. Remove form marks or irregularities from finish surfaces.

3.7 **TOLERANCES**

A. Curb, Gutter, Curb and Gutter: APWA Plan 205, 209, 211, 213.
   1. Line: Less than 1/2 inch variance in 10 feet and not more than 1 inch from true line at any location.
   2. Grade: Not more than 1/4 inch variance in 10 feet. Flood curb and gutter with water after final set has been reached. Remove and replace any area where ponding is found.
   3. Standing Water: None allowed.

B. Sidewalk: APWA Plan 231:
   1. Cross slope one (1) percent minimum, two (2) percent maximum.
   2. Standing Water: None allowed.

C. Driveway Approach: APWA Plan 215, 216, 221, 225, 229.

3.8 **CURING**

A. Section 03 39 00.

B. Curing compound: Apply at two (2) times manufacturer's recommended rate. Apply total coverage in two (2) directions after texturing.

C. Eliminate thermal shock of concrete by keeping cure temperature even throughout extent and depth of concrete slab.

3.9 **PROTECTION AND REPAIRS**

A. General: All expenses are at no additional cost to OWNER.

B. Protection: Section 03 30 10:

1. Protect concrete work from deicing chemicals during the 28 days cure period.

2. Immediately after placement, protect concrete from graffiti or other types of mechanical injury.

C. Repair: Section 03 30 10. Consider also guidelines published by the American Concrete Pavement Association (ACPA). Do not begin corrective work until ENGINEER agrees with repair option:

1. Correct all humps or depressions.

2. Standing Water: Remove and replace any area where ponding is found. If necessary, flood construction to determine ponding extent.

3. Restore surfaces damaged by saw cutting, grinding, or removal operations.

END OF SECTION

SECTION 32 17 23

PAVEMENT MARKINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Words, striping, and other pavement markings.

B. One-way or two-way prismatic reflectors.

1.2 REFERENCES

A. **AASHTO Standards**:

M237 Epoxy Resin Adhesive for Bonding Traffic Markers to Hardened Concrete.

M247 Glass Beads Used in Traffic Paint.

M248 Ready-Mixed White and Yellow Traffic Paints.

M249 White and Yellow Reflective Thermoplastic Striping Material (Solid Form).

B. **ASTM Standards**:

D638 Tensile Properties of Plastics.

E303 Measuring Surface Frictional Properties Using the British Pendulum Tester.

E1710 Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer.

C. **DOT Standards**:

MUTCD Manual on Uniform Traffic Control Devices for Streets and Highways.

1.3 DEFINITIONS

A. **Retroreflective**: Majority of reflected light is directed back to the light source.

1.4 SUBMITTALS

A. Product data for primer to be used for tape applications.

B. Manufacturer's affidavit certifying paint products meet or exceed material requirements of this section.

C. Sample of prismatic reflector to be used along with manufacturer's statement of the reflector's minimum reflective area and specific intensity at the 0.2 degrees observation angle.

D. Manufacturer's recommendation for type of adhesive to be used.

E. Samples of each thermoplastic or preformed plastic pavement markings along with manufacturer's instructions of how the materials are to be applied.

1.5 **QUALITY ASSURANCE**

A. At the end of the correction period, pavement markings, when applied according to the recommendations of the manufacturer, show a neat, durable marking with no flow or distortion due to temperature if the pavement surface remained stable. The tape shows no appreciable fading, lifting or shrinkage, and no significant tearing, roll back or other sign of poor adhesion.

1.6 **WEATHER**

A. Apply pavement striping and markings only when pavement surface is dry and air temperature is above 40 deg F during daylight hours.

B. Do not apply pavement striping and markings when rain is anticipated within 12 hours.

PART 2 PRODUCTS

2.1 **GLASS BEADS**

A. AASHTO M247.

2.2 **FILM AND ADHESIVE**

A. **Film**: A pliant polymer with retroreflective glass beads distributed throughout its cross-sectional area and bonded to its top surface. The film is selected and blended to conform to standard white or yellow highway colors and has a minimum thickness of 0.06 inches at pattern height.

1. Skid Resistance: 35 BPN minimum, ASTM E303.
2. Tensile Strength: ASTM D638. Using a Sample size 6 x 1 inch, a temperature between 70 and 80 deg F, and a test jaw speed of 10 to 12 inches per minute, the film has an elongation of 75 percent maximum at break and a strength as follows.
   a. Type 1: 150 pounds minimum tensile strength per square inch of cross-section area.
   b. Type 2: 40 pounds minimum tensile strength per square inch of cross-section area.
3. Reflectivity: Meet film reflectivity in the following table.

Table 1 - Film Reflectivity

Application	Tensile Strength	Color	
		White	Yellow
Non-residential	Type 1	500	350
Residential	Type 2	300	250

NOTES
(a) Follow ASTM E1710 procedures using 30 meter test distance, an entrance angle of 88.76 degrees, and an observation angle of 1.05

degrees.
(b) Reflectivity is measured in millicandelas per square foot per footcandle (mcd/sf/fc).

B. **Adhesive**:

1. Class 1: Without pre-coated adhesive for applications with surface preparation adhesive recommended by the manufacturer at temperatures of 40 deg F or above and moderate humidity.
2. Class 2: With pre-coated pressure sensitive adhesive with minimum adhesion value of 1.1 pounds per inch width, AASHTO M237

2.3 **PAINT**

A. Alkyd type F (fast dry) ready-mix, AASHTO M248.

B. Thermoplastic, AASHTO M249.

2.4 **PRISMATIC REFLECTORS**

A. Unless indicated otherwise, provide single lens snowplow resistant reflectors of the color indicated:

1. With a cast iron housing and acrylic prismatic reflector.
2. With an overall size not less than nine (9) inches long, five (5) inches wide, and 1-3/4 inch thick with a 7/16 inch maximum projection above its base.
3. With a minimum reflective area of 1.6 square inches per face.

B. Reflector Specific Intensity: Meet intensity in the following table.

Table 2 - Intensity

Color	Entrance Angle	
	0 Degrees	20 Degrees
White	3.0	1.2
Yellow	1.8	0.72

NOTES
(a) Intensity measured at 0.2 degree observation angle.

PART 3 EXECUTION

3.1 **CONSTRUCTION EQUIPMENT**

A. Use equipment manufactured for pavement marking. Use workers experienced in operating such equipment.

B. Use equipment capable of applying a strip, or strips with a width tolerance of plus or minus 1/4 inch. Equip machine with an automatic skip control giving a 10 feet long marked segment and a 30 feet long gap within a linear tolerance of six (6) inches over that cycle.

C. If applying glass beads, locate bead applicator directly behind and synchronized with marking applicator.

D. For thermoplastic paint materials, use equipment that is designed to

agitate the paint to prevent scorching, discoloration, or excessive high temperatures.

3.2 PREPARATION

A. **General**: DO NOT begin pavement painting and marking operations without ENGINEER's knowledge of such activity.

B. **Repair of Receiving Surface**: Method of payment to be determined by ENGINEER if any of the following repairs are required.

1. Raising low areas to grade, lowering high areas to grade, hole patching, inlays.
2. Crack sealing and crack repairing, Section 32 01 17.
3. Pushing or shoving pavement repair.
    a. Mill damaged area at least three (3) inches below required surface elevation.
    b. Install and compact three (3) inches of bituminous concrete, Section 32 12 16.13. ENGINEER to determine Mix Designator.

C. **Traffic Control**:

1. Implement notification and traffic control plan requirements, Section 01 55 26. Provide safe passage for pedestrians and vehicles. Do not proceed without certified flaggers if work requires.
2. Grind off confusing pavement markings and lane stripes.

D. **Cleaning**: Broom or flush the surface to remove dirt, loose stones, or other foreign material. For better adhesion results clean the surface using high velocity compressed air.

E. **Mark Roadway**: Mark roadway between control points established by ENGINEER. ENGINEER will establish points on tangent at least every 100 feet and at 25 feet long intervals on curves. Maintain the line within 1 inch of the established control points. ENGINEER may also designate other pavement striping locations such as stop bars, crosswalks, zebra striping, etc.

F. **Markings**: Markings that adhere to bituminous concrete or Portland cement concrete by either a pressure sensitive pre-coated adhesive or an epoxy cement shall mold to the pavement contours by traffic action at normal pavement temperatures and shall be ready for traffic immediately after application.

3.3 INSTALLATION - ALKYD RESIN PAINT STRIPING

A. Adjust pavement striping machine to apply paint at rate recommended by paint manufacturer. Provide two (2) applications over new pavement (pavement correction period has not expired)

B. Glass Bead Application Rate (Final Application): 5.9 to 6.1 pounds per gallon of paint.

C. Protect the markings until dry by placing approved guarding or warning device wherever necessary. Remove any markings not authorized or smeared or otherwise damaged, or correct as approved by ENGINEER.

3.4 INSTALLATION - THERMOPLASTIC PAINT STRIPING

A. Clean off dirt, glaze, and grease before pre-striping.

B. Pre-stripe the application area with a binder material that will form, when sprayed, a continuous film over pavement surface, and will dry rapidly and mechanically adhere to pavement surface. Install material in varying widths if indicated.

C. At a temperature recommended by the equipment manufacturer, extrude thermoplastic material from equipment that is proven to produce a line 1/8 inch to 3/16 inch thick, continuous, uniform in shape and has clean and sharp dimensions.

D. Do not use material that produces fumes that are toxic, obnoxious, or injurious to persons or property.

E. Apply so finished lines have well-defined edges free of waviness.

F. Glass Bead Application Rate: Six (6) pounds of glass beads to every 100 square feet of marking.

3.5 INSTALLATION - TAPE STRIPING

A. Apply pavement marking tape as indicated or directed. ENGINEER will establish control points.

B. Apply tape only on surfaces that are dry and free of oils, grease, dust and dirt, and primed at the rate of approximately 1 quart per 60 feet with an approved primer material.

C. Maintain the line on established control points. Apply intermittent pavement marking tape 24 inches long, spaced approximately 100 feet on tangents, and approximately 25 feet on curves unless otherwise directed. The ENGINEER will designate other pavement striping locations such as stop bars, crosswalks, zebra striping, etc.

D. Press down tape immediately after application until it adheres and conforms to pavement surface.

E. Completely remove all tape on sections where tape conflicts with revised traffic lanes before opening new lanes to traffic.

3.6 INSTALLATION PAVEMENT MARKING FILMS

A. Apply before traffic is allowed on freshly paved surface.

B. Unless indicated otherwise, provide Type 1, Class 2, polymer film markings in specified widths and shapes. Provide and layout words and marking symbol configurations per MUTCD requirements and as indicated.

C. When indicated, inlay markings in fresh bituminous concrete pavement with a compaction roller during the paving operation.

D. Apply all markings in accordance with manufacturer's recommendations.

3.7 INSTALLATION - PRISMATIC REFLECTORS

A. Install reflectors by cutting pavement and partially filling cut area with epoxy adhesive. Place reflector housing in the adhesive and apply pressure to properly seat. Allow epoxy to completely set before allowing traffic on markers.

B. Install markers so that housing top surface and edges are flush with pavement surface.

3.8 **INSTALLATION - WORDS, SYMBOLS AND OTHER MARKINGS**

A. Wet sandblast existing or temporary pavement markings that may be confusing. Removal of markings by high-pressure water may be used if approved by ENGINEER.

B. Apply word markings, letters, numerals and symbols with indicated stencils and templates. In the absence of such information all stencils and templates shall be identical to those currently used by OWNER.

3.9 **REPAIR**

A. Before the end of the correction period, renew stripes and markings if original visual effectiveness is reduced by 50 percent.

END OF SECTION

SECTION 32 91 19
LANDSCAPE GRADING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Landscape grading requirements.

B. Backfill materials.

1.2 SUBMITTALS

A. Submit maximum laboratory dry density and optimum laboratory moisture content for:

1. Subgrade material, and

2. Each type of fill to be used.

1.3 QUALITY ASSURANCE

A. Do not change material sources, or aggregate without ENGINEER's knowledge.

B. Reject backfill material that does not comply with requirements in this Section.

C. Landscape grading is aesthetic by nature and subject to continual monitoring and modification during the backfilling process. Work closely with ENGINEER particularly when grading and construction berms, channels, or other aesthetic considerations.

D. If requested, submit a quality control and testing report describing source and field quality assurance activities performed by CONTRACTOR and Suppliers.

1.4 STORAGE

A. Safely stockpile backfill materials.

B. Separate differing materials, prevent mixing, and maintain optimum moisture content of backfill materials.

C. Avoid displacement of and injury to Work while compacting or operating equipment.

D. Movement of construction machinery over Work at any stage of construction is solely at CONTRACTOR's risk.

1.5 SITE CONDITIONS

A. Do not place, spread, or roll any backfill material over material that is damaged by water. Remove and replace damaged material at no additional cost to OWNER.

B. Control traffic and erosion. Keep area free of trash and debris. Repair settled, eroded, and rutted areas.

C. Reshape and compact damaged structural section to required density.

1.6 **ACCEPTANCE**

A. Native material may be wasted if there is no additional cost to substitute material acceptable to ENGINEER.

B. For material acceptance refer to:

1. Common fill, Section 31 05 13.
2. Crushed aggregate base, Section 32 11 23.
3. Cement treated fill, Section 31 05 15.

1.7 **WARRANTY**

A. Any settlement noted in landscaped surfaces will be considered to be caused by improper compaction methods and shall be corrected at no additional cost to the OWNER.

B. Restore incidentals damaged by settlement at no additional cost to OWNER.

PART 2 PRODUCTS

2.1 **BACKFILL MATERIALS**

A. Common fill, Section 31 05 13.

B. Cement treated fill, Section 31 05 15.

C. Crushed aggregate base, Section 32 11 23.

D. Structural soil mix, Section 32 91 13.

2.2 **WATER**

A. Make arrangements for sources of water during construction and make arrangements for delivery of water to site.

B Comply with local Laws and Regulations at no additional cost to OWNER when securing water from water utility company.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Implement traffic control plan requirements, Section 01 55 26.

B. Identify required line, levels, contours, and datum.

C. Stake and flag locations of underground utilities.

D. Upon discovery of unknown utility or concealed conditions, notify ENGINEER.

E. Verify stockpiled fill meets gradation requirements, areas to be backfilled are free of debris, snow, ice or water, and ground surface is not frozen.

F. If subgrade is not readily compactable secure written authorization for

stabilization excavation and backfill. Refer to Section 31 23 16.

3.2 **PROTECTION**

A. Protect existing trees, shrubs, lawns, existing structures, fences, roads, sidewalks, paving, curb and gutter and other features.

B. Protect above or below grade utilities. Contact utility companies to repair utility damage. Pay all cost of repairs.

C. Protect subgrade from desiccation, flooding and freezing.

D. Do not fill adjacent to structures until Excavation is checked by ENGINEER.

E. Do not use compaction equipment adjacent to walls or retaining walls that may cause wall to become over-stressed or moved from alignment.

F. Do not disturb or damage foundation perimeter drainage, foundation, damp-proofing, foundation waterproofing and protective cover, or utilities in trenches.

G. Restore any damaged structure to its original strength and condition.

3.3 **LAYOUT**

A. Maintain all benchmarks, control monuments and stakes, whether newly established by surveyor or previously existing. Protect from damage and dislocation.

B. If discrepancy is found between Contract Documents and site, ENGINEER shall make such minor adjustments in the Work as necessary to accomplish the intent of Contract Documents without increasing the Cost of the Work to CONTRACTOR or OWNER.

3.4 **BACKFILLING**

A. General: Conduct work in an orderly manner. Do not create a nuisance. Do not permit soil accumulation on streets or sidewalks. Do not allow soil to be washed into sewers and storm drains.

B. Grading Intent: Spot elevations and contours indicated are based on the best available data. The intent is to maintain constant slopes between spot elevations. If a spot elevation is determined to be in error, or the difference in elevation between points change, then the minimum percentage of slope as a result of field adjustment of specific spot elevations is as follows:

1. Pavement Areas: 1 percent.
2. Concrete or Brick Areas: 0.30 percent.
3. Lawn or Planted Area: 0.75 percent.

C. Planted Surfaces:

1. Place backfill to a finished grade.
2. Grade slopes to provide adequate drainage after compaction. Do not create water pockets or ridges. Prevent erosion of freshly graded areas during construction until surfaces have been constructed and landscaping areas have taken hold.
3. Remove surface stones greater than 1 inch from finished grading.

D. Hard Surfaces: Place structural soil to depth specified.

3.5 **MODIFIED BACKFILL LAYER METHOD**

A. Section 33 05 20.

3.6 **COMPACTION**

A. Ninety-two (92) percent relative to a standard proctor density, Section 31 23 26, unless indicated elsewhere.

3.7 **SURFACE FINISHING**

A. Restore paved surfaces, Section 33 05 25.

B. Finish landscaped surfaces to match existing with grass, Section 32 92 00 or with other ground cover, Section 32 93 13.

1. Backfill areas to contours and elevations required. Do not use frozen materials.
2. Make smooth changes in grade. Blend slopes into level areas.
3. Remove surplus backfill materials from site.
4. Leave stockpile areas completely free of excess fill materials.
5. Slope grade away from building at a minimum of five (5) percent for ten (10) feet unless indicated otherwise.

3.8 **CLEANING**

A. Remove stockpiles from the site. Grade site surface to prevent free standing surface water.

B. Leave borrow areas clean and neat.

END OF SECTION

SECTION 32 93 13
GROUND COVER

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Plants and ground cover requirements.

B. Bedding, topsoil, and temporary support.

1.2 **REFERENCES**

A. **AAN Standards**:

B. **ANSI Standards**:

Z60.1 American Standard for Nursery Stock.

C. **FS Standard**:

OF 241 Fertilizers, Mixed, Commercial.

1.3 **QUALITY ASSURANCE**

A. Perform work in conformity with applicable requirements of AAN.

B. Obtain nursery stock and other plant materials from acceptable sources.

C. Provide plants free of disease and insects.

1.4 **SUBMITTALS**

A. Submit samples of fertilizers and a complete listing of all plantings, origins and sizes.

B. All necessary inspection certificates for each shipment of plants as required by Laws and Regulations.

C. Schedule of planting times.

1.5 **DELIVERY, STORAGE, AND HANDLING**

A. Exercise care in digging, transporting, handling, and packing of all plants.

B. Handle plants so roots are protected at all times. If delivery is in open vehicles, cover entire load without causing over heating.

C. Deliver plant materials immediately before placement. Keep plant materials moist.

D. Protect balls from sun and wind by covering with soil or other suitable material if not planted immediately on delivery.

E. Store fertilizer in a weatherproof location such so its effectiveness will not be impaired.

1.6 **ACCEPTANCE**

A. Ball of earth surrounding roots has not been cracked or broken.

B. Burlap, staves, and ropes required in connection with transplanting are installed.

C. Heeled in stock from cold storage not accepted.

1.7 **WARRANTY**

A. Warrant plantings through one year plus one continuous growing season. Replace any unsatisfactory or dead plantings within 10 days of written notice. Make corrections at no additional cost to OWNER.

PART 2 PRODUCTS

2.1 **GENERAL**

A. Provide plants of normal growth and uniform height, according to species, with straight canes and well developed leaders, roots, and tops.

B. Provide plants of sizes indicated, Size stated in each case being interpreted to mean dimensions of plant as to stands in its natural position in nursery without straightening of any branches or leaders.

C. Provide legible labels attached to all plants, specimens, bundles, boxes, bales, or other containers indicating botanical genus, species, and size of each.

D. Plants cut back from larger sizes to meet Specifications shall be rejected.

E. Container growth deciduous shrubs will be acceptable in lieu of bailed and burlapped deciduous shrubs subject to limitations for container grown stock.

2.2 **NATIVE GRASSES AND WILDFLOWERS**

A. Unless indicated otherwise, provide the following mixture: 77 percent Festuca ovina duriuscula (Hard Fescue) and 23% Wildflower seeds of equal proportioned quantities of the following, Aster alpinus (Alpine Aster), Campanual carpatica 'Jacqueline' (Bluebells), Coreopsis grandiflora 'Sunray' (Dwarf Coreopsis), Eschschlzia californica (California Poppy), linum Lewisii (Blue Flax), Primula (While Primrose), Tagetes (Marigold), Viguiera Multiflora (Showy golden eye).

B. Purity of all seed types: 90 percent.

C. Germination of all seed types: 90 percent.

2.3 **ORGANIC MULCH**

A. Horticultural grade Class A decomposed plant material, elastic and homogeneous, free of decomposed colloidal residue, wood sulphur, and iron.

B. pH value of 5.5 to 7.5.

C. 60 percent organic matter by weight, moisture content not exceeding 15 percent, and water absorption capacity of not less than 300 percent by

weight on oven dry basis.

2.4 **ACCESSORIES**

A. Fertilizer, FS O-F-241: Uniform in composition, dry and free flowing. Provide nutrients required by soil analysis.

B. Wrapping Materials: Quality burlap tightly tied around plant root system.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Plan to install materials during normal planting seasons for each type of landscape work required. Correlate planting time with maintenance periods and warranty.

B. Verify area to receive plants is to grade, all work is completed in the area, and topsoil has been placed. Follow Section 31 23 23 grading requirements.

C. Do not proceed with work until unsatisfactory conditions have been corrected.

D. Examine grade, verify elevations, observe conditions under which work is to be performed, and notify ENGINEER of unsatisfactory conditions.

3.2 **GRADING**

A. Site tolerances:

1. 12 inches minimum total topsoil depth.
2. 2 inches below walks, hard surfaces or edges.

B. Do not expose or damage existing shrub or tree roots.

C. Slope away from building five (5) percent for 10 feet minimum. Fill low spots and pockets. High point of finish grade shall be at least six (6) inches below finish floor level.

3.3 **FERTILIZING SEEDED AREAS**

A. Apply fertilizer in formulation and quantity required by soil analysis.

B. Apply after fine grading and mix thoroughly into upper two (2) inches of topsoil.

C. Do not apply seed and fertilizer at same time in same machine unless one step hydro seeding is used.

D. Lightly water to aid breakdown of fertilizer and to provide moist soil for seed.

3.4 INSTALLATION

A. Place plant materials for orientation approval by ENGINEER before installation.

B. Set all shrubs slightly lower than finished grade. Use plant mix consisting of three (3) parts topsoil and 1 part organic mulch. Do not fill around stems. Carefully place and tamp plant mix soil to fill all voids.

C. Spread excess soil from excavated plant pits in surrounding planting beds.

D. Sow seed at the rate of 78 pounds per acre. Rake seed into soil and top-dress all seeded areas with 1/4 inch topsoil. Do not let seed installation be subject to damage by climatic conditions.

E. Restore pavements, grassed areas, planted areas, and other improvements damaged to a condition equal to original conditions.

3.5 CLEANING AND MAINTENANCE

A. Remove from site foreign materials collected during cultivation.

B. Dispose of cleanings.

C. Trees, plants, and ground cover maintenance, Section 32 01 90.

END OF SECTION

SECTION 32 98 00

VEGETATION ESTABLISHMENT PERIOD

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Establish and care for plantings requiring watering.

B. Length of time CONTRACTOR is responsible to care for and establish plant materials.

1.2 **ACCEPTANCE**

A. At ENGINEER's discretion conduct one or more inspections to determine condition of planting.

B. Acceptance occurs at end of establishment period or if ENGINEER accepts plantings in writing.

1.3 **WARRANTY**

A. Begins after irrigation system and plant installation inspections and acceptance have been completed and continues for one (1) calendar year, or indicated otherwise in the Contract Documents.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Establish healthy trees, shrubs, groundcovers, and turf.

B. Replace defective plant materials at no additional cost to OWNER.

C. CONTRACTOR will not be held responsible for damage due to acts of nature, vandalism, errant vehicles. Notify ENGINEER immediately if such event occurs.

3.2 **PLANTS**

A. Watering: As necessary to establish and maintain growth.

B. Keep weed-free plant basins and areas where mulch has been placed.

C. Prune broken or dead branches. Replace sub-standard sized plants that require excessive pruning to American Nurseryman Standards.

D. Repair non-functional water basins.

3.3 **LAWNS**

A. Apply 16-0-0 fertilizer (NPK ratio) in fall season following manufacturer's recommendation.

B. Control broadleaf weeds using selective herbicide.

C. Repair, reseed or resod areas showing rodent damage, erosion damage and other damage.

3.4 **LAWN MOWING AND TRIMMING**

A. Times are 7:00 to 10:00 a.m. or 5:00 to 8:00 p.m.

B. Height three (3) inches.

C. Clean cut with sharp blade.

3.5 **IRRIGATION SYSTEMS**

A. Repair installed pressurized irrigation systems to operate properly.

B. Repair erosion. settlement around Street Fixtures and irrigation system components.

C. Winterize system after October 15. Use compressed air at 100 psi only in pressurized systems. Do not put 100 psi air through drip circuits. Coordinate with ENGINEER.

D. Repair irrigation system components broken by CONTRACTOR.

END OF SECTION

DIVISION 33 – UTILITIES

SECTION 33 01 10.58 – DISINFECTION OF WATER UTILITY PIPING SYSTEM

PART 1 - GENERAL

Work under this specification includes the general requirements for flushing, and disinfecting as outlined in the latest edition of AWWA Standard C651. The information given in this section is intended to emphasize only certain provisions of the AWWA Standards and provide supplemental information. Where there is conflicting information between this section and the AWWA Standards, the AWWA Standards shall be followed. Water used for flushing and disinfecting operations shall be furnished by the Owner.

PART 2 – PRODUCTS

A. Liquid Chlorine: AWWA B301 with chlorine 99.5 percent pure by volume.

B. Sodium Hypochlorite: AWWA B300 with not less than 100 grams per liter available chlorine.

C. Calcium Hypochlorite: AWWA B300 with 65 to 70 percent available chlorine by weight in granular form.

D. Powder, tablet, or gas according to manufacturer's specification.

PART 3 - EXECUTION

A. After each section of pipeline for the water supply has been laid, the valves installed, and the trenches partially backfilled, the Contractor shall subject the pipe to a hydrostatic pressure and leakage test. Refer to Section 33 05 05.29 for pipeline testing requirements.

D. Disinfection (Chlorination): All culinary water lines shall be disinfected by chlorination. Chlorination shall provide a minimum of 25 ppm residual after 24-hours contact in the pipeline. This may be expected with an application of 50 ppm although some conditions may require more. Chlorine, in the form of a 1 percent slurry of high-test calcium hypochlorite (HTM, Perchloron, Pittchlor, etc.) shall be fed into the pipeline in such a manner as to mix with the water flowing in the pipeline. (A 1 percent slurry results from mixing 1-pound on the calcium hypochlorite with 7.5 gallons of water.)

The following table provides information as to the required quantity of slurry to be used per 100-feet of pipe to provided a chlorine concentration of 150 ppm:

Pipe Size (Inches)	Vol. Of 100 Ft Length (Gallon)	Required Amount of Slurry (Gallon)
4 Inches	66	0.33
6 Inches	147	0.73
8 Inches	261	1.30
10 Inches	408	2.04
12 Inches	588	3.00
14 Inches	800	4.00
16 Inches	1044	5.20
18 Inches	1321	6.60
20 Inches	1631	8.20

If the pipes and appurtenances are kept clean and dry during construction, at the Contractors option, chlorination of the water lines may be accomplished by adding a small amount of hypochlorite powder or tablets in each length of pipe as it is laid. The following table gives the amount of calcium hypochlorite (70 percent available chlorine) or the number of tablets to be used for each 20-foot length of pipe to give a chlorine concentration of 50 ppm.

Pipe Size (Inches)	Amount of Powder For Each 20-Feet (Tablespoons)	Number of Hypochlorite Tablets of 5-G, for ea. 20 Ft.
4 Inches	3/4	1
6 Inches	1-1/2	2
8 Inches	2-1/2	3
10 Inches	4	5
12 Inches	5-3/4	8
14 Inches	8	10
16 Inches	10-1/2	14
18 Inches	13-1/2	18
20 Inches	17	22

Upon completion of each section of the system, the pipe shall be slowly filled with water to avoid washing the chlorine to one end of the pipe. After the chlorine has been present with water for 24 hours, the Engineer will test for residual.

During the process of chlorinating the pipeline, all valves and other pipeline appurtenances shall be operated several times to provide sufficient contact with chlorinating agent. Following chlorination, the waterline shall be drained and thoroughly flushed and, if necessary, rechlorination until a satisfactory bacteriological test is obtained.

After the applicable retention period, the heavily chlorinated water shall be flushed from the main until the chlorine concentration in the water leaving the main is no longer higher than that generally prevailing in the system, or less than 1 mg/1.

The environment to which the chlorinated water is to be discharged shall be inspected and if there is any question that the chlorinated discharge will cause damage to the environment, then a reducing agent shall be applied to the water to be wasted to neutralize thoroughly the chlorine residual remaining in the water. Where necessary, federal, state, and local regulatory agencies should be contracted to determine special provisions for the disposal of heavily chlorinated water.

After final flushing and before the water main is placed in service, two water samples shall be collected by the Owner's personnel and tested for bacteriologic quality and shall show the absence of coliform organisms. In the event satisfactory bacteriological tests cannot be obtained after chlorination by these methods, re-chlorination using the slurry method will be required until satisfactory tests are obtained.

END OF SECTION

SECTION 33 01 10.92 - MODIFICATION OF WATER SUPPLY WELLS

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

A. Compliance with all applicable governmental rules and regulations for public water supply wells will be as follows:

i. The well is to be rehabilitated and equipped in accordance with Utah State Engineer's rules and regulations for drinking water wells pursuant to UAC R655-4 and the State of Utah Water Well Handbook. In all instances, these standards shall be adhered to during rehabilitation, completing and testing operations. Applicable standards (most recent revisions) include:

1. ANSI/AWWA A100-AWWA Standard for Water Wells
2. ANSI/ASTM A53-Standard Specifications for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
3. ANSI/ASTM A139-Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and over)
4. ANSI/AWWA C200-Standard for Steel Water Pipe-6 in. and Larger
5. ASTM A589-89-Standard Specification for Seamless and Welded Carbon Steel Water-Well Pipe
6. API Spec 5L and 5LS-Specification for Liner Pipe
7. ASTM A106-Standard Specification for Seamless Carbon Steel Pipe for High Temperature Service
8. ASTM A778-Standard Specifications for Welded, Unannealed Austenitic Stainless Steel Tubular Products
9. ASTM A252-Standard Specification for Welded and Seamless Steel Pipe Piles
10. ASTM A312-Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
11. ANSI/NSF Standard 60, Drinking Water Treatment Chemicals
12. ANSI/ NSF Standard 61, Drinking Water System Components
13. ISO 9001, Current Edition, Quality Management Systems – Requirements
14. ANSI/ AWWA Standard 654, Current Edition, Standard for Disinfection of Wells
15. Utah Administrative Code (UAC) R655-4, Water Wells

ii. Rehabilitation activities will be performed only by a licensed Utah water well driller in accordance with UAC R655-4-8, and a licensed well driller will be on site supervising activities at all times rehabilitation operations are occurring.

iii. DRILLER will comply with all applicable state, county and local laws, rules, regulations and standards.

iv. The DRILLER shall submit to the State Engineer's office a start card showing his intent to drill, construct, deepen, replace, repair, renovate, clean, or develop any well prior to commencing any work pursuant to UAC R655-4-4.2. DRILLER shall also submit within 30 days of completion of work to the Utah State Engineer's office a well log and record of work pursuant to UAC R655-4-4.5, as well as provide copies to OWNER and ENGINEER.

B. DRILLER shall provide all equipment and materials for rehabilitation of the well unless otherwise specified herein or negotiated with OWNER. All equipment and machinery used for rehabilitation, equipping and testing the well shall be adequate to complete the work and in good working condition prior to use and subject to inspection by OWNER and ENGINEER.

i. DRILLER shall obtain and comply with any permits required by the State or County.

ii. DRILLER shall be responsible for construction of pads, pits, etc. and the restoration of the well site, including the removal of chemicals, etc. unless otherwise provided for.

iii. OWNER will provide water testing and sampling. DRILLER shall coordinate with OWNER for water sampling and testing.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, application rates and instructions, and MSDS sheet for each type of product used in the rehabilitation process.

PART 2 – PRODUCTS

2.1 GENERAL

A. Any product, material or procedure designed for use in the drilling, construction, cleaning, renovation, development pump installation/repair, or abandonment of water production or non-production wells, which has received certification and approval for its intended use by the National Sanitation Foundation (NSF) under ANSI/NSF Standard 60 or 61, the American Society for Testing Materials (ASTM), the American Water Works Association (AWWA) or the American National Standards Institute (ANSI) may be utilized. Other products, materials or procedures may also be utilized for their intended purpose upon manufacturers certification that they meet or exceed the standards or certifications referred to in this section and upon state engineer approval. (UAC R644-11.1.1)

2.2 EXISTING WELL LOGS

A. Park Well is an artesian well and does not have a well log, but is anticipated to be an 8-inch diameter well with a depth of approximately 500-feet.

PART 3 – EXECUTION

3.1 WELL VIDEO

A. The existing Park Well shall be videoed after well head improvements and a few days after water has cleared in the well to determine screen intervals and well information. The DRILLER shall provide a digital copy of the well video to the OWNER.

3.2 MODIFICATION OF EXISTING WELL TO DRINKING WATER STANDARDS

A. DRILLER shall be responsible for protecting the aquifer from the introduction of contaminants through the drilling process, including spills of material through the open well bore and through spills and contaminants on the ground at the well site.

B. It is anticipated that the well head shall be modified in five (5) parts as follows, but the sequencing is responsibility of the DRILLER:

i. Allow water to flow into the existing 3,000-gallon tank by the existing Well House to relieve artesian pressure and remove the existing well head flange.

ii. Insert a temporary submersible pump capable of pumping between 20 to 100 gpm approximately 20-feet below ground surface to pump the artesian well during well head modifications. The existing well flow is approximately 35 gpm.

iii. Install a pitless adapter unit at the well head along with piping, fittings, and appurtenances as detailed on the project drawings.

iv. Open new artesian relief line into the Great Salt Lake and finish installation of improvements.

v. Disinfect the well and piping as noted in Section 3.3 and place the well back into service after water sampling and testing results are satisfactory.

C. At all times when not on-site, DRILLER shall provide that the wellhead is protected from any accidental or purposeful tampering which could allow for the insertion of materials or liquids into the well.

3.3 MODIFICATION COMPLETION

A. After modification is complete and the temporary pump is pulled, DRILLER shall sound the well and determine if any materials. If materials are found, they shall be removed from the well prior to demobilization.

B. Upon completion of work on a well, the driller or pump installer shall disinfect the well using accepted disinfection procedures to give 100 parts per million free chlorine residual equally distributed in the well water from static level to the bottom of the well. (UAC R655-4-11.6.5)

C. Before leaving the well site, the production casing must be secured by DRILLER in such a manner so that it is lockable, and that the wellhead is protected from accidental or purposeful tampering.

END OF SECTION

SECTION 33 05 05.29 – HYDROSTATIC PIPELINE TESTING

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall perform flushing and testing of all pipelines and appurtenant piping complete, including conveyance of test water from Owner-designated source to point of use and all disposal thereof, all in accordance with the requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MATERIALS REQUIREMENTS

A. All test equipment, temporary valves, bulkheads or other water control equipment and materials shall be determined and furnished by the Contractor subject to the Engineer's review.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall notify the Engineer at least 48-hours in advance of any planned testing and shall review the testing procedures with the Engineer.

B. Unless otherwise provided herein, water for testing pipelines shall be furnished by the Owner; however, the Contractor shall make all necessary provisions for conveying the water from the Owner-designated source to the points of use.

C. All pipelines shall be tested. All testing operations shall be performed in the presence of the Engineer.

D. Disposal or release of test water from pipelines, after testing shall be acceptable to the Engineer.

3.2 HYDROSTATIC TESTING OF PIPELINES

A. Prior to hydrostatic testing, all pipelines shall be flushed or blown out as appropriate. The Contractor shall test all pipelines either in sections or as a unit. The Contractor shall be responsible for ascertaining that all test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to, or movement of, the adjacent pipe. Care shall be taken to see that all air vents are open during filling.

B. The pipeline shall be filled at a rate which will not cause any surges or exceed the rate at which the air can be released through the air valves at a reasonable velocity and all the air within the pipeline shall be properly purged. After the pipeline or section thereof has been filled it shall

be allowed to stand under a slight pressure for at least 24-hours to allow the concrete or mortar lining, as applicable, to absorb what water it will and to allow the escape of air from any air pockets. During this period, bulkheads, valves and connections shall be examined for leaks. If leaks are found, corrective measures satisfactory to the Engineer shall be taken.

C. The hydrostatic test shall consist of holding the test pressure on the pipeline for a period of 4-hours. The test pressure for distribution and transmission pipelines shall be 133% of the pipe pressure class shown or specified measured at the lowest point of the pipeline being tested. The test pressure for yard piping shall be as shown or specified on the Piping Schedule measured at the lowest point of the pipeline section being tested. All leaks shall be repaired in a manner acceptable to the Engineer.

D. All piping shall have no leakage. In the case of pipelines that fail to pass the leakage test, the Contractor shall determine the cause of the leakage, shall take corrective measures necessary to repair the leaks and shall again test the pipelines.

END OF SECTION

SECTION 33 05 05.32 – DISINFECTION OF CONCRETE TANKS

PART 1 - GENERAL

1.1 SUMMARY

A. Work under this specification includes the general requirements for concrete tank testing. The information given in this section is intended to emphasize only certain provisions of the ACI350.1R/AWWA 400 Standards and provide supplemental information. Where there is conflicting information between this section and the ACI/AWWA Standards, the ACI/AWWA Standards shall be followed.

PART 2 – PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.1 TANKS

A. Cleaning and disinfection of the tank shall comply with latest edition of AWWA C652 latest edition prior to being placed into service.

1. Clean interior and exterior of water storage tanks.
2. Tanks entered for cleaning/inspection to be disinfected per latest edition of AWWA C652.

B. Super-chlorinated water shall be disposed of properly per Utah Administrative Code (UAC) R317.

C. VOC analysis of drinking water is required prior to placing tank in service.

END OF SECTION

SECTION 33 05 07

POLYVINYL CHLORIDE PIPE

PART 1 GENERAL

1.1. **SECTION INCLUDES**

A. Polyvinyl chloride pipe, couplings, fittings and joint materials.

1.2 **REFERENCES**

A. **ASTM Standards**:

D1784 Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

D2241 Poly (Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR - Series).

D2321 Underground Installation of Flexible Thermoplastic Sewer Pipe.

D2412 Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.

D2564 Solvent Cement for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

D2729 Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

D2774 Underground Installation of Thermoplastic Pressure Piping.

D2855 Making Solvent Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.

D3034 Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

D3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

D3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

F656 Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

F679 Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

F949 Poly(vinyl Chloride) (PVC) Corrugated sewer Pipe with a Smooth Interior and Fittings.

B. **AWWA Standards**:

C110 Ductile-Iron and Gray-Iron Fitting, 3 inches Through 48 inches, for Water and Other Liquids.

C900 Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution.

C905 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In.

C909 Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 in. Through 24 In., for Water, Wastewater, and Reclaimed Water Service.

1.3 **DEFINITIONS**

A. **Standard Dimension Ratio (SDR):** Outside diameter of pipe divided by wall thickness.

1.4 **QUALITY ASSURANCE**

A. Evaluate pipes that show damage such as dents, cuts, cracks, breaks, fractures, or distortions. Recommend appropriate action. ENGINEER may require CONTRACTOR provide certification by a professional engineer competent in the structural design of the pipe material for action recommended.

PART 2 PRODUCTS

2.1 **PRESSURE PIPE SYSTEM**

A. Pipe: AWWA C900, C905, or C909 as applicable. Use outside diameters defined by ductile iron pipe sizes. Dimensions, class, SDR, and tolerances per ASTM D2241.

B. Compounds: Type 1, Grade 1, Class 12454A, ASTM D1784.

C. Joints:

1. Bell and spigot with flexible elastomeric seals, ASTM D3139. Use non-toxic lubricant.
2. Solvent weld, ASTM D2564.

D. Fittings (4 inch and larger): Ductile iron Class 250, ASTM C110.

2.2 **GRAVITY PIPE SYSTEM**

A. Pipe:

1. Solid smooth wall:
   a. 4 to 15 inch diameter, ASTM D3034.
   b. 18 to 27 inch diameter, ASTM F679.
2. Corrugated wall with a smooth interior, 4 to 10 inches diameter, ASTM F949.

B. Fittings: ASTM D1784.

C. Stiffness: 50 psi minimum when measured at five (5) percent deflection, ASTM D2412.

D. Additives and Fillers: Not to exceed 10 parts by weight; 100 parts of resin in the compound.

E. Joints: Bell and spigot with flexible elastomeric seals, ASTM D3212.

F. Flattening: No visual evidence of splitting, cracking, or breaking when

flattened to 60 percent deflection, ASTM D2412.

2.3 **PERFORATED PIPE SYSTEM**

A. Pipe: Refer to gravity pipe products above.

B. Perforations: ASTM D2729.

C. Joints: Push-on, solvent weld or other.

2.4 **SOLVENT WELDS**

A. Primer, ASTM F656.

B. Glue, ASTM D2564.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Assembly: Abide by manufacturer's instructions and the following. Use the more stringent provisions if there are any conflicts.

1. Pressurized Systems:
   a. Water distribution and transmission, Section 33 11 00, AWWA C900, C905, and C909.
   b. Underground irrigation, Section 32 84 23, and ASTM D2855.
2. Gravity Systems:
   a. Sanitary sewers, Section 33 31 00.
   b. Under drains and storm drains, Section 33 41 00.

B. Burial: Comply with Section 33 05 20 and the following. Use the more stringent provisions if there are any conflicts.

1. ASTM D2774 for pressure pipe systems.
2. ASTM D2321 for gravity pipe systems.

END OF SECTION

SECTION 33 05 19 – DUCTILE IRON UTILITY PIPE

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish and install all ductile iron pipe, fittings, transitions, connections and appurtenant work, complete and in accordance with the requirements of the Contract Documents.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Piping, General. Section 15050

B. Water Pipeline testing Section 02666

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Commercial Standards:

ANSI/AWWA C104/A21.4	Cement-mortar lining for Ductile Iron and Gray Iron Pipe and Fittings for Water.
ANSI/AWWA C105/A21.5	Polyethylene Encasement for Gray and Ductile Cast Iron Piping for Water and Other Liquids.
ANSI/AWWA C110/A21.10	Fittings, 3-inch through 48-inch for Water and Other Liquids, Gray Iron and Ductile Iron.
ANSI/AWWA C111/A21.11	Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.
ANSI/AWWA C115/A21.15	Flanged Ductile Iron and Gray Iron Pipe with Threaded Flanges.
ANSI/AWWA C150/A21.50	Thickness Design of Ductile Iron Pipe.
ANSI/AWWA C153/A21.53	Mechanical Joints (MJ), Push-on joints.
ANSI/AWWA C151/A21.51	Ductile Iron Pipe, Centrifugally Cast, in Metal Molds or Sand Lined Molds for Water and Other Liquids.
ANSI/AWWA C209	Cold Applied Coatings for the Exterior of Special Sections, Connections and Fittings for Steel Water Pipelines.
ANSI/AWWA C214	Tape Coating Systems for the Exterior of Steel Water Pipelines.

ANSI/AWWA C600	Water Mains and Appurtenances, Installation of Ductile Iron.
ANSI/ASTM D 1248	Polyethylene Lining Material for Ductile Iron Pipe and Fittings.
ASTM C 150	Specification for Portland Cement.
ASTM A 746	Installation of Ductile Iron Pipe for Gravity Sewers.

1.4 CONTRACTOR SUBMITTALS

A. The Contractor shall furnish a certified affidavit of compliance for all pipe and other products or materials furnished under this Section of the Specifications and as specified in the referenced standards. Certification shall include physical and chemical properties of pipe materials and hydrostatic test reports.

B. All expenses incurred in sampling and testing for certifications shall be borne by the Contractor.

1.5 QUALITY ASSURANCE

A. Ductile iron pipe shall be manufactured with the material, have the dimensions, be within the tolerances and meet the testing requirements set forth in ASTM A746 and ANSI A21.51. Ductile iron pipe shall be manufactured in nominal 18-foot or 20-foot laying lengths and shall have the lining called for in the Contract Documents.

B. All pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of the referenced standards, as supplemented by the requirements herein.

C. In addition to those tests specifically required, the Engineer may request additional samples of any material including lining and coating samples for testing by the Owner. The additional samples shall be furnished at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 GENERAL

A. Mortar lined and polyethylene encased ductile iron pipe shall conform to ANSI/AWWA C151, C104, C105, C214 and D1248, subject to the following supplemental requirements. The pipe shall be of the diameter and class shown, shall be furnished complete with rubber gaskets as indicated in the Contract Documents and all specials and fittings shall be provided as required under the Contract Documents.

B. The pipe shall be handled by use of wide slings, padded cradles or other devices acceptable to the Engineer, designed and constructed to prevent damage to the pipe lining and/or coating. The use of chains, hooks or other equipment which might injure the pipe lining and coating will not be permitted. Stockpiled pipe shall be safely and properly supported to prevent accidental rolling. The Contractor shall be fully liable for the cost of replacement or repair of pipe which is damaged.

C. Maximum pipe laying lengths shall be 20-foot with shorter lengths provided as required by the Drawings.

D. The pipe shall have a smooth dense interior surface and shall be free from fractures, defects and roughness.

2.2 MATERIALS

A. Ductile iron pipe materials shall conform to the requirements of ANSI/AWWA C151/A21.51.

C. Fittings for ductile iron pipe shall conform to the requirements of ANSI/AWWA C110/A21.10 for diameters 3-inch through 48-inch. Ductile iron fittings larger than 48-inch shall conform to the above referenced standard with the necessary modifications for the larger size.

C. Cement for mortar lining shall conform to the requirements of ANSI/AWWA C104/A21.4; provided, that cement for mortar lining shall be Type II or V. A fly ash or pozzolan shall not be used as a cement replacement.

D. Not used.

E. Material for the polyethylene encasement shall conform to the requirements of ANSI/AWWA C105/A21.5.

F. All elastomer gaskets used for ductile iron pipe shall be of neoprene material.

G. All bolts, nuts, and washers, which are buried, submerged or below the top of the wall inside any hydraulic structure used in the assembly of ductile iron pipe and fittings shall be of Type 316 Stainless Steel.

2.3 DESIGN OF PIPE

A. Ductile iron pipe shall be designed in accordance with the requirements of ANSI/AWWA C150/A21.50, as applicable and as modified in this Section. The pipe furnished shall be either mortar-lined or polyethylene-lined as called out in the Contract Documents. Buried ductile iron pipe shall be polyethylene encased.

B. The pipe shall be designed, manufactured, tested, inspected and marked according to applicable requirements previously stated and except as hereinafter modified, shall conform to ANSI/AWWA C151.

C. The pipe and fittings shall be of the diameter shown and shall be of pressure Class 350 for pipe sizes twelve inches and below and pressure Class 250 for pipe fourteen inches to twenty inches and pressure class 200 for twenty four inch pipe and pressure class 150 for thirty inch and above, except that where mechanical couplings are used and the pipe is grooved, the ductile iron pipe shall be of special thickness Class 53.

D. Ductile iron pipe and fittings shall be furnished with mechanical joints, push-on joints, flanged joints and restrained joints as required.

1. All Mechanical and push-on joints may conform to ANSI/AWWA C153/A21.53 or C110/A21.10.

2. Flanged joints shall conform to ANSI/AWWA C115/A21.15.

3. Restrained joints shall be "Lok-Ring" Restrained Joint by American Ductile Iron Pipe, "TR FLEX" Restrained Joint by U.S. Pipe, "Mechanical Lock Joint" by Pacific States Cast Iron Pipe Company, or equal.

E. For bell-and-spigot ends with rubber gaskets, the clearance between the bells and spigots shall be such that when combined with the gasket groove configuration and the gasket itself, will provide watertight joints under all operating conditions when properly installed. The Contractor shall require the pipe manufacturer to submit details complete with significant dimensions and tolerances and also to submit performance data indicating that the proposed joint has performed satisfactorily under similar conditions. In the absence of a history of field performance, the results of a test program shall be submitted.

2.4 CEMENT-MORTAR LINING

A. Except as otherwise provided herein, interior surfaces of ductile iron pipe, fittings and specials to be furnished with cement-mortar lining shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with ANSI/AWWA C104. If lining is damaged or found faulty at delivery site, the damaged or unsatisfactory portions shall be replaced with lining conforming to these Specifications.

B. The minimum lining thickness shall be as follows:

Nominal Pipe Diameter (inches)	Minimum Lining Thickness (inches)
3-12	1/8
14-24	3/16
30-54	1/4

C. For all pipe and fittings with plant-applied cement mortar linings, the Contractor shall provide a polyethylene or other suitable bulkhead on the ends of the pipe and on all special openings. All bulkheads shall be substantial enough to remain intact during shipping and storage until the pipe is installed.

2.5 EXTERIOR COATING OF PIPE

A. The exterior surfaces of ductile iron pipe which will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and then give a shop coat of rust-inhibitive primer conforming to the requirements of Section 09 98 00 entitled, "Protective Coatings." This exposed piping shall not be coated with the bituminous coating by the manufacturer prior to delivery.

B. Buried ductile iron pipe shall be polyethylene encased in accordance with the requirements of ANSI/AWWA C105/A21.5.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPE

A. All pipe, fittings, etc. shall be carefully handled and protected against damage, impact shocks and free fall. All pipe handling equipment shall be acceptable to the Engineer. Pipe shall not be placed directly on rough ground, but shall be supported in a manner which will protect the pipe against injury whenever stored at the trench site in accordance with Paragraph 2.01, herein. All pipe damaged prior to Substantial Completion shall be repaired or replaced by the Contractor.

B. The Contractor shall inspect each pipe and fitting prior to installation to ensure that there are no damaged portions of the pipe. No pipe shall be installed where the lining or coating show defects that may be harmful as determined by the Engineer. Such damaged lining or coating shall be repaired, or a new undamaged pipe shall be furnished and installed.

C. The pipe shall be installed in accordance with ANSI/AWWA C600. Before placement of the pipe in the trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance which may have collected thereon and shall be kept clean at all times thereafter. For this purpose, the openings of all pipes and fittings in the trench shall be closed during any interruption to the Work. As pipe laying progresses, the Contractor shall keep the pipe interior free of all debris. The Contractor shall completely clean the interior of the pipe of all sand, dirt, rocks and any other debris following completion of pipe laying prior to testing and disinfecting the completed pipeline.

D. Pipe shall be laid directly on the imported bedding material. No blocking will be permitted and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent joint loading at the bells or couplings. Excavation shall be made as needed outside the normal trench section at field joints to permit adequate access to the joints for field connection operations and for application of coating on field joints.

E. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the Engineer may change the alignment and/or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters or by the use of additional fittings. However, in no case shall the deflection in the joint exceed the maximum deflection recommended by the pipe manufacturer.

F. No pipe shall be installed upon a foundation into which frost has penetrated or at any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation. No pipe shall be laid unless it can be established that the trench will be backfilled before the formation of ice and frost occurs.

G. The openings of all pipe and specials where the pipe and specials have been cement-mortar lined in the shop shall be protected with suitable bulkheads to prevent unauthorized access by persons, animals, water or any undesirable substance. At all times, means shall be provided to prevent the pipe from floating.

H. Immediately before jointing pipe, the bell end of the pipe shall be thoroughly cleaned and a clean rubber gasket lubricated with an approved vegetable-based lubricant shall be

placed in the bell groove. The spigot end of the pipe shall be carefully cleaned and lubricated with a vegetable-based lubricant. The spigot end of the pipe section shall then be inserted into the bell of the previously laid joint and telescoped into its proper position. Tilting of the pipe to insert the spigot into the bell will not be permitted.

I. All valves shall be handled in a manner to prevent any injury to any part of the valve. All joints shall be thoroughly cleaned and prepared prior to installation. The Contractor shall adjust all stem packing and operate each valve prior to installation to ensure proper operation. All valves shall be installed so that the valve stems are plumb and, in the location, shown.

END OF SECTION

SECTION 33 05 20

BACKFILLING TRENCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Backfill materials in trenches and backfilling requirements.

1.2 REFERENCES

A. **APWA (Utah) Standards**:

Plan 381 Trench backfill

Plan 382 Pipe zone backfill

B. **ASTM Standards**:

D698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).

D1557 Laboratory Compaction Characteristics of Soil using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D4832 Preparation and Testing of Soil-Cement Slurry Test Cylinders.

1.3 DEFINITIONS

A. **Bedding**: That surface of the excavation or portion of the Pipe Zone below the pipe.

B. **Pipe Zone**: That zone in a backfilling operation which supports, and surrounds the pipe barrel, and extends to 1 foot above the top of the pipe barrel.

1.4 SUBMITTALS

A. Submit maximum laboratory dry density and optimum laboratory moisture content for:

1. Subgrade material, and
2. Each type of fill to be used.

B. Submit aggregate batch delivery tickets showing name of material source, serial number of ticket, date and truck number, name of Supplier, job name and location, volume or weight. And aggregate classification or Supplier's identification code.

1.5 QUALITY ASSURANCE

A. Do not change material sources, or aggregate without ENGINEER's knowledge.

B. Reject backfill material that does not comply with requirements in this Section.

C. If requested, submit a quality control inspections and testing report describing source and field quality control activities performed by CONTRACTOR and Suppliers.

1.6 **STORAGE**

A. Safely stockpile backfill materials.

B. Separate differing materials, prevent mixing, and maintain optimum moisture content of backfill materials.

1.7 **SITE CONDITIONS**

A. Do not place, spread, or roll any backfill material over material that is damaged by water. Remove and replace damaged material at no additional cost to OWNER.

B. Control traffic and erosion. Keep area free of trash and debris. Repair settled, eroded, and rutted areas.

C. Reshape and compact damaged structural section to required density.

D. Restore any damaged structure to its original strength and condition.

E. Replace contaminated backfill at no additional cost to OWNER.

1.8 **SEQUENCING**

A. Coordinate backfilling operation with pipeline commissioning, Section 33 08 00.

1.9 **ACCEPTANCE**

A. General: Native material may be wasted if there is no additional cost to substitute material acceptable to ENGINEER.

B. Material: For material acceptance refer to:

1. Common fill, Section 31 05 13.
2. Aggregate base course, Section 32 11 23.
3. Cement treated fill, Section 31 05 15.

C. Lift Thickness: One test per lot.

D. Compaction: One test per lot. Verify density using nuclear tests, ASTM D2922. Compaction standard and Lot sizes as follows:

Table 1: Compaction Standard and Lot Size

Material	Proctor	Lot Size
Subgrade	Standard	200 linear feet
Common Fill	Standard	200 linear feet per lift 25 square feet of footing area per lift
Aggregate base course	Modified	200 linear feet per lift 25 square feet of footing area per lift
NOTES (a) Standard proctor, ASTM D698. (b) Modified proctor, ASTM D1557. (c) Lift thickness above pipe zone before compaction, 8 inches.		

E. Flowable Fill Strength: Lot size is one (1) day production with sub-lots

of 50 cubic yards or part thereof. Verify strength using cylinders, ASTM D4832.

F. Grade, Cross Slope: Measured at random locations.

1.10 **WARRANTY**

A. Correct any settlement of Trench backfill or structures built over Trench backfill at no cost to OWNER.

B. Restore structures damaged by settlement at no additional cost to OWNER.

PART 2 PRODUCTS

2.1 **BACKFILL MATERIALS**

A. Common fill, Section 31 05 13. Granular material, CONTRACTOR's choice.

B. Aggregate base course, Section 32 11 23. Untreated base course.

C. Cement treated fill, Section 31 05 15. Use a flowable fill so vibration is not required.

D. Slag or bitumen bearing material NOT ALLOWED in trench.

2.2 **WATER**

A. Make arrangements for sources of water during construction and make arrangements for delivery of water to site.

B. Comply with local Laws and Regulations at no additional cost to OWNER when securing water from water utility company.

2.3 **GEOTEXTILE FABRIC**

A. Section 31 05 19. Use woven or non-woven stabilization-separation fabric. Select either moderate MARV or high MARV as needed.

2.4 **IDENTIFICATION TAPE**

A. Permanent, bright colored, continuous printed magnetic plastic tape, intended for direct burial service; not less than six (6) inches wide by four (4) mils thick. Tape shall read "**CAUTION: BURIED INSTALLATION BELOW**". Color as follows.

Red	Electric power lines, cables, conduit and lighting cables
Yellow	Gas, oil, steam, petroleum or gaseous materials
Orange	Communications, alarm, signal, cables or conduits
Blue	Potable water
Purple	Reclaimed water, irrigation and slurry lines
Green	Sewer and storm drain lines

PART 3 EXECUTION

3.1 PREPARATION

A. Implement traffic control plan requirements, Section 01 55 26.

B. Identify required line, levels, contours, and datum.

C. Stake and flag locations of underground utilities.

D. Verify:

1. Backfill material meets gradation requirements.
2. Foundation walls are braced to support surcharge forces imposed by backfilling operations, areas to be backfilled are free of debris, snow, ice or water.
3. Trench bottom is not frozen.

E. If ground water is in the intended backfill zone, dewater.

3.2 SUBGRADE

A. Protect subgrade from desiccation, flooding, and freezing.

B. Before backfilling over Subgrade, get ENGINEER's review of Subgrade surface preparations.

C. If Subgrade is not readily compactable, get ENGINEER's permission to stabilize the subgrade:

1. Excavation for Subgrade stabilization is incidental work, Section 31 23 16.
2. Place geotextile fabric. Place acceptable fill in lifts. Compact.

3.3 PROTECTION

A. During installation or repair, plug end of pipe or fitting except when installing next section of pipe or fitting.

B. Movement of construction machinery over Work at any stage of construction is solely at CONTRACTOR's risk.

3.4 GENERAL BACKFILLING REQUIREMENTS

A. Avoid injuring and displacement of conduit, pipe and structures while compacting soil or operating equipment next to pipeline.

B. Place geotextile fabrics; Section 31 05 19.

C. Do not damage corrosion protection on pipe.

D. Repair or replace damaged pipe at no additional cost to OWNER.

E. Withdraw sheathing, shoring, piles, and similar supports as backfilling progresses. Backfill and compact all holes left by removals.

F. Provide sufficient water quality facilities to protect downstream fish and wildlife, and to meet State water quality requirements.

G. Water settling of trench backfill is not permitted. "Jetting" of trench backfill is prohibited.

3.5 PIPE ZONE

A. Follow APWA Plan 382 requirements.

B Maintain uniform foundation along barrel of pipe with sufficient relief for joint connections.

C. Use backfill materials meeting pipe manufacturer's recommendations. Maximum backfill particle size is 3/4 inch for plastic pipe.

D. Do not permit free fall of backfill material that may damage pipe, pipe finish, or pipe alignment.

E. Except where piping must remain exposed for tests, fill pipe zone as soon as possible.

3.6 **TRENCH ABOVE PIPE ZONE.**

A. Follow APWA Plan 381 requirements.

B. Maximum lift thickness before compaction is eight (8) inches.

C. Fill unauthorized excavations with material acceptable to ENGINEER at no additional cost to OWNER.

D. Do not damage adjacent structures or service lines.

E. Install continuous identification tape directly over buried lines 18 inches below finished grade.

3.7 **MODIFIED BACKFILL LAYER METHOD**

A. At discretion of CONTRACTOR, backfill may be placed in thicker layers than indicated above subject to the following provisions:

1. CONTRACTOR proves the ability of proposed method to achieve specified average compaction density.
2. ENGINEER, on the basis of test results, approves the system in writing.

B. Should CONTRACTOR find it necessary to change the method or any part of it, including the source of material, or the rate of placing the material, obtain approval of ENGINEER, who may require a further trial area.

C. If testing shows a previously approved system is no longer producing the required degree of compaction, make changes to comply.

D. Where vibration effects are creating environmental problems, make changes to eliminate problems.

3.8 **TOLERANCES**

A. Compaction: Ninety-five (95) percent or greater relative to a standard or modified proctor density, Section 31 23 26.

B. Lift Thickness (before compaction):

1. Eight (8) inches when using riding compaction equipment.
2. Six (6) inches when using hand held compaction equipment.
3. As proven in the modified backfill layer method.

C. Cement Treated Fill: Compressive strength targets are 60 psi in 28 days and 90 psi maximum in 28 days.

3.9 **FIELD QUALITY CONTROL**

A. Test trench backfilling until a compaction pattern acceptable to CONTRACTOR and ENGINEER is achieved. Continue random quality control compaction testing.

3.10 **SURFACE FINISHING**

A. Provide temporary paved surfaces where trenches pass through roadways, driveway approaches or sidewalks.

B. Restore paved surfaces, Section 33 05 25.

C. Landscapes: Restore landscaping as indicated and as follows where applicable.

1. Section 32 92 00 for turf and grasses.
2. Section 32 93 13 for other ground cover.

D. Repair public and private facilities damaged by CONTRACTOR.

3.11 **CLEANING**

A. Remove stockpiles from site when work is complete. Grade site to prevent free standing surface water.

B. Leave borrow areas clean and neat.

END OF SECTION

SECTION 221050 – POLYETHYLENE PRESSURE PIPE AND TUBING (AWWA C901 AND AWWA C906)

PART 1 – GENERAL

1.1 TERMS AND CONDITIONS

A. Scope. This specification covers requirements for polyethylene pressure pipe and tubing for general purpose applications. All work shall be performed in accordance with these specifications.

B. Referenced Standards. All standard specification, i.e., Federal, ANSI, ASTM, etc., made a portion of these Specifications by reference, shall be the latest edition and revision thereof.

1.2 CONTRACTOR SUBMITTALS

A. Contractor shall submit copies of the manufacture's product specifications according to the requirements of section 01 33 00 entitled, "Submittal Procedures".

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Qualification of Manufacturers. The Manufacturer shall have manufacturing and quality control facilities capable of producing and assuring the quality of the pipe and fittings required by these Specifications. The Manufacturer's production facilities shall be open for inspection by the Customer or his Authorized Representative. Qualified Manufacturers shall be approved by the Project Engineer.

B. Materials. Materials used for the manufacture of polyethylene pipe and fittings shall be PE4710 high density polyethylene meeting cell classification 445574C per ASTM D 3350; and shall be listed in the name of the pipe and fitting Manufacturer in PPI[1] TR-4, Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fittings Compounds, with a standard grade HDB rating of 1600 psi at 73 degrees F. The Manufacturer shall certify that the materials used to manufacture pipe and fittings meet these requirements.

1. Typical material properties shall be submitted to the project design engineer for analysis. These properties are to be used for engineering evaluation and are not to be misconstrued as specification minimums.

C. Interchangeability of Pipe and Fittings. Polyethylene pipe and fittings shall be supplied by the same Manufacturer. Pipe and fittings from different Manufacturers shall not be interchanged.

1. Polyethylene Pipe. Polyethylene pipe shall be manufactured in accordance with ASTM F 714, Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter, or ASTM D 3035, Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter and shall be so marked. Each production lot of pipe shall be tested for (from material or pipe) melt index, density, percent carbon (from pipe), dimensions and either quick burst or ring tensile strength (equipment permitting).

2. Polyethylene Fittings & Custom Fabrications. Polyethylene fittings and custom fabrications shall be molded or fabricated by the pipe manufacturer. Butt fusion outlets shall be made to the same outside diameter, wall thickness, and tolerances as the mating pipe. All fittings and custom fabrications shall be fully rated for the same internal pressure as the mating pipe. Pressure de-rated fabricated fittings are prohibited.

   a. Molded Fittings. Molded fittings shall be manufactured in accordance with ASTM D 3261, Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing, and shall be so marked. Each production lot molded fittings shall be subjected to the tests required under ASTM D 3261.

   b. Fabricated Fittings. Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet rock, or molded fittings. Fabricated fittings shall be rated for internal pressure service equivalent to the full-service pressure rating of the mating pipe. Directional fittings 16" IPS and larger such as elbows, tees, crosses, etc., shall have a plain end inlet for butt fusion and flanged directional outlets. Part drawing shall be submitted for the approval of the Project Engineer.

      i. Back-up Rings & Flange Bolts. Flange adapters shall be fitted with lap joint flanges pressure rated equal to or greater than the mating pipe. The lap joint flange bore shall be chamfered or radiused to provide clearance to the flange adapter radius. Flange bolts and nuts shall be Grade 2 or higher.

D. Manufacturer's Quality Control. The pipe and fitting manufacturer shall have an established quality control program responsible for inspecting incoming and outgoing materials. Incoming polyethylene materials shall be inspected for density, melt flow rate, and contamination. The cell classification properties of the material shall be certified by the supplier, and verified by Manufacturer's Quality Control. Incoming materials shall be approved by Quality Control before processing into finished goods.

Outgoing materials shall be checked for:

- Outside diameter, wall thickness, and eccentricity as per ASTM D2122 at a frequency of at least once/hour or once/hour, whichever is less frequent.
- Out of Roundness at a frequency of at least once/hour or once/coil whichever is less frequent.
- Straightness, inside and outside surface finish, markings and end cuts shall be visually inspected as per ASTM F714 on every length of pipe.

Quality Control shall verify production checks and test for:

- Density as per ASTM D1505 at a frequency of at least once per extrusion lot.
- Melt Index as per ASTM D1238 at a frequency of at least once per extrusion lot.
- Carbon content as per ASTM D1603 at a frequency of at least once per day per extrusion line.
- Quick burst pressure (sizes thru 4-inches as per ASTM D1599 at a frequency of at least once per day per line.

- Ring Tensile Strength (sizes above 4-inches equipment permitting) as per ASTM D2290 at a frequency of a least once per day per line.
- ESCR (size permitting) as per ASTM F1248 at a frequency of at least once per extrusion lot.

X-Ray inspection shall be used to inspect molded fittings for voids, and knit line strength shall be tested. All fabricated fittings shall be inspected for joint quality and alignment.

1. Permanent Records. The Manufacturer shall maintain permanent QC and QA records.

E. Compliance Tests – Manufacturer's inspection and testing of the materials. In case of conflict with Manufacturer's certification, the Contractor, Project Engineer, or Customer my request retesting by the Manufacturer or have retests performed by an outside testing service. All retesting shall be at the requestor's expense, and shall be performed in accordance with the Specifications.

PART 3 – EXECUTION

3.1 JOINING

A. Heat Fusion Joining. Joints between plain end pipes and fittings shall be made by butt fusion, and joints between the main and saddle branch fittings shall be made using only saddle fusion procedures that are recommended by the pipe and fitting Manufacturer. The Contractor shall ensure that persons making heat fusion joints have received training in the Manufacturer's recommended procedure. The Contractor shall maintain records of trained personnel, and shall certify that training was received not more than 12 months before commencing construction. External and internal beads shall not be removed.

1. Heat Fusion Training Services. Upon request, the Manufacturer shall provide assistance in the Customer's recommended butt fusion and saddle fusion procedures to the Contractor's installation personnel, and to inspectors representing the Customer.

B. Mechanical Joining. Polyethylene pipe and fittings may be joined together or to other materials by means of flanged connections (flange adapters and back-up rings) or mechanical couplings designed for joining polyethylene pipe or for joining polyethylene pipe to another material. Mechanical couplings shall be fully pressure rated and fully thrust restrained such that when installed in accordance with manufacturer's recommendations, a longitudinal load applied to the mechanical coupling will cause the pipe to yield before the mechanical coupling disjoins. External joint restraints shall not be used in lieu of fully restrained mechanical couplings.

C. Branch Connections. Branch connections to the main shall be made with saddle fittings or tees. Polyethylene saddle fittings shall be saddle fused to the main pipe per 3.1.

3.2 INSTALLATION

A. General. The Manufacturer shall package products for shipment in a manner suitable for safe transport by commercial carrier. When delivered, a receiving inspection shall be performed, and any shipping damage shall be reported to the Manufacturer within 7 days. Installation shall be in accordance with Manufacturer's recommendations, and this specification. All necessary precautions shall be taken to ensure a safe working environment in accordance with applicable codes and standards.

B. Large Diameter Fabricated Fittings. Fabricated directional fittings 16-inch IPS and larger shall be butt fused to the end of a pipe. The flanged directional outlet connections shall be made up in the trench.

C. Foundation & Bedding. Pipe shall be laid on grade and on a stable foundation. Unstable or mucky trench bottom soils shall be removed, and a 6-inch foundation or bedding of compacted Type 4 material shall be installed to pipe bottom grade. Excess groundwater shall be removed from the trench before laying the foundation or bedding and the pipe. A trench cut in rock or stony soil shall be excavated to 6-inches below pipe bottom grade, and brought back to grade with compacted Type 4 bedding. All ledge rock, boulders and large stones shall be removed.

D. Pipe Handling. When lifting with slings, only wide fabric choker slings capable of safely carrying the load, shall be used to lift, move, or lower pipe and fittings. Wire rope or chain shall not be used. Slings shall be of sufficient capacity for the load, and shall be inspected before use. Worn or defective equipment shall not be used.

3.3 TESTING

A. QUALITY ASSURANCE

1. Butt Fusion Testing. On every day butt fusions are to be made, the first fusion of the day shall be a trial fusion. The trial fusion shall be allowed to cool completely, then fusion test straps shall be cut out. The test strap shall be 12-inches (min) or 30 times the wall thickness in length with the fusion in the center, and 1-inch (min) or 1.5 times the wall thickness in width. Bend the test strap until the ends of the strap touch. If the fusion fails at the joint, a new trial fusion shall be made, cooled completely and tested. Butt fusion of pipe to be installed shall not commence until a trial fusion has passed the bent strap test.

   Pressure Testing. The initial pressure test can be conducted before the line is backfilled. However, it is advisable to cover the pipe at intervals or particularly at curves to hold the pipe in place during pressure test. Flanged connections may be left exposed for visual leak inspection. The main shall be tested after the final installation is completed.

   Test pressure should not exceed 1.5 times the rated operating pressure of the pipe or the lowest rated component in the system. The initial pressure test shall be applied and allowed to stand without make up pressure for a sufficient time to allow for diametric expansion or pipe stretching to stabilize. This usually occurs within 2 to 3 hours. After this equilibrium period, the test section can be returned to the 1.5 times operating pressure, the pump turned off, and a final test pressure held for 2 hours.

   Allowable amounts of make-up water for expansion during pressure test is shown in Chart 6, taken from PPI technical report TR 31/9-79. There shall be no visual leaks or pressure drops greater than 5 PSI during the final test period.

   Under no circumstances shall the total time under test exceed 3 hours at 1 ½ times the pressure rating. If the test is not completed because of leakage, equipment failure, or other reason, the test section shall be permitted to ‘relax’ for 8 hours before the next testing sequence. Pneumatic pressure testing is **NOT** allowed.

END OF SECTION

SECTION 220523 – VALVES

PART 1 - GENERAL

1.1 SCOPE

A. Furnish and install all valves complete and in accordance to the requirements of the Contract Documents.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of valve. Include pressure drop curve or chart for each type and size of valve.

B. Shop Drawings: Submit manufacturer's assembly-type (exploded view) shop drawings for each type of valve, indicating dimensions, weights, materials, and methods of assembly of components.

C. Maintenance Data: Submit maintenance data and spare parts list for each type of valve. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 1.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of valves, of types and sizes required, whose products have been in satisfactory use in similar service.

B. Valve Types: Provide valves of same type by same manufacturer.

C. Valve Identification: Provide valves with manufacturer's name (or trademark) and pressure rating clearly marked on valve body.

D. Codes and Standards:

1. MSS Compliance: Mark valves in accordance with MSS-25 "Standard Marking System for Valves, Fittings, Flanges and Unions".
2. ANSI Compliance: For face-to-face and end-to-end dimensions of flanged- or welded-end valve bodies, comply with ANSI B16.10 "Face-to-Face and End-to-End Dimensions of Ferrous Valves".
3. For all valves: Provide EPDM gaskets on valves on air lines from the blowers.

PART 2 - PRODUCT

2.1 BRASS BALL VALVES

A. Features:

1. Adjustable packing gland
2. RPTFE seats and seals
3. Blowout proof stem
4. 200 psig water, CWP, non-shock
5. Temperature range, 50°F to 200°F

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering ball valves which may be incorporated in the work are:

1. Apollo
2. Watts
3. Or equal.

2.2 STAINLESS STEEL BALL VALVES

A. Features:

1. 316 SS Ball Construction
2. SS Body construction
3. RPTFE seat
4. Threaded
5. Full Port
6. Two-piece body design
7. Solid Ball Construction
8. SS Lever and Nut
9. Blow out proof stern design
10. Nylon lever grip
11. 150 psi rated

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering ball valves which may be incorporated in the work are:

1. Apollo Valves
2. Watts
3. Or equal.

2.3 SWING CHECK VALVES

A. The rubber flapper swing check valve shall have a heavily constructed cast iron body and cover in accordance with ASTM A126 Grade B. The body shall be long pattern design (not wafer) with integrally cast-on end flanges. The flapper shall be Buna-N, or other elastomer, having an O-ring seating edge and be internally reinforced with steel.

B. Flapper to be captured between the body and the body cover in a manner to permit the flapper to flex from closed to full open position. Flapper shall be easily removed without the need to remove the valve from line. Check Valves to have full pipe size flow area. Seating surface to be on a 45-degree requiring the flapper to travel only 35 degrees from closed to full open position for minimum headloss. Valve has non-slam closure characteristics.

C. Buna-N flapper which creates an elastic spring effect to assist the flapper to close against a slight head to prevent or minimize slamming.

D. Valve designed for 175 psi differential pressure for water, sewage, oil or gas (higher pressure available). The valve shall be suitable for buried service, in which case, stainless cover bolts must be furnished.

E. When necessary to prime or backflush a clogged pump, an external backflow device can be furnished—sizes 3-inch and larger.

F. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering swing check valves which may be incorporated in the work are:

1. APCO
2. Flomatic
3. Or equal.

2.4 WAFER CHECK VALVES

A. Check valve shall be cast iron, seat and plug bronze.

B. The seat and plug shall be hand replaceable. The seating surfaces shall be metal to metal or resilient (Buna-N) to metal.

C. The valve plug shall have a central shaft and spring loaded. The spring must be stainless steel 316. The spring shall be helical or conical in form.

D. All materials of construction shall be certified in writing to conform to ASTM specifications as follows:

1.	Body	Cast Iron	ASTM A 126 Gr.B
2.	Seat & Plug	Bronze	ASTM 584
3.	Seat w/ Buna-N Seal	Bronze	Buna-N
4.	Spring	Stainless Steel	ASTM A313 T316
5.	Exterior Paint	Universal Primer	FDA Approved for Potable Water
6.	Or equal.		

E. Acceptable Manufacturers:

1. APCO
2. Flomatic
3. Or equal.

2.5 POTABLE / UTILITY WATER GATE VALVES

A. Description: The valves shall be suitable for an ordinary waterworks service intended to be installed in a normal position as indicated in the Plans. All valves shall be Mueller, AVK, or equal, with non-rising stem valves. CPVC valves shall be Asahi/America, or equal.

The minimum requirements for all gate valves shall, in design, material and workmanship, conform to the standards of AWWA C509 or AWWA C515 for Resilient-Sealed Gate Valves. All materials used in the manufacture of waterworks gate valves shall conform to the AWWA Standards designed for each material listed. All gate valve operating stems shall be equipped with a two (2) inch operating nut. All gate valves shall open counterclockwise.

Where static line pressure exceeds 125 psi, only 250 psi working-pressure valves shall be used.

B. Materials:

1. Manufacture and Marking: The valves shall have the name or mark of the manufacturer, year valve casting was made, size and working pressure plainly cast in raised letters on the valve body.

2. Type and Mounting: The valve bodies shall be ductile iron, mounted with approved non-corrosive metals. All wearing surfaces shall be bronze or other approved non-corrosive material. Contact surfaces shall be machined and finished in the best workmanlike manner, and all wearing surfaces shall be easily renewable.

3. Valve Seats: Resilient seats shall be applied to the gate and shall seat against a corrosion-resistant surface. The surface may be either metallic or non-metallic, applied in a manner to withstand the action of line fluids and the operation of the sealing gate under long-term service. A metallic surface shall have a corrosion resistance equivalent to or better then bronze. A non-metallic surface shall be in compliance with ANSI/AWWA C550. Resilient seats shall be bonded or mechanically attached to the gate. The method used for bonding or vulcanizing shall be proved by ASTM D429; either method A or method B. For method A, the minimum strength shall not be less than 250 psi (1,725 kPa). For method B, the peel strength shall not be less than 75 lb/in. (9.3 kg/m).

4. All exposed mechanical attaching devices and hardware used to retain the resilient seat shall be made of a corrosion-resistant material.

5. End Connections: The dimensions push-on end connections shall conform to the dimensions of the AWWA Standard C111/A21.11. The dimensions for the mechanical joint connections shall conform to the ANSI/AWWA C111/A21.11.

6. The end flanges of flanged valves shall conform in dimensions and drilling to the standard ANSI B16.1 for ductile iron flanges and flanged fittings, Class 125, unless specifically provided otherwise. The bolt holes shall straddle the vertical center line.

7. Gate Valve Stem Seals: Unless otherwise designated in the Approved Plans, all gate valves up to and including 12-inch in size shall be furnished with O-ring Stem Seals. Number, size and design shall conform to the AWWA Standards for gate valve O-Ring Stem Seals. For all valves over 12", the stem seals shall be conventional type stuffing-box with graphite packing per AWWA Standard No. C600-18.1.

8. Installation of Gate Valves: All gate valves shall be inspected upon delivery in the field to insure proper working order before installation. They shall be set and jointed to the pipe in the manner as set forth in the AWWA Standards for the type of connection ends furnished. The valves shall also be carefully inspected for injury to the outer protective coatings.

2.6 BUTTERFLY VALVES (CLASS 150B)

A. Components

1. Bodies: Valves bodies shall be constructed of ASTM-A126, Class B cast iron for flanged, mechanical joint, push-on, mechanical x flanged, and push-on x flanged valves. Flanged valves shall be fully faced and drilled in accordance with ANSI Standards B16.1, Class 125

2. Seat: Rubber body seats shall be of one-piece construction, simultaneously molded and bonded into a recessed cavity in the valve body protecting the leading edge of the seat from shearing force of the line flow. Seats may not be located on the disc or be retained by segments and/or screws. For wafer style valves, the seat shall cover the entire inner surface of the valve body and extend over the outside face of the valve body to form a flange gasket.

3. Bearings: Valve bearings shall be of a self-lubricating, nonmetallic material to effectively isolate the disc-shaft assembly from the valve body. Metal-to metal thrust bearings in the flow stream are not allowed.

4. Disc: The disc shall be an on-center, lens-shaped design to afford minimal pressure drop and line turbulence. Materials of construction shall be: ASTM A126, Class B cast iron disc and a stainless-steel type 316 edge with a minimum width equal to the width of disc edge.
   Discs shall be retained by stainless steel pin, extending through the full diameter of the shaft to withstand the specified line pressure up to valve rating and the torque required to operate the valve. Disc stops located in the flow stream are not allowed.
5. Shafts: Valve shaft shall be stainless steel type 304. At the operator end of the valve shaft, a packing gland utilizing “V” type chevron packing shall be utilized. “O” ring and “U” cup packing is not allowed.
6. Painting: All surfaces of the valve interior shall be clean, dry and free from grease before painting. The valve surfaces except for disc edge, rubber seat and finished portions shall be a minimum of 8 mils Ameron 370.

B. Operators

1. Operators and component parts: AWWA C504, unless otherwise specified in these Specifications.

2. Provide with counter-clockwise opening manual operators.

   a. Compute operation torque of each valve and operator in accordance with Appendix of AWWA Standard C504 for velocity of 16 fps and applicable pressure drop across valve.
   b. Operators: Sized for bi-directional flow and 450 ft-lb input torque.

3. Required input torque with maximum handwheel pull of:

    a. 80 lbs. for hand wheels and chain wheels, or
    b. 150 ft.-lbs. for operating nuts.

4. Hand wheels shall have a maximum diameter of 24-inches.

5. Totally enclosed, permanently lubricated and sealed gear reducers. A vent shall be provided between the valve trunnion and actuator base to prevent infiltration of fluid into the actuator.

    a. Self-locking with open and close stops provided to limit valve disc travel.
    b. Traveling nut type.
    c. Submit calculations for valve torque requirements to Engineer as part of Shop Drawing submittal package. Velocity for dynamic torque must be 16 fps.
    d. Valve operators, as manufactured by:
        i. Mueller Co.
        ii. DeZurik
        iii. or approved Equal

6. Provide butterfly valves 3 inches in diameter and larger, and butterfly valves which are not directly buried or submerged, with manual hand wheels and position indicators. Install valves with valve shaft in horizontal position unless otherwise specified.

7. Provide butterfly valves which are directly buried or submerged with 2-inch square operating nut and do not equip with position indicator unless otherwise specified.

8. Valves located in vaults: Provide adequate clearance for handwheel operation.
    a. Orientate handwheel as shown in Drawings.

C. Manufacturers

1. Butterfly valves, as manufactured by:
    a. Muller Co.
    b. Bray
    c. Asahi/America (CPVC Butterfly Valves)
    d. Or approved Equal

2.7 AIR VACUUM AND RELIEF VALVES

A. Combination Air Valves (single body, double orifice) are used to allow large volumes of air to escape or enter thru the larger diameter air / vacuum orifice when filling or draining a pipeline.

B. When the pipeline is filled and under pressure the large air / vacuum orifice shall stay closed, but the smaller diameter air release orifice shall remain operative and open to allow small pockets of accumulating air to escape automatically and independently of the large orifice. The large air / vacuum orifice shall shut off when the free acting center guided plug is raised into the orifice by the lifting force of the CONCAVE bottom float. The large orifice shut-off shall be “WITHOUT SPILLING”. The Float* shall be heavily constructed stainless steel

(hermetically sealed) having a concave bottom impact area to provide immediate resistance to flow and instant upwards movement to shut off the large orifice “WITHOUT SPILLING”. The Buna-N seat must be fastened to the valve cover without distortion for drop tight shut-off.

C. Materials

1. Body & Cover Cast Iron ASTM A126 GR.
2. Concave Float* Patented Stainless-Steel ASTM A240 T304
3. Float Stem Stainless Steel ASTM A581 T303
4. Needle & Seat Buna-N
5. Plug (1-inch, 2-inch, 3-inch, 4-inch) Brass ASTM B124 (6-inch Size) Stainless Steel ASTM A240 T304
6. Leverage Frame Cast Iron ASTM A126 GR. B.

D. Acceptable Manufacturers

1. Apco Willamette
2. Valmatic
3. Vent-O-Mat
4. Or Equal

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Except as otherwise indicated, comply with the following requirements:

Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary.

Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward from horizontal plane.

B. Insulation: Where insulation is indicated, install extended-stem valves, arranged in proper manner to receive insulation.

C. Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select and install valves with the following ends or types of pipe/tube connections.

1. Pipe Size 2-inch and Smaller: One of the following, at Installer's option:

   a. Threaded valves.
   b. Flanged valves.

2. Pipe Size 2-1/2-inch and Larger:

   a. Flanged valves.
   b. Grooved joint valves.

D. Valve System: Select and install valves with outside screw and yoke stems, except provide inside screw non-rising stem valves where headroom prevents full opening of OS&Y valves.

E. Renewable Seats: Select and install valves with renewable seats, except where otherwise indicated.

3.2 ADJUSTING AND CLEANING

A. Valve Adjustment: After piping systems have been tested and put into service, but before final testing, adjusting, and balancing, inspect each valve for possible leaks. Adjust or replace packing to stop leaks, replace valve if leak persists.

B. Valve Identification: Tag each valve in accordance project specifications.

3.3 VALVE INSTALLATION

A. Locate all valves in locations which will allow easy operation and facilitates maintenance.

B. Provide chain operators for any valves located more than 8 feet above finished floor. This means double acting lever handles for quarter turn valves, or chain wheels for multi-turn valves. Arrange valves and set up chain length for proper operation.

END OF SECTION 220523

SECTION 33 14 43.05 – VARIABLE SPEED PACKAGE PUMPING SYSTEMS FOR WATER UTILITY SERVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

A. Variable Speed Packaged Pumping System

1.2 REFERENCE STANDARDS

A. The work in this section is subject to the requirements of applicable portions of the following standards:
   1. Hydraulic Institute
   2. ANSI – American National Standards Institute
   3. ASTM – American Society for Testing and Materials
   4. IEEE – Institute of Electrical and Electronics Engineers
   5. NEMA – National Electrical Manufacturers Association
   6. NEC – National Electrical Code
   7. ISO – International Standards Organization
   8. UL – Underwriters Laboratories, Inc.

PART 2 – PRODUCTS

2.1 VARIABLE SPEED PACKAGED PUMPING SYSTEM

A. Furnish and install a pre-fabricated and tested variable speed packaged pumping system to maintain constant water delivery pressure.

B. The packaged pump system shall be a standard product of a single pump manufacturer. The entire pump system including pumps and pump logic controller, shall be designed, built, and tested by the same manufacturer.

C. The complete packaged water booster pump system shall be certified and listed by UL (Category QCZJ – Packaged Pumping Systems) for conformance to U.S. Standards.

D. The complete packaged pumping system shall be NSF61 / NSF372 Listed for drinking water and low lead requirements.

E. The packaged pump system shall be ASHRAE 90.1 – 2010 compliant without the need of a remote mounted sensor. The control logic used to simulate a remote mounted sensor shall be proportional pressure control with squared or linear adaptation. An actual flow rate or calculated flow rate based on performance curves (5^{th} order polynomial) loaded into the controller; shall be used to adjust setpoint pressure in proportional pressure control.

2.2 PUMPS

A. All pumps shall be ANSI NSF 61 / NSF372 Listed for drinking water and low lead requirements.

B. The pumps shall be of the in-line vertical multi-stage design.

C. The head-capacity curve shall have a steady rise in head from maximum to minimum flow within the preferred operating region. The shut-off head shall be a minimum of 20 percent higher than the head at the best efficiency point.

D. Small Vertical In-Line Multi-Stage Pumps (Nominal flow from 3 to 125 gallons per minute) shall have the following features:

1. The pump impellers shall be secured directly to the pump shaft by means of a splined shaft arrangement.
2. The suction/discharge base shall have ANSI Class 250 flange or internal pipe thread (NPT) connections as determined by the pump station manufacturer.
3. Pump Construction.

a.	Suction/discharge base, pump head, motor stool:	Cast iron (Class 30)
b.	Impellers, diffuser chambers, outer sleeve:	304 Stainless Steel
c.	Shaft	316 or 431 Stainless Steel
d.	Impeller wear rings:	304 Stainless Steel
e.	Shaft journals and chamber bearings:	Silicon Carbide
f.	O-rings:	EPDM

Shaft couplings for motor flange sizes 184TC and smaller shall be made of cast iron or sintered steel. Shaft couplings for motor flange sizes larger than 184TC shall be made of ductile iron (ASTM 60-40-18).

Optional materials for the suction/discharge base and pump head shall be cast 316 stainless steel (ASTM CF-8M) resulting in all wetted parts of stainless steel.

4. The shaft seal shall be a balanced o-ring cartridge type with the following features:

a.	Collar, Drivers, Spring:	316 Stainless Steel
b.	Shaft Sleeve, Gland Plate:	316 Stainless Steel
c.	Stationary Ring:	Silicon Carbide
d.	Rotating Ring:	Silicon Carbide
e.	O-rings:	EPDM

The Silicon Carbide shall be imbedded with graphite.

5. Shaft seal replacement shall be possible without removal of any pump components other than the coupling guard, shaft coupling and motor. The entire cartridge shaft seal shall be removable as a one-piece component. Pumps with motors equal to or larger than 15 hp (fifteen horsepower) shall have adequate space within the motor stool so that shaft seal replacement is possible without motor removal.

E. Large In-line Vertical Multi-Stage Pumps (Nominal flows from 130 to 500 gallons per minute) shall have the following features:

1. The pump impellers shall be secured directly to the smooth pump shaft by means of a split cone and nut design.
2. The suction/discharge base shall have ANSI Class 125 or Class 250 flange connections in a slip ring (rotating flange) design as indicated in the drawings or pump schedule.
3. Pump Construction.

a.	Suction/discharge base, pump head	Ductile Iron (ASTM 80-55-06)
b.	Shaft couplings, flange rings:	Ductile Iron (ASTM 80-55-06)
b.	Shaft	431 Stainless Steel
c.	Motor Stool	Cast Iron (ASTM Class 30)
d.	Impellers, diffuser chambers, outer sleeve:	304 Stainless Steel
e.	Impeller wear rings:	304 Stainless Steel

f. Intermediate Bearing Journals: Silicon Carbide
g. Intermediate Chamber Bearings: Leadless Tin Bronze
h. Chamber Bushings: Graphite Filled PTFE
I. O-rings: EPDM

4. The shaft seal shall be a balanced o-ring cartridge type with the following features:
   a. Collar, Drivers, Spring: 316 Stainless Steel
   b. Shaft Sleeve, Gland Plate: 316 Stainless Steel
   c. Stationary Ring: Silicon Carbide
   d. Rotating Ring: Silicon Carbide
   e. O-rings: EPDM

   The Silicon Carbide shall be imbedded with graphite.

5. Shaft seal replacement shall be possible without removal of any pump components other than the coupling guard, motor couplings, motor and seal cover. The entire cartridge shaft seal shall be removable as a one-piece component. Pumps with motors equal to or larger than 15 hp (fifteen horsepower) shall have adequate space within the motor stool so that shaft seal replacement is possible without motor removal.

2.3 INTEGRATED VARIABLE FREQUENCY DRIVE MOTORS

A. Each motor shall be of the Integrated Variable Frequency Drive design consisting of a permanent magnet synchronous motor (ECM) and a Variable Frequency Drive (VFD) built and tested as one unit by the same manufacturer.

B. The VFD shall be of the PWM (Pulse Width Modulation) design using IGBT (Insulated Gate Bipolar Transistor) technology.

C. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of motor. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor current suitable for centrifugal pump control and to eliminate the need for motor de-rating.

D. The VFD shall automatically reduce the switching frequency and/or the output voltage and frequency to the motor during periods of sustained ambient temperatures that are higher than the normal operating range. The switching frequency shall be reduced before motor speed is reduced.

E. An integral RFI filter shall be standard in the VFD.

F. The VFD shall have a minimum of two skip frequency bands which can be field adjustable.

G. The VFD shall have internal solid-state overload protection designed to trip within the range of 105-110 percent of rated current.

H. The integrated VFD motor shall include protection against input transients, phase imbalance, loss of AC line phase, over-voltage, under-voltage, VFD over-temperature, and motor over-temperature. Three-phase integrated VFD motors shall be capable of providing full output voltage and frequency with a voltage imbalance of up to 10%.

I. The integrated VFD motor shall have, as a minimum, the following input/output capabilities:
   1. Speed Reference Signal: 0-10 VDC, 4-20mA
   2. Digital remote on/off
   3. Fault Signal Relay (NC or NO)

4. Fieldbus communication port (RS485)

J. The motor shall be Totally Enclosed Fan Cooled (TEFC) with a standard NEMA C-Face, Class F insulation with a temperature rise no higher than Class B.

K. The cooling design of the motor and VFD shall be such that a Class B motor temperature rise is not exceeded at full rated load and speed at a minimum switching frequency of 9.0 kHz.

L. The overall efficiency of the VFD and motor must exceed NEMA Premium Efficiency.

M. Motor drive end bearings shall be adequately sized so that the minimum L10 bearing life is 20,000 hours at the minimum allowable continuous flow rate for the pump at full rated speed.

2.4 PUMP SYSTEM CONTROLLER

A. The pump system controller shall be a standard product developed and supported by the pump manufacturer.

B. The controller shall be microprocessor based capable of having software changes and updates via personal computer (notebook). The controller user interface shall have a color display with a minimum screen size of 3-1/2-inches x 4-5/8-inches for easy viewing of system status parameters and for field programming. The display shall have a back light with contrast adjustment. Password protection of system settings shall be standard.

C. The controller shall provide internal galvanic isolation to all digital and analog inputs as well as all fieldbus connections.

D. The controller shall have the ability to be connected to a battery to maintain power on controller during periods of loss of supply power.

E. The controller shall have built in data logging capability. Logged vales shall be graphically displayed on the controller and able to be exported. A minimum of 3600 samples per logged value with the following parameters available for logging:
- Estimated flow-rate
- Speed of pumps
- Inlet pressure
- Process Value (usually discharge pressure of differential pressure depending on application)
- Power consumption
- Controlling parameter (process value)

F. The controller shall display the following as status readings from a single display on the controller (this display shall be the default):
- Current value of the control parameter, (typically discharge pressure)
- Most recent existing alarm (if any)
- System status with current operating mode
- Status of each pump with current operating mode and rotational speed as a percentage (percent)
- Estimated flow-rate, (not requiring flow meter connection)

G. The controller shall have as a minimum the following hardware inputs and outputs:
- Three analog inputs (4-20mA or 0-10VDC)
- Three digital inputs
- Two digital outputs

- Ethernet connection
- Field Service connection to PC for advanced programming and data logging

H. Pump system programming (field adjustable) shall include as a minimum the following:
- Water shortage protection (analog or digital)
- Sensor Settings (Suction, Discharge, Differential Pressure analog supply/range)
- PI Controller (Proportional gain and Integral time) settings
- High system pressure indication and shut-down
- Low system pressure indication and shut-down
- Low suction pressure/level shutdown (via digital contact)
- Low suction pressure/level warning (via analog signal)
- Low suction pressure/level shutdown (via analog signal)
- Flow meter settings (if used, analog signal)

I. The system controller shall be able to accept up to seven programmable set-points via a digital input, (additional input/output module may be required).

J. The controller shall have advanced water shortage protection. When analog sensors (level or pressure) are used for water shortage protection, there shall be two indication levels. One level is for warning indication only (indication that the water level/pressure is getting lower than expected levels) and the other level is for complete system shut-down (water or level is so low that pump damage can occur). System restart after shut-down shall be manual or automatic (user selectable).

K. The system pressure set-point shall be capable of being automatically adjusted by using an external set-point influence. The set-point influence function enables the user to adjust the control parameter (typically pressure) by measuring an additional parameter. (Example: Lower the system pressure set-point based on a flow measurement to compensate for lower friction losses at lower flow rates).

L. The controller shall be capable of receiving a remote analog set-point (4-20mA or 0-10 VDC) as well as a remote system on/off (digital) signal.

M. The controller shall be able to adjust the ramp time of a change in set point on both an increase or decrease change in set point.

N. The pump system controller shall store up to 24 warning and alarms in memory. The time, date and duration of each alarm shall be recorded. A potential-free relay shall be provided for alarm notification to the building management system. The controller shall display the following alarm conditions:

High System Pressure	Low system pressure
Low suction pressure (warning and alarm)	Individual pump failure
VFD trip/failure	Loss of sensor signal (4-20 mA)
Loss of remote set-point signal (4-20mA)	External Fault

O. The pump system controller shall be mounted in a UL Type 3R rated enclosure. A self-certified NEMA enclosure rating shall not be considered equal. The entire control panel shall be UL 508 listed as an assembly. The control panel shall include a main disconnect, circuit breakers for each pump and the control circuit and control relays for alarm functions.

Control panel options shall include, but not be limited to:
Pump Run Lights, System Fault Light, Surge Arrestor, Emergency/Normal Operation Switches Service Disconnect Switches, Qty (9) Configurable Digital Outputs available for monitoring, Qty (7) Configurable Digital Inputs available for control

P. The controller shall be capable of receiving a redundant sensor input to function as a backup to the primary sensor (typically discharge pressure).

Q. The controller shall have a pump "Test Run" feature such that pumps are switched on during periods of inactivity (system is switched to the "off" position but with electricity supply still connected). The inoperative pumps shall be switched on for a period of two to three (3-4) seconds every 24 hours, 48 hours or once per week and at specific time of day (user selectable).

R. The controller shall be capable of changing the number of pumps available to operate or have the ability limit the maximum power consumption by activation of a digital input for purposes of limited generator supplied power.

S. The controller shall be capable of displaying instantaneous power consumption (Watts or kilowatts) and cumulative energy consumption (kilowatt-hours).

T. The controller shall be capable of displaying instantaneous specific energy use (kW/gpm), (optional flow meter must be connected).

U. The actual pump performance curves (5^{th} order polynomial) shall be loaded (software) into the pump system controller. Pump curve data shall be used for the following:
1. Display and data logging of calculated flow rate (not requiring flow measurement)
2. Proportional pressure control
3. Pump outside of duty range protection
4. Pump cascade control based on pump efficiency

V. The controller shall be capable of displaying an estimated flow-rate on the default status screen.

W. The controller shall have proportional pressure control to compensate for pipe friction loss by decreasing pressure set-point at lower flow-rates and increasing pressure set-point at higher flow-rates by using actual flow rate or calculated flow rate. Proportional pressure control that uses pump speed or power consumption only shall not be considered equal to proportional pressure control that uses actual or calculated flow rate.

X. The controller shall have the ability to communicate common field-bus protocols, (BACnet, Modbus, Profibus, and LON), via optional communication expansion card installed inside controller.

Y. The controller shall have Ethernet connection with a built-in server allowing for connection to a network with read/write access to controller via web browser and internet.

Z. The controller shall have a programmable Service Contact Field that can be populated with service contact information including: contact name, address, phone number(s) and website.

2.5 SEQUENCE OF OPERATION

A. The system controller shall operate equal capacity variable speed pumps to maintain a constant discharge pressure or differential pressure (system set-point), depending on the application. The system controller shall receive an analog signal [4-20mA] from the factory installed pressure transducer on the discharge manifold, indicating the actual system pressure.

Standard Cascade Control (Pumping Efficiency Based):

The pump system controller shall adjust pump speed as necessary to maintain system set-point pressure as flow demand increases. Utilizing the pump curve information (5th order polynomial), the pump system controller shall stage on additional pumps when pump hydraulic efficiency will be higher with additional pumps in operation. Exception: When the flow and head are outside the operating pump(s) allowable operating range the controller shall switch on an additional pump thus distributing flow and allowing all pump(s) to operate in allowable operating range. When the system pressure is equal to the system set-point, all pumps in operation shall reach equal operating speeds. The pump system controller shall have field adjustable Proportional Gain and Integral time (PI) settings for system optimization.

Optional Cascade Control (Pump Start Speed Based):

As flow demand increases the pump speed shall be increased to maintain the system set-point pressure. When the operating pump(s) reach 96 percent of full speed (adjustable), an additional pump will be started and will increase speed until the system set-point is achieved. When the system pressure is equal to the system set-point all pumps in operation shall reach equal operating speeds. The pump system controller shall have field adjustable Proportional Gain and Integral time (PI) settings for system optimization.

B. The system controller shall be capable of switching pumps on and off to satisfy system demand without the use of flow switches, motor current monitors or temperature measuring devices.

C. All pumps in the system shall alternate automatically based on demand, time and fault. If flow demand is continuous (no flow shut-down does not occur), the system controller shall have the capability to alternate the pumps every 24 hours, every 48 hours or once per week. The interval and actual time of the pump change-over shall be field adjustable.

D. The system controller shall be able to control a pressure maintenance pump, (jockey pump), in the system in pressure boosting applications. The set point of the pressure maintenance pump shall be able to be any value above or below the pump system's set point. The pressure maintenance pump shall be able to be staged on as back-up pump when capacity of pump system is exceeded.

2.6 LOW FLOW STOP FUNCTION (Constant Pressure Applications)

A. The system controller shall be capable of stopping pumps during periods of low-flow or zero-flow without wasting water or adding unwanted heat to the liquid. Temperature based no flow shut-down methods that have the potential to waste water and add unwanted temperature rise to the pumping fluid are not acceptable and shall not be used.

B. Standard Low Flow Stop and Energy Saving Mode

1. If a low or no flow shut-down is required (periods of low or zero demand) a bladder type diaphragm tank shall be installed with a pre-charge pressure of 70 percent of system set-point. The tank shall be piped to the discharge manifold or system piping downstream of the pump system. When only one pump is in operation the system controller shall be capable of detecting low flow (less than 10 percent of pump nominal flow) without the use of additional flow sensing devices. When a low flow is detected, the system controller shall increase pump speed until the discharge pressure reaches the stop pressure (system set-point plus 50 percent of programmed on/off band, adjustable). The pump shall remain off until the discharge pressure reaches the start pressure (system set-

point minus 50 percent of programmed on/off band, adjustable). Upon low flow shut-down a pump shall be restarted in one of the following two ways:

C. Low Flow Restart: If the low flow condition still exists, the pump shall start and the speed shall again be increased until the stop pressure is reached and the pump shall again be switched off.

D. Normal Flow Restart: If the pump system controller determines a low flow condition no longer exists the pump shall start and the speed shall be increased until the system pressure reaches the system set-point.

E. Low Flow Stop and Energy Saving Mode (Optional)

1. The pump system controller shall be capable receiving a digital signal from a flow switch or an analog signal from a flow meter to indicate a low flow condition. A bladder type diaphragm tank shall be installed with a pre-charge pressure of 70 percent of system set-point. The tank shall be piped to the discharge manifold or system piping downstream of the pump system. When low flow is detected (signal from flow switch or meter), the system controller shall increase pump speed until the discharge pressure reaches the stop pressure (system set-point plus 50 percent of programmed on/off band). The pump shall remain off until the discharge pressure reaches the start pressure (system set-point minus 50 percent of programmed on/off band). The pump shall remain in the energy saving on/off mode during low flow indication. When low flow is no longer present (low flow indication ceases), the pump(s) shall resume constant pressure operation.

F. It shall be possible to change from the standard low flow stop to the optional low flow stop (and vice-versa) via the user interface.

2.6 SYSTEM CONSTRUCTION

A. Suction and discharge manifold construction shall be in way that ensures minimal pressure drops, minimize potential for corrosion, and prevents bacteria growth at intersection of piping into the manifold. Manifold construction that includes sharp edge transitions or interconnecting piping protruding into manifold is not acceptable. Manifold construction shall be such that water stagnation can not exist in manifold during operation to prevent bacteria growth inside manifold.

B. The suction and discharge manifolds material shall be 316 stainless steel. Manifold connection sizes shall be as follows:

3 inch and smaller:	Male NPT threaded
4 inch through 8 inch:	ANSI Class 150 rotating flanges
10 inch and larger:	ANSI Class 150 flanges

C. Pump Isolation valves shall be provided on the suction and discharge of each pump. Isolation valve sizes 2 inch and smaller shall be nickel plated brass full port ball valves. Isolation valve sizes 3 inch and larger shall be a full lug style butterfly valve. The valve disk shall be of stainless steel. The valve seat material shall be EPDM and the body shall be cast iron, coated internally and externally with fusion-bonded epoxy.

D. A spring-loaded non-slam type check valve shall be installed on the discharge of each pump. The valve shall be a wafer style type fitted between two flanges. The head loss through the check valve shall not exceed 5 psi at the pump design capacity. Check valves 1-1/2-inch and smaller shall have a POM composite body and poppet, a stainless-steel spring with EPDM or NBR seats. Check valves 2-inch and larger shall have a body material of stainless steel or epoxy coated iron (fusion bonded) with an EPDM or NBR resilient seat. Spring material shall be stainless steel. Disk shall be of stainless steel or leadless bronze.

E. For systems that require a diaphragm tank, a connection of no smaller than ¾-inch shall be provided on the discharge manifold.

F. A pressure transducer shall be factory installed on the discharge manifold (or field installed as specified on plans). Systems with positive inlet gauge pressure shall have a factory installed pressure transducer on the suction manifold for water shortage protection. Pressure transducers shall be made of 316 stainless steel. Transducer accuracy shall be +/- 1.0 percent full scale with hysteresis and repeatability of no greater than 0.1 percent full scale. The output signal shall be 4-20 mA with a supply voltage range of 9-32 VDC.

G. A bourdon tube pressure gauge, 2.5-inch diameter, shall be placed on the suction and discharge manifolds. The gauge shall be liquid filled and have copper alloy internal parts in a stainless-steel case. Gauge accuracy shall be 2 1/2 percent. The gauge shall be capable of a pressure of 30 percent above its maximum span without requiring recalibration.

H. Systems with a flooded suction inlet or suction lift configuration shall have a factory installed water shortage protection device on the suction manifold.

I. The base frame shall be constructed of corrosion resistant 304 stainless steel. Rubber vibration dampers shall be fitted between each pump and base frame to minimize vibration.

J. Depending on the system size and configuration, the control panel shall be mounted in one of the following ways:

On a 304 stainless steel fabricated control cabinet stand attached to the system skid.
On a 304 stainless steel fabricated skid, separate from the main system skid
On its own base (floor mounted with plinth)

PART 3 - EXECUTION

3.1 TESTING

A. The tester used for testing the pump system shall be constructed and calibrated according to the requirements of hydraulic test standard ISO 9906.

B. The entire pump station shall as a minimum be factory tested for functionality and documented results of functionality test supplied with pump station.

Functionality testing shall include the following parameters:

1. Complete System Hydrostatic Test – 1.5 times the nameplate maximum pressure
2. No-Flow Detection Shutoff Test
3. Water Shortage Test
4. Two-Point Setpoint Performance Test.

C. Water used for testing shall be treated with three different filtration systems to ensure only clean water is used for testing pump station.

1. 25-micron mechanical filter – removes solid parts from water
2. Activated carbon filter – keeps water clear and eliminates odor
3. Ultraviolet light system – kills all bacteria growth

3.2 WARRANTY

A. The warranty period shall be a non-prorated period of 24 months from date of installation, not to exceed 30 months from date of manufacture.

END OF SECTION

33 14 43.10 – CONSTANT SPEED PACKAGED PUMPING SYSTEMS FOR WATER UTILITY SERVICE

PART I – GENERAL

1.1 WORK INCLUDED

A. Constant Speed Packaged Pumping System

1.2 REFERENCE STANDARDS

The work in this section is subject to the requirements of applicable portions of the following standards:

A. Hydraulic Institute
B. ANSI – American National Standards Institute
C. ASTM – American Society for Testing and Materials
D. IEEE – Institute of Electrical and Electronics Engineers
E. NEMA – National Electrical Manufacturers Association
F. NEC – National Electrical Code
G. ISO – International Standards Organization
H. UL – Underwriters Laboratories, Inc.

1.3 DESIGN CRITERIA

A. Operating Capacity - Refer to project drawings

The booster pumps and motors shall be capable of operating within the specified parameters without permanent damage.

PART 2 – PRODUCTS

2.1 CONSTANT SPEED PACKAGED PUMPING SYSTEM

A. Furnish and install a pre-fabricated and tested constant speed packaged pumping system to maintain water delivery pressure.

B. The packaged pump system shall be a standard product of a single pump manufacturer. The entire pump system including pumps and pump logic controller, shall be designed and built by the same manufacturer.

C. The complete packaged water booster pump system shall be certified and listed by UL (Category QCZJ – Packaged Pumping Systems) for conformance to U.S. and Canadian Standards.

2.2 PUMPS

A. All pumps shall be ANSI/NSF 61 approved for drinking water.

B. The pumps shall be of the in-line vertical multi-stage design.

C. The head-capacity curve shall have a steady rise in head from maximum to minimum flow within the preferred operating region. The shut-off head shall be a minimum of 20% higher than the head at the best efficiency point.

D. Small Vertical In-Line Multi-Stage Pumps (Nominal flow from 3 to 125 gallons per minute) shall have the following features:

1. The pump impellers shall be secured directly to the pump shaft by means of a splined shaft arrangement.

2. The suction/discharge base shall have ANSI Class 250 flange or internal pipe thread (NPT) connections as determined by the pump station manufacturer.

3. Pump Construction.

a. Suction/discharge base, pump head, motor stool:	Cast iron (Class 30)
b. Impellers, diffuser chambers, outer sleeve:	304 Stainless Steel
c. Shaft	316 or 431 Stainless Steel
d. Impeller wear rings:	304 Stainless Steel
e. Shaft journals and chamber bearings:	Silicon Carbide
f. O-rings:	EPDM

Shaft couplings for motor flange sizes 184TC and smaller shall be made of cast iron or sintered steel. Shaft couplings for motor flange sizes larger than 184TC shall be made of ductile iron (ASTM 60-40-18).

Optional materials for the suction/discharge base and pump head shall be cast 316 stainless steel (ASTM CF-8M) resulting in all wetted parts of stainless steel.

4. The shaft seal shall be a balanced o-ring cartridge type with the following features:

a. Collar, Drivers, Spring:	316 Stainless Steel
b. Shaft Sleeve, Gland Plate:	316 Stainless Steel
c. Stationary Ring:	Silicon Carbide
d. Rotating Ring:	Silicon Carbide
e. O-rings:	EPDM

The Silicon Carbide shall be imbedded with graphite.

5. Shaft seal replacement shall be possible without removal of any pump components other than the coupling guard, shaft coupling and motor. The entire cartridge shaft seal shall be removable as a one-piece component. Pumps with motors equal to or larger than 15 hp (fifteen horsepower) shall have adequate space within the motor stool so that shaft seal replacement is possible without motor removal.

E. Large In-line Vertical Multi-Stage Pumps (Nominal flows from 130 to 500 gallons per minute) shall have the following features:

1. The pump impellers shall be secured directly to the smooth pump shaft by means of a split cone and nut design.

2. The suction/discharge base shall have ANSI Class 125 or Class 250 flange connections in a slip ring (rotating flange) design as indicated in the drawings or pump schedule.

3. Pump Construction.

a. Suction/discharge base, pump head	Ductile Iron (ASTM 65-45-12)
b. Shaft couplings, flange rings:	Ductile Iron (ASTM 65-45-12)
b. Shaft	431 Stainless Steel
c. Motor Stool	Cast Iron (ASTM Class 30)
d. Impellers, diffuser chambers, outer sleeve:	304 Stainless Steel
e. Impeller wear rings:	304 Stainless Steel
f. Intermediate Bearing Journals:	Tungsten Carbide
g. Intermediate Chamber Bearings:	Leadless Tin Bronze
h. Chamber Bushings:	Graphite Filled PTFE
I. O-rings:	EPDM

4. The shaft seal shall be a single balanced metal bellows cartridge with the following construction:

a. Bellows:	904L Stainless Steel
b. Shaft Sleeve, Gland Plate, Drive Collar:	316 Stainless Steel
c. Stationary Ring:	Carbon
d. Rotating Ring:	Tungsten Carbide
e. O-rings:	EPDM

5. Shaft seal replacement shall be possible without removal of any pump components other than the coupling guard, motor couplings, motor and seal cover. The entire cartridge shaft seal shall be removable as a one-piece component. Pumps with motors equal to or larger than 15 hp (fifteen horsepower) shall have adequate space within the motor stool so that shaft seal replacement is possible without motor removal.

2.3 MOTORS

A. Motors are to be provided with the following basic features:

1. Motors shall be designed for continuous duty operation, NEMA design B with a 1.15 S.F.

2. Totally Enclosed Fan Cooled Motors are to be furnished with minimum class F insulation. Open Drip Proof Motors are to be furnished with minimum class B insulation.

3. Nameplate shall have, as a minimum, all information as described in NEMA Standard MG 1-20.40.1.

4. Open Drip Proof (ODP) motors shall have drip covers.

5. Motors over 50 lbs shall having lifting provisions.

6. Motors shall have a NEMA C-Flange for vertical mounting.

7. Drive end bearings shall be adequately sized so that the minimum L10 bearing life is 17,500 hours at the minimum allowable continuous flow rate for the pump.

2.4 PUMP SYSTEM CONTROLLER

A. The pump system controller shall be a standard product developed and supported by the pump manufacturer.

B. The controller shall be microprocessor based capable of having software changes and updates via personal computer (notebook). The controller user interface shall have a VGA display with a minimum screen size of 3-1/2" x 4-5/8" for easy viewing of system status parameters and for field programming. The display shall have a back light with contrast adjustment. Password protection of system settings shall be standard.

C. The controller shall provide internal galvanic isolation to all digital and analog inputs as well as all fieldbus connections.

D. The controller shall display the following as status readings from a single display on the controller (this display shall be the default):

- Current value of the control parameter, (typically discharge pressure)
- Most recent existing alarm (if any)
- System status with current operating mode
- Status of each pump with current operating mode and rotational speed as a percentage (%)

E. The controller shall have as a minimum the following hardware inputs and outputs:

- Three analog inputs (4-20mA or 0-10VDC)
- Three digital inputs
- Two digital outputs
- Ethernet connection
- Field Service connection to PC for advanced programming and data logging

F. Pump system programming (field adjustable) shall include as a minimum the following:

- Water shortage protection (analog or digital)
- Transducer Settings (Suction and Discharge Analog supply/range)
- PI Controller (Proportional gain and Integral time) settings
- High system pressure indication and shut-down
- Low system pressure indication and shut-down
- Low suction pressure/level shutdown (via digital contact)
- Low suction pressure/level warning (via analog signal)
- Low suction pressure/level shutdown (via analog signal)
- Flow meter settings (if used, analog signal)

G. The system controller shall be able to accept up to seven programmable set-points via a digital input, (additional input/output module may be required).

H. The controller shall have advanced water shortage protection. When analog sensors (level or pressure) are used for water shortage protection, there shall be two indication levels. One level is for warning indication only (indication that the water level/pressure is getting lower than expected levels) and the other level is for complete system shut-down (water or level is so low that pump damage can occur). System restart after shut-down shall be manual or automatic (user selectable).

I. The system pressure set-point shall be capable of being automatically adjusted by using an external set-point influence. The set-point influence function enables the user to adjust the control parameter (typically pressure) by measuring an additional parameter. (Example: Lower the system pressure set-point based on a flow measurement to compensate for lower friction losses at lower flow rates).

J. The controller shall be capable of receiving a remote analog set-point (4-20mA or 0-10 VDC) as well as a remote system on/off (digital) signal.

K. The pump system controller shall store up to 24 warning and alarms in memory. The time, date and duration of each alarm shall be recorded. A potential-free relay shall be provided for alarm notification to the building management system. The controller shall display the following alarm conditions:

High System Pressure	Low system pressure
Low suction pressure (warning and/or alarm)	Individual pump failure
VFD trip/failure	Loss of sensor signal (4-20 mA)
Loss of remote set-point signal (4-20mA)	System power loss

L. The pump system controller shall be mounted in a UL Type 3R rated enclosure. A self-certified NEMA enclosure rating shall not be considered equal. The entire control panel shall be UL 508 listed as an assembly. The control panel shall include a main disconnect, circuit breakers for each pump and the control circuit and control relays for alarm functions.

Control panel options shall include, but not be limited to:

Pump Run Lights	Pump Alarm Lights
System Fault Light	Audible Alarm (80 db[A])
Surge Arrestor	Control Panel Internal Illumination
Emergency/Normal Operation Switches	Service Disconnect Switches

M. The controller shall be capable of receiving a redundant sensor input to function as a backup to the primary sensor (typically discharge pressure).

N. The controller shall have a pump "Test Run" feature such that pumps are switched on during periods of inactivity (system is switched to the "off" position but with electricity supply still connected). The inoperative pumps shall be switched on for a period of two to three (2-3) seconds every 24 hours, 48 hours or once per week (user selectable).

O. The actual pump performance curves (5^{th} order polynomial) shall be loaded (software) into the pump system controller.

2.5 SEQUENCE OF OPERATION

The system controller shall operate from two to six equal capacity pumps to maintain a discharge pressure (system set-point) range. The system controller shall receive an analog signal [4-20mA] from the factory installed pressure transducer on the discharge manifold, indicating the actual system pressure. When a flow demand is detected (drop in system pressure) a pump shall be switched on. If the discharge pressure is above the system set-point pressure and below the stop pressure, that pump shall remain in operation. If the system pressure continues to fall below the system set-point, an additional pump shall be started. If the actual system pressure is above the system set-point and below the stop pressure, all pumps in operation shall continue to run. When the system pressure rises above the stop pressure (decreasing flow), the system controller shall

switch a pump off. Additional pumps shall be switched off if the system pressure is above the stop pressure.

The system controller shall be capable of switching pumps on and off to satisfy system demand without the use of flow switches, motor current monitors or temperature measuring devices.

If a no flow shut-down is required (periods of zero demand) a bladder type diaphragm tank shall be installed. The tank shall be piped to the discharge manifold or system piping downstream of the pump system. When zero flow is detected by the system controller, the remaining pump(s) shall be switched off. When the system pressure falls to 50% of ON/OFF band below the system set-point (flow begins after shut-down), a pump shall be switched on, increasing speed to maintain the system set-point pressure.

All pumps in the system shall alternate automatically based on demand, time and fault. If flow demand is continuous (no flow shut-down does not occur), the system controller shall have the capability to alternate the pumps every 24 hours. The time of the pump change-over shall be field adjustable.

2.6 SYSTEM CONSTRUCTION

A. The suction and discharge manifolds shall be constructed of 316 stainless steel. Manifold connection sizes shall be as follows:

3 inch and smaller:	Male NPT threaded
4 inch through 8 inch:	ANSI Class 150 rotating flanges
10 inch and larger:	ANSI Class 150 flanges

B. Pump Isolation valves shall be provided on the suction and discharge of each pump. Isolation valve sizes 2 inch and smaller shall be nickel plated brass full port ball valves. Isolation valve sizes 3 inch and larger shall be a full lug style butterfly valve. The valve disk shall be of stainless steel. The valve seat material shall be EPDM and the body shall be cast iron, coated internally and externally with fusion-bonded epoxy.

B. A spring-loaded non-slam type check valve shall be installed on the discharge of each pump. The valve shall be a wafer style type fitted between two flanges. The head loss through the valve shall not exceed 5 psi at the pump design capacity. Check valves 1-1/2” and smaller shall have a POM composite body and poppet, a stainless-steel spring with EPDM or NBR seats. Check valves 2” and larger shall have a body material of stainless steel or epoxy coated iron (fusion bonded) with an EPDM or NBR resilient seat. Spring material shall be stainless steel. Disk shall be of stainless steel or leadless bronze.

C. For systems that require a diaphragm tank, a minimum diaphragm tank connection size of ¾” shall be provided on the discharge manifold.

D. A pressure transducer shall be factory installed on the discharge manifold (or field installed as specified on plans). Systems with positive inlet gauge pressure shall have a factory installed pressure transducer on the suction manifold for water shortage protection. Pressure transducers shall be made of 316 stainless steel. Transducer accuracy shall be +/- 1.0% full scale with hysteresis and repeatability of no greater than 0.1% full scale. The output signal shall be 4-20 mA with a supply voltage range of 9-32 VDC.

E. A bourdon tube pressure gauge, 2.5-inch diameter, shall be placed on the suction and discharge manifolds. The gauge shall be liquid filled and have copper alloy internal parts in a stainless-

steel case. Gauge accuracy shall be 2/1/2 %. The gauge shall be capable of a pressure of 30% above its maximum span without requiring recalibration.

F. Systems with a flooded suction inlet or suction lift configuration shall have a factory installed water shortage protection device on the suction manifold.

G. The base frame shall be constructed of corrosion resistant 304 stainless steel. Rubber vibration dampers shall be fitted between each pump and base frame to minimize vibration.

H. Depending on the system size and configuration, the control panel shall be mounted in one of the following ways:

On a 304 stainless steel fabricated control cabinet stand attached to the system skid
On a 304 stainless steel fabricated skid, separate from the main system skid
On its own base (floor mounted with plinth)

2.7 TESTING

A. The entire pump station shall be factory performance tested as a complete unit prior to shipment. Job-site programming shall be entered into the controller prior to shipment (details of installation requirements shall be communicated to the pump system manufacturer). A verified performance test report shall be made available from the system manufacturer.

B. The system shall undergo a hydrostatic test of 350 psig for a minimum of 15 minutes prior to shipment.

2.8 WARRANTY

A. The warranty period shall be a non-prorated period of 24 months from date of installation, not to exceed 30 months from date of manufacture.

PART 3 – EXECUTION

Not Applicable

END OF SECTION

SECTION 33 31 00

SANITARY SEWERAGE SYSTEMS

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Installation of a buried non-pressure sanitary sewer pipe system.

B. Refer to Section 33 11 00 if installation is a pressurized pipe system.

1.2 **REFERENCES**

A **APWA (Utah) Standards**:

Plan 255 Bituminous concrete T-patch

Plan 256 Concrete pavement patch

Plan 381 Trench backfill

Plan 382 Pipe zone backfill

Plan 411 Sanitary sewer manhole

Plan 431 Sewer lateral connection

B. **ASTM Standards**:

C478 Precast Reinforced Concrete Manhole Section.

C891 Installation of Underground Precast Concrete Utility Structures.

C923 Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.

1.3 **DEFINITIONS**

A. **Non-pressure Pipe System**: Defined in Section 33 41 00.

1.4 **PERFORMANCE REQUIREMENTS**

A. Vertical Cover: Unless indicated otherwise, provide at least two (2) feet of protection cover during construction.

B. Remove any section of pipe already placed that is found to be out of alignment tolerance, defective, or damaged. Relay or replace at no additional cost to OWNER.

1.5 **SUBMITTALS**

A. Product data: Submit manufacturer's technical product data and installation instructions.

B. Commissioning: Provide Section 33 08 00 submittals.

1.6 **SITE CONDITIONS**

A. Minimize neighborhood traffic interruptions. Barricade stockpiles.

B. Provide access to adjacent properties for local traffic and pedestrians, Section 01 31 13.

1.7 **ACCEPTANCE**

A. Each samitary sewer system component must pass aapplicable commissioning requirements in Section 33 08 00.

PART 2 PRODUCTS

2.1 **PIPES AND FITTINGS**

A. Provide piping materials and factory fabricated piping products of sizes, types, and classes required.

B. Where not indicated, select product acceptable to ENGINEER and comply with installation requirements.

C. Provide pipe fittings and accessories of same material and weight or class as pipe, with joining method indicated or recommended by manufacturer.

2.2 **MORTAR, GROUT AND CONCRETE**

A. Portland cement mortar, Section 04 05 16.

B. Non-shrink grout, Section 03 61 00.

C. Concrete:

1. Cast-in-place: Section 03 30 04.
2. Precast Concrete: Section 03 40 00.

2.3 **MANHOLES**

A. Basin: Concrete floor and walls, or ASTM C478 precast concrete.

B. Steps: None.

C. Top: Concentric cone. Concentric flat slab concrete deck allowed only with ENGINEER's permission.

D. Frame and Cover: Scoriated, asphalt coated, heavy duty, ductile iron Section 05 56 00, with flat top design meeting load rating H-20 and appropriate utility lettering. Shape, size and lifting device as necessary.

E. Pipe Connectors:

1. Precast Bases: Resilient, ASTM C923. Sand mortar grout pipe connections.
2. Cast in Place or Connections to Existing Fixture with Plastic Pipe: Use rubber adapter gasket for precast sections. Grout, Section 03 61 00 for cast in place sections.

F. Joints in Sections: Bituminous mastic gasket-type sealant or otherwise acceptable to ENGINEER.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify Trench Excavation is ready to receive work, and dimensions, and elevations are correct. Commencing installation means acceptance of existing conditions.

B. Hand trim excavations to required elevations. Backfill over excavations and compact, Section 31 23 26.

C. Examine areas and conditions under which materials and products are to be installed. Do not proceed with system installation until unsatisfactory conditions have been corrected in manner acceptable to system installer.

D. Clearly identify and promptly set aside defective or damaged pipe.

E. Use pipe cutting tool acceptable to pipe manufacturer.

3.2 ABANDONED UTILITIES

A. Use concrete to plug and cap openings in abandoned underground utilities that are to remain in place.

B. Provide closures to withstand hydrostatic or earth pressure that may result after abandoned utilities have been closed.

3.3 INSTALLATION - PIPE AND FITTINGS

A. Install pipe and fittings per APWA Plan 382.

B. Place bell or groove end facing upstream.

C. Install gaskets per manufacturer's recommendations.

D. Plug pipeline branches, stubs or other open ends that are not to be immediately connected.

E. Clean interior of pipe of dirt and debris as work progresses.

F. Meet line and grade tolerance in Section 33 08 00. Use a laser device or demonstrate an equivalent method of establishing line and grade.

3.4 INSTALLATION - JOINTS

A. Join pipe per manufacturer's recommendation.

B. Join pipe of different sizes at manholes only.

C. Use neoprene couplings with stainless steel bands to make connections between dissimilar pipe, or where standard pipeline joints are impractical.

3.5 INSTALLATION - MANHOLES

A. Install manholes per APWA Plan 411.

B. Form bottom of excavation clean and smooth to correct elevation.

C. Place structures in location indicated.

D. Provide elevations and pipe inverts for inlets and outlets indicated.

E. When structures occur in Pavements, mount frame and cover 1/2 inch below finished surface. Provide a concrete Cover Collar between the frame and bituminous Pavement. Elsewhere set frame and cover three (3) inches above finished grade.

3.6 **INSTALLATION - TAP CONNECTIONS-6 INCHES AND SMALLER**

A. Install connections per APWA Plan 431.

B. Field cutting into new or existing piping will not be permitted unless written permission is obtained from ENGINEER.

C. Make connections to existing pipe and underground structures, so connections will conform as nearly as practicable to requirements specified for new work.

D. Use commercially manufactured wyes for branch connections. Spring wyes into existing line and encase entire wye, plus six (6) inches overlap, with not less than six (6) inches of concrete.

E. For taps into existing 24 inches or larger piping, or to underground structures, cut opening into unit sufficiently large to allow three (3) inches of concrete to be packed around entering connection. Cut ends of connection passing through pipe or structure wall to conform to shape of and parallel with inside wall, unless otherwise indicated. Grout connection to provide smooth transition inlet into pipe.

3.7 **INSTALLATION - TAP CONNECTIONS-LARGER THAN 6 INCHES**

A. Not allowed. Provide a Manhole structure per APWA Plan 411.

3.8 **BACKFILLING**

A. Trench Backfill: Place backfill per Section 33 05 20. Provide product and placement indicated in the following Standard Plans.

1. APWA Plan 382 for pipe zone backfill.
2. APWA Plan 381 for trench backfill above pipe zone.

B. Landscape and Structural Backfill: Place backfill per Section 31 23 23. Provide product and placement indicated.

C. Repair public and private facilities damaged by CONTRACTOR.

3.9 **SURFACE FINISHING**

A. Roadway Trenches and Patches: Restore pavement patches per Section 33 05 25. Provide product and placement indicated in the following standard plans.

1. APWA Plan 255 for bituminous pavement T-patch.
2. APWA Plan 256 for Portland cement concrete pavement patch.

B. Landscapes: Restore landscaping as indicated and as follows where applicable.

1. Section 32 92 00 for turf and grass cover.

2. Section 32 93 13 for other ground cover.

C. Repair public and private facilities damaged by CONTRACTOR.

3.10 **COMMISSIONING**

A. Before surface finishing, commission pipeline per Section 33 08 00. Provide sizes and types of equipment connections and fittings that match pipe materials when pressure testing system.

B. If paved surfaces must be kept open prior to commissioning, provide temporary paved surfaces.

3.11 **CLEANING**

A. Remove debris, concrete, or other extraneous material that accumulates in existing pipes or structures.

B. Clean all pipelines after testing. Do not flush sand, gravel, concrete, debris or other materials into existing piping systems.

END OF SECTION

SECTION 33 32 16 – GRINDER PUMP STATIONS

PART 1 - GENERAL

1.1 GENERAL DESCRIPTION

A. The MANUFACTURER shall furnish complete factory-built and tested grinder pump unit(s), each consisting of a grinder pump core suitably mounted on an integral stand of stainless steel, special polyethylene tank, electrical quick disconnect (NEMA 6P), pump removal harness, discharge assembly/shut-off valve, anti-siphon valve/check valve assembly, electrical alarm assembly and all necessary internal wiring and controls. For ease of serviceability, all pump motor/grinder units shall be of like type and horsepower throughout the system.

1.2 SUBMITTALS

A. After receipt of notice to proceed, the MANUFACTURER shall furnish a minimum of six sets of shop drawings detailing the equipment to be furnished including dimensional data and materials of construction. The ENGINEER shall promptly review this data, and return two copies as accepted, or with requested modifications. Upon receipt of accepted shop drawings, the MANUFACTURER shall proceed immediately with fabrication of the equipment.

1.3 MANUFACTURER

A**.** Grinder pump stations, complete with all appurtenances, form an integral system, and as such, shall be supplied by one grinder pump station manufacturer. The CONTRACTOR shall be responsible for the satisfactory operation of the entire system. The equipment specified shall be a product of a company experienced in the design and manufacture of grinder pumps for specific use in low pressure sewage systems. The company shall submit detailed installation and user instructions for its product, submit evidence of an established service program including complete parts and service manuals, and be responsible for maintaining a continuing inventory of grinder pump replacement parts. The MANUFACTURER shall provide, upon request, a reference and contact list from ten of its largest contiguous grinder pump installations of the type of grinder pumps described within this specification.

B. Attention is directed to the fact that the drawings and overall system design are based on a particular piece of equipment from a particular manufacturer. These specifications are intended to provide guidelines for standard equipment of a recognized manufacturer who already meets all the requirements of this specification.

1.3 EXPERIENCE

A. The equipment furnished hereunder shall be the product of a company experienced in the design and manufacture of grinder pumps specifically designed for use in low pressure systems. All manufacturers proposing equipment for this project shall have at least 10 years of experience in the design and manufacture of units of identical size(s) and performance to the specified units.

1.4 OPERATING CONDITIONS

A. The pumps shall be capable of delivering 15 GPM against a rated total dynamic head of 0 feet (0 PSIG), 11 GPM against a rated total dynamic head of 92 feet (40 PSIG), and 7.8 GPM against a rated

total dynamic head of 185 feet (80 PSIG). The pump(s) must also be capable of operating at negative total dynamic head without overloading the motor(s). Under no conditions shall in-line piping or valving be allowed to create a false apparent head.

1.5 WARRANTY

A. The grinder pump MANUFACTURER shall provide a part(s) and labor warranty on the complete station and accessories, including, but not limited to, the panel for a period of 24 months after notice of OWNER'S acceptance, but no greater than 27 months after receipt of shipment. Any manufacturing defects found during the warranty period will be reported to the MANUFACTURER by the OWNER and will be corrected by the MANUFACTURER at no cost to the OWNER.

PART 2 - PRODUCTS

2.1 PUMP

A. The pump shall be a custom designed, integral, vertical rotor, motor driven, solids handling pump of the progressing cavity type with a single mechanical seal. Double radial O-ring seals are required at all casting joints to minimize corrosion and create a protective barrier. All pump castings shall be cast iron, fully epoxy coated to 8-10 mil Nominal dry thickness, wet applied. The rotor shall be through-hardened, highly polished, precipitation hardened stainless steel. The stator shall be of a specifically compounded ethylene propylene synthetic elastomer. This material shall be suitable for domestic wastewater service. Its physical properties shall include high tear and abrasion resistance, grease resistance, water and detergent resistance, temperature stability, excellent aging properties, and outstanding wear resistance. Buna-N is not acceptable as a stator material because it does not exhibit the properties as outlined above and required for wastewater service.

2.2 GRINDER

A. The grinder shall be placed immediately below the pumping elements and shall be direct-driven by a single, one-piece motor shaft. The grinder impeller (cutter wheel) assembly shall be securely fastened to the pump motor shaft by means of a threaded connection attaching the grinder impeller to the motor shaft. Attachment by means of pins or keys will not be acceptable. The grinder impeller shall be a one-piece, 4140 cutter wheel of the rotating type with inductively hardened cutter teeth. The cutter teeth shall be inductively hardened to Rockwell 50 – 60c for abrasion resistance. The shredder ring shall be of the stationary type and the material shall be white cast iron. The teeth shall be ground into the material to achieve effective grinding. The shredder ring shall have a staggered tooth pattern with only one edge engaged at a time, maximizing the cutting torque. These materials have been chosen for their capacity to perform in the intended environment as they are materials with wear and corrosive resistant properties.

B. This assembly shall be dynamically balanced and operate without objectionable noise or vibration over the entire range of recommended operating pressures. The grinder shall be constructed so as to minimize clogging and jamming under all normal operating conditions including starting. Sufficient vortex action shall be created to scour the tank free of deposits or sludge banks which would impair the operation of the pump. These requirements shall be accomplished by the following, in conjunction with the pump:

1. The grinder shall be positioned in such a way that solids are fed in an upward flow direction.

2. The maximum flow rate through the cutting mechanism must not exceed 4 feet per second. This is a critical design element to minimize jamming and as such must be adhered to.

3. The inlet shroud shall have a diameter of no less than 5 inches. Inlet shrouds that are less than 5 inches in diameter will not be accepted due to their inability to maintain the specified 4 feet per second maximum inlet velocity which by design prevents unnecessary jamming of the cutter mechanism and minimizes blinding of the pump by large objects that block the inlet shroud.

4. The impeller mechanism must rotate at a nominal speed of no greater than 1800 rpm.

C. The grinder shall be capable of reducing all components in normal domestic sewage, including a reasonable amount of "foreign objects," such as paper, wood, plastic, glass, wipes, rubber and the like, to finely-divided particles which will pass freely through the passages of the pump and the 1-1/4-inch diameter stainless steel discharge piping.

2.3 ELECTRIC MOTOR

A. As a maximum, the motor shall be a 1 HP, 1725 RPM, 240 Volt 60 Hertz, 1 Phase, capacitor start, ball bearing, air-cooled induction type with Class F installation, low starting current not to exceed 30 amperes and high starting torque of 8.4-foot pounds. The motor shall be press-fit into the casting for better heat transfer and longer winding life. Inherent protection against running overloads or locked rotor conditions for the pump motor shall be provided by the use of an automatic-reset, integral thermal overload protector incorporated into the motor. This motor protector combination shall have been specifically investigated and listed by Underwriters Laboratories, Inc., for the application. Non-capacitor start motors or permanent split capacitor motors will not be accepted because of their reduced starting torque and consequent diminished grinding capability. The wet portion of the motor armature must be 300 Series stainless. To reduce the potential of environmental concerns, the expense of handling and disposing of oil, and the associated maintenance costs, oil-filled motors will not be accepted.

2.4 MECHANICAL SEAL

A**.** The pump/core shall be provided with a mechanical shaft seal to prevent leakage between the motor and pump. The seal shall have a stationary ceramic seat and carbon rotating surface with faces precision lapped and held in position by a stainless-steel spring.

2.5 TANK

A. High Density Polyethylene Construction

1. The tank shall be a Wetwell/Drywell design made of polyethylene, with a grade selected to provide the necessary environmental stress cracking resistance. Corrugated sections are to be made of a double wall construction with the internal wall being generally smooth to promote scouring. The corrugations of the outside wall are to be a minimum amplitude of 1-1/2-inch to provide necessary transverse stiffness. Any incidental sections of a single wall construction are to be 0.250-inch thick (minimum). All seams created during tank construction are to be thermally welded and factory tested for leak tightness. The tank wall and bottom must withstand the pressure exerted by saturated soil loading at maximum burial depth. All station components must function normally when exposed to 150 percent of the maximum external soil and hydrostatic pressure.

B. The tank shall be furnished with one EPDM grommet fitting to accept a 4.50-inch OD DWV or Schedule 40 pipe.

C. The Drywell accessway shall be an integral extension of the Wetwell assembly and shall include a lockable cover assembly providing low profile mounting and watertight capability. The cover shall be high density polyethylene, green in color, with a load rating of 150 lbs per square foot. The accessway design and construction shall enable field adjustment of the station height in increments of 3-inch or less without the use of any adhesives or sealants requiring cure time before installation can be completed.

D. The station shall have all necessary penetrations molded in and factory sealed. To ensure a leak free installation no field penetrations will be acceptable.

E. All discharge piping shall be constructed of 304 stainless steel. The discharge shall terminate outside the accessway bulkhead with a stainless steel, 1-1/4-inch Female NPT fitting. The discharge piping shall include a stainless-steel ball valve rated for 235 psi WOG; PVC ball valves or brass ball/gate will not be accepted. The bulkhead penetration shall be factory installed and warranted by the manufacturer to be watertight.

F. The accessway shall include a single NEMA 6P Electrical Quick Disconnect (EQD) for all power and control functions, factory installed with accessway penetrations warranted by the manufacturer to be watertight. The EQD will be supplied with 32-feet, 25-feet of useable Electrical Supply Cable (ESC) outside the station, to connect to the alarm panel. The ESC shall be installed in the basin by the manufacturer. Field assembly of the ESC into the basin is not acceptable because of potential workmanship issues. The EQD shall require no tools for connecting, seal against water before the electrical connection is made, and include radial seals to assure a watertight seal regardless of tightening torque. Plug-type connections of the power cable onto the pump housing will not be acceptable due to the potential for leaks and electrical shorts. A junction box shall not be permitted in the accessway due to the large number of potential leak points. The EQD shall be so designed to be conducive to field wiring as required. The accessway shall also include an integral 2-inch vent to prevent sewage gases from accumulating in the tank.

2.6 CHECK VALVE

A. The pump discharge shall be equipped with a factory installed, gravity operated, flapper-type integral check valve built into the discharge piping. The check valve will provide a full-ported passageway when open, and shall introduce a friction loss of less than 6 inches of water at maximum rated flow. Moving parts will be made of a 300 Series stainless steel and fabric reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly providing a maximum degree of freedom to assure seating even at a very low back-pressure. The valve body shall be an injection molded part made of an engineered thermoplastic resin. The valve shall be rated for continuous operating pressure of 235 psi. Ball-type check valves are unacceptable due to their limited sealing capacity in slurry applications.

2.7 ANTI-SIPHON VALVE

A. The pump discharge shall be equipped with a factory-installed, gravity-operated, flapper-type integral anti-siphon valve built into the discharge piping. Moving parts will be made of 300 Series stainless steel and fabric-reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly, providing a maximum degree of freedom to ensure proper operation even at a very low pressure. The valve body shall be injection-molded from an engineered thermoplastic resin. Holes or ports in the

discharge piping are not acceptable anti-siphon devices due to their tendency to clog from the solids in the slurry being pumped. The anti-siphon port diameter shall be no less than 60% of the inside diameter of the pump discharge piping.

2.8 CORE UNIT

A. The grinder pump station shall have an easily removable core assembly containing pump, motor, grinder, all motor controls, check valve, anti-siphon valve, electrical quick disconnect and wiring. The watertight integrity of the core unit shall be established by a 100 percent factory test at a minimum of 5 PSIG.

2.9 CONTROLS

A. All necessary motor starting controls shall be located in the cast iron enclosure of the core unit secured by stainless steel fasteners. Locating motor starting controls in a plastic enclosure is not acceptable. Wastewater level sensing controls shall be housed in a separate enclosure from motor starting controls. Level sensor housing must be sealed via a radial type seal; solvents or glues are not acceptable. Level sensing control housing must be integrally attached to pump assembly so that it may be removed from the station with the pump and in such a way as to minimize the potential for the accumulation of grease and debris accumulation, etc. Level sensing housing must be a high-impact thermoplastic copolymer over-molded with a thermo plastic elastomer. The use of PVC for the level sensing housing is not acceptable.

B. Non-fouling wastewater level controls for controlling pump operation shall be accomplished by monitoring the pressure changes in an integral air column connected to a pressure switch. The air column shall be integrally molded from a thermoplastic elastomer suitable for use in wastewater and with excellent impact resistance. The air column shall have only a single connection between the water level being monitored and the pressure switch. Any connections are to be sealed radially with redundant O-rings. The level detection device shall have no moving parts in direct contact with the wastewater and shall be integral to the pump core assembly in a single, readily-exchanged unit. Depressing the push to run button must operate the pump even with the level sensor housing removed from the pump.

C. All fasteners throughout the assembly shall be 300 Series stainless steel. High-level sensing will be accomplished in the manner detailed above by a separate air column sensor and pressure switch of the same type. Closure of the high-level sensing device will energize an alarm circuit as well as a redundant pump-on circuit. For increased reliability, pump ON/OFF and high-level alarm functions shall not be controlled by the same switch. Float switches of any kind, including float trees, will not be accepted due to the periodic need to maintain (rinsing, cleaning) such devices and their tendency to malfunction because of incorrect wiring, tangling, grease buildup, and mechanical cord fatigue. To assure reliable operation of the pressure switches, each core shall be equipped with a factory installed equalizer diaphragm that compensates for any atmospheric pressure or temperature changes. Tube or piping runs outside of the station tank or into tank-mounted junction boxes providing pressure switch equalization will not be permitted due to their susceptibility to condensation, kinking, pinching, and insect infestation. The grinder pump will be furnished with a 6 conductor, 14-gauge, type SJOW cable, pre-wired and watertight to meet UL requirements with a FACTORY INSTALLED NEMA 6P EQD half attached to it.

2.10 STAINLESS STEEL CURB STOP/CHECK VALVE ASSEMBLY (UNI-LATERAL)

A. The curb stop shall be pressure-tight in both directions. The ball valve actuator shall include position stop features at the fully opened and closed positions. The curb stop/check valve assembly shall be designed to withstand a working pressure of 235 psi.

B. The stainless-steel check valve shall be integral with the curb stop valve. The check valve will provide a full-ported 1-1/4-inch passageway and shall introduce minimal friction loss at maximum rated flow. The flapper hinge design shall provide a maximum degree of freedom and ensure seating at low back pressure.

C. Engineered Thermoplastic Fittings – All plastic fitting components are to be in compliance with applicable ASTM standards.

D. All pipe connections shall be made using compression fitting connections including a Buna-N O-ring for sealing to the outside diameter of the pipe. A split-collet locking device shall be integrated into all pipe connection fittings to securely restrain the pipe from hydraulic pressure and external loading caused by shifting and settling.

E. Curb Boxes – Curb boxes shall be constructed of ABS, conforming to ASTM-D 1788. Lid top casting shall be cast iron, conforming to ASTM A-48 Class 25, providing magnetic detectability, and be painted black. All components shall be inherently corrosion-resistant to ensure durability in the ground. Curb boxes shall provide height adjustment downward (shorter) from their nominal height.

F. High Density Polyethylene Pipe (Supplied by others) – Pipe shall have a working pressure of 160 psi minimum and shall be classified SDR per ASTM D 3035.

G. Pipe Dimensions – The SDR (Standard Dimension Ratio) of the pipe supplied shall be as specified by the SPECIFYING ENGINEER. SDR 7, 9 and 11 fittings are available from the MANUFACTURER.

H. Factory Test – The stainless steel, combination curb stop/check valve component shall be 100 percent hydrostatically tested to 150 psi in the factory.

I. Construction Practices – Pipe shall be stored on clean, level ground to prevent undue scratching or gouging of the pipe. If the pipe must be stacked for storage, such stacking should be in accordance with the pipe manufacturer's recommendations. The pipe should be handled in such a manner that it is not damaged by being dragged over sharp objects or cut by chokers or lifting equipment.

J. Segments of pipe having cuts or gouges in excess of 10 percent of the wall thickness of the pipe shall be cut out and removed. The undamaged portions of the pipe shall be rejoined using the butt fusion joining method. Sections of polyethylene pipe should be joined into continuous lengths on the job site above ground. The joining method shall be the butt-fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The butt-fusion equipment used in the joining procedure shall be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, fusion temperature, alignment, and fusion pressure.

K. Fused segments of pipe shall be handled so as to avoid damage to the pipe. When lifting fused sections of pipe, chains or cable-type chokers should be avoided. Nylon slings are preferred. Spreader bars should be used when lifting long, fused sections. Care should be exercised to avoid cutting or gouging the pipe.

L. Installation – Assemble the compression fittings according to the fitting manufacturer's recommendations.

M. The trench and trench bottom should be constructed in accordance with ASTM D 2321. Embedment materials should be Class I, Class II or Class III materials as defined in ASTM D 2321. The use of Class IV and/or Class V materials for embedment is not recommended and should be allowed only with the approval of the SPECIFYING ENGINEER. Bedding of the pipe should be performed in accordance with ASTM D 2321. Compaction should be as specified in ASTM D 2321. Deviations from the specified compaction shall be approved by the SPECIFYING ENGINEER.

N. Haunching and initial backfill should be as specified in ASTM D 2321 using Class I, Class II or Class III materials. Materials used and compaction shall be as specified by the SPECIFYING ENGINEER. In cases where a compaction of 85 percent Standard Proctor Density is not attainable, the SPECIFYING ENGINEER may wish to increase the SDR of the pipe to provide adequate stiffness. ASTM D 2321 sections titled "Minimum Cover for Load Application," "Use of Compaction Equipment" and "Removal of Trench Protection" should apply unless directed otherwise by the SPECIFYING ENGINEER.

2.11 ALARM PANEL

A. Each grinder pump station shall include a NEMA 4X, UL-listed alarm panel suitable for wall or pole mounting. The NEMA 4X enclosure shall be manufactured of thermoplastic polyester to ensure corrosion resistance. The enclosure shall include a hinged, lockable cover with padlock, preventing access to electrical components, and creating a secured safety front to allow access only to authorized personnel. The enclosure shall not exceed 10.5-inch (Width) x 14-inch (Height) x 7-inch (Depth), or 12.5-inch (Width) x 16-inch (Height) x 7.5-inch (Depth) if certain options are included.

B. The alarm panel shall contain one 15-amp, double-pole circuit breaker for the pump core's power circuit and one 15-amp single-pole circuit breaker for the alarm circuit. The panel shall contain a push-to-run feature, an internal run indicator, and a complete alarm circuit. All circuit boards in the alarm panel are to be protected with a conformal coating on both sides and the AC power circuit shall include an auto resetting fuse.

C. The alarm panel shall include the following features: external audible and visual alarm; push-to-run switch; push-to-silence switch; redundant pump start; and high-level alarm capability. The alarm sequence is to be as follows when the pump and alarm breakers are on:

1. When liquid level in the sewage wet-well rises above the alarm level, the contacts on the alarm pressure switch activate, audible and visual alarms are activated, and the redundant pump starting system is energized.

2. The audible alarm may be silenced by means of the externally mounted, push-to-silence button.

3. Visual alarm remains illuminated until the sewage level in the wet-well drops below the "off" setting of the alarm pressure switch.

D. The visual alarm lamp shall be inside a red, oblong lens at least 3.75-inch (Length) x 2.38-inch (Width) x 1.5-inch (Heiht). Visual alarm shall be mounted to the top of the enclosure in such a manner as to maintain NEMA 4X rating. The audible alarm shall be externally mounted on the bottom of the enclosure, capable of 93 dB @ 2 feet. The audible alarm shall be capable of being deactivated by depressing a push-type switch that is encapsulated in a weatherproof silicone boot and mounted on the bottom of the enclosure (push-to-silence button).

E. The entire alarm panel, as manufactured and including any of the following options shall be listed by Underwriters Laboratories, Inc.

2.12 SERVICEABILITY

A. The grinder pump core, including level sensor assembly, shall have two lifting hooks complete with lift-out harness connected to its top housing to facilitate easy core removal when necessary. The level sensor assembly must be easily removed from the pump assembly for service or replacement. All mechanical and electrical connections must provide easy disconnect capability for core unit removal and installation. Each EQD half must include a water-tight cover to protect the internal electrical pins while the EQD is unplugged. A pump push-to-run feature will be provided for field trouble shooting. The push-to-run feature must operate the pump even if the level sensor assembly has been removed from the pump assembly. All motor control components shall be mounted on a readily replaceable bracket for ease of field service.

2.13 OSHA CONFINED SPACE

A**.** All maintenance tasks for the grinder pump station must be possible without entry into the grinder pump station (as per OSHA 1910.146 Permit-required confined spaces). *"Entry means the action by which a person passes through an opening into a permit-required confined space. Entry includes ensuing work activities in that space and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space."*

2.14 SAFETY

A**.** The grinder pump shall be free from electrical and fire hazards as required in a residential environment. As evidence of compliance with this requirement, the completely assembled and wired grinder pump station shall be listed by Underwriters Laboratories, Inc., to be safe and appropriate for the intended use. UL listing of components of the station, or third-party testing to UL standard are not acceptable.

B. The grinder pump shall meet accepted standards for plumbing equipment for use in or near residences, shall be free from noise, odor, or health hazards, and shall have been tested by an independent laboratory to certify its capability to perform as specified in either individual or low-pressure sewer system applications. As evidence of compliance with this requirement, the grinder pump shall bear the seal of NSF International. Third-party testing to NSF standard is not acceptable.

PART 3 - EXECUTION

3.1 FACTORY TEST

A. Each grinder pump shall be submerged and operated for 1.5 minutes (minimum). Included in this procedure will be the testing of all ancillary components such as, the anti-siphon valve, check valve, discharge assembly and each unit's dedicated level controls and motor controls. All factory tests shall incorporate each of the above listed items. Actual appurtenances and controls which will be installed in the field shall be particular to the tested pump only. A common set of appurtenances and controls for all pumps is not acceptable. Certified test results shall be available upon request showing the operation of each grinder pump at two different points on its curve. Additional validation tests include: integral level control performance, continuity to ground and acoustic tests of the rotating components.

B. The ENGINEER reserves the right to inspect such testing procedures with representatives of the OWNER, at the GRINDER PUMP MANUFACTURER'S facility.

All completed stations shall be factory leak tested to assure the integrity of all joints, seams and penetrations. All necessary penetrations such as inlets, discharge fittings and cable connectors shall be included in this test along with their respective sealing means (grommets, gaskets etc.).

3.2 CERTIFIED SERVICE PROGRAM

A. The grinder pump MANUFACTURER shall provide a program implemented by the MANUFACTURER'S personnel as described in this specification to certify the service company as an authorized serviced center. As evidence of this, the MANUFACTURER shall provide, when requested, sufficient evidence that they have maintained their own service department for a minimum of 30 years and currently employ a minimum of five employees specifically in the service department.

B. As part of this program, the MANUFACTURER shall evaluate the service technicians as well as the service organization annually. The service company will be authorized by the MANUFACTURER to make independent warranty judgments. The areas covered by the program shall include, as a minimum:

1. Pump Population Information — The service company will maintain a detailed database for the grinder pumps in the territory that tracks serial numbers by address.

2. Inventory Management — The service company must maintain an appropriate level of inventory (pumps, tanks, panels, service parts, etc.) including regular inventory review and proper inventory labeling. Service technicians will also maintain appropriate parts inventory and spare core(s) on service vehicles.

3. Service Personnel Certification — Service technicians will maintain their level-specific certification annually. The certifications are given in field troubleshooting, repair, and training.

4. Service Documentation and Records — Start up sheets, service call records, and customer feedback will be recorded by the service company.

5. Shop Organization — The service company will keep its service shop organized and pumps will be tagged with site information at all times. The shop will have all required equipment, a test tank, and cleaning tools necessary to service pumps properly.

3.3 DELIVERY

A. All grinder pump core units, including level controls, will be delivered to the job site 100 percent completely assembled, including testing, ready for installation. Grinder pump cores will be shipped separately from the tanks. Installing the cores and discharge piping/hose into the tanks is the only assembly step required and allowed due to the workmanship issues associated with other on-site assembly. Grinder pump cores must be boxed for ease of handling.

3.4 INSTALLATION

A. Earth excavation and backfill are specified under SITE WORK, but are also to be done as a part of the work under this section, including any necessary sheeting and bracing.

B. The CONTRACTOR shall be responsible for handling ground water to provide a firm, dry subgrade for the structure, and shall guard against flotation or other damage resulting from general water or flooding.

C. The grinder pump stations shall not be set into the excavation until the installation procedures and excavation have been approved by the ENGINEER.

D. Remove packing material. User instructions MUST be given to the OWNER. Hardware supplied with the unit, if required, will be used at installation. The basin will be supplied with a standard 4-inch inlet grommet (4.50-inch OD) for connecting the incoming sewer line. Appropriate inlet piping must be used. The basin may not be dropped, rolled or laid on its side for any reason.

E. Installation shall be accomplished so that 1 inch to 4 inches of accessway, below the bottom of the lid, extends above the finished grade line. The finished grade shall slope away from the unit. The diameter of the excavated hole must be large enough to allow for the concrete anchor.

F. A 6-inch inch (minimum) layer of naturally rounded aggregate, clean and free flowing, with particle size of not less than 1/8-inch or more than ¾-inch shall be used as bedding material under each unit.

G. A concrete anti-flotation collar, as detailed on the drawings, and sized according to the manufacturer's instructions, shall be required and shall be pre-cast to the grinder pump or poured in place. Each grinder pump station with its pre-cast anti-flotation collar shall have a minimum of three lifting eyes for loading and unloading purposes.

H. If the concrete is poured in place, the unit shall be leveled, and filled with water, to the bottom of the inlet, to help prevent the unit from shifting while the concrete is being poured. The concrete must be manually vibrated to ensure there are no voids. If it is necessary to pour the concrete to a level higher than the inlet piping, an 8" sleeve is required over the inlet prior to the concrete being poured.

I. The CONTRACTOR will provide and install a 4-foot piece of 4-inch SCH 40 PVC pipe with water tight cap, to stub-out the inlet for the property owners' installation contractor, as depicted on the contract drawings.

J. A E/One Uni-Lateral assembly (E/One part number NB0184PXX or NC0193GXX), E/One Redundant Check Valve (E/One part number PC0051GXX), or approved equal is required to be installed in the pipe lateral outside the building between the pump discharge and the street main on all installations.

K. The electrical enclosure shall be furnished, installed and wired to the grinder pump station by the CONTRACTOR. An alarm device is required on every installation, there shall be NO EXCEPTIONS. It will be the responsibility of the CONTRACTOR and the ENGINEER to coordinate with the individual property owner(s) to determine the optimum location for the alarm panel.

L. The CONTRACTOR shall mount the alarm device in a conspicuous location, as per national and local codes. The alarm panel will be connected to the grinder pump station by a length of 6-conductor type TC cable as shown on the contract drawings. The power and alarm circuits must be on separate power circuits. The grinder pump stations will be provided with 32 feet total, 25 feet of useable, electrical supply cable to connect the station to the alarm panel. This cable shall be supplied with a FACTORY INSTALLED EQD half to connect to the mating EQD half on the core.

3.5 BACKFILL REQUIREMENTS

A. Proper backfill is essential to the long-term reliability of any underground structure. Several methods of backfill are available to produce favorable results with different native soil conditions. The most highly recommended method of backfilling is to surround the unit to grade using Class I or Class II backfill material as defined in ASTM 2321. Class 1A and Class 1B are recommended where frost heave is a concern; Class 1B is a better choice when the native soil is sand or if a high, fluctuating water table is expected. Class 1, angular crushed stone, offers an added benefit in that it doesn't need to be compacted.

B. Class II, naturally rounded stone, may require more compactive effort, or tamping, to achieve the proper density. If the native soil condition consists of clean compactable soil, with less than 12 percent fines, free of ice, rocks, roots and organic material, it may be an acceptable backfill. Soil must be compacted in lifts not to exceed one foot to reach a final Proctor Density of between 85 percent and 90 percent. Heavy, non-compactable clays and silts are not suitable backfill for this or any underground structure such as inlet or discharge lines.

C. If you are unsure of the consistency of the native soil, it is recommended that a geotechnical evaluation of the material is obtained before specifying backfill.

D. Another option is the use of a flowable fill (i.e., low slump concrete). This is particularly attractive when installing grinder pump stations in augured holes where tight clearances make it difficult to assure proper backfilling and compaction with dry materials. Flowable fills should not be dropped more than four feet from the discharge to the bottom of the hole to avoid separation of the constituent materials.

E. Backfill of clean, native earth, free of rocks, roots, and foreign objects, shall be thoroughly compacted in lifts not exceeding 12-inches to a final Proctor Density of not less than 85 percent. Improper backfilling may result in damaged accessways. The grinder pump station shall be installed at a minimum depth from grade to the top of the 1 ¼-inch discharge line, to assure maximum frost protection. The finish grade line shall be 1-inch to 4-inches below the bottom of the lid, and final grade shall slope away from the grinder pump station.

F. All restoration will be the responsibility of the CONTRACTOR. Per unit costs for this item shall be included in the CONTRACTOR'S bid price for the individual grinder pump station. The properties shall be restored to their original condition in all respects, including, but not limited to, curb and sidewalk replacement, landscaping, loaming and seeding, and restoration of the traveled ways, as directed by the ENGINEER.

3.6 START-UP AND FIELD TESTING

A. The MANUFACTURER shall provide the services of qualified factory trained technician(s) who shall inspect the placement and wiring of each station, perform field tests as specified herein, and instruct the OWNER'S personnel in the operation and maintenance of the equipment before the stations are accepted by the OWNER.

B. All equipment and materials necessary to perform testing shall be the responsibility of the INSTALLING CONTRACTOR. This includes, as a minimum, a portable generator and power cable (if temporary power is required), water in each basin (filled to a depth sufficient to verify the high-level alarm is operating), and opening of all valves in the system. These steps shall be completed prior to the qualified factory trained technician(s) arrival on site.

C. The services of a trained, factory-authorized technician shall be provided at a rate of 40 hours for every 100 grinder pump stations supplied.

D. Upon completion of the installation, the authorized factory technician(s) will perform the following test on each station:

1. Make certain the discharge shut-off valve in the station is fully open.

2. Turn ON the alarm power circuit and verify the alarm is functioning properly.

3. Turn ON the pump power circuit. Initiate the pump operation to verify automatic "on/off" controls are operative. The pump should immediately turn ON.

4. Consult the Manufacturer's Service Manual for detailed start-up procedures.

E. Upon completion of the start-up and testing, the MANUFACTURER shall submit to the ENGINEER the start-up authorization form describing the results of the tests performed for each grinder pump station. Final acceptance of the system will not occur until authorization forms have been received for each pump station installed and any installation deficiencies corrected.

3.8 SPARE CORE

A. The MANUFACTURER will supply one spare grinder pump core for every 50 grinder pump stations installed or portion thereof, complete with all operational controls, level sensors, check valve, anti-siphon valve, pump/motor unit, and grinder.

3.9 MANUALS

A. The MANUFACTURER shall supply four copies of Operation and Maintenance Manuals to the OWNER, and one copy of the same to the ENGINEER.

END OF SECTION

DIVISION 40 – PROCESS INTERCONNECTIONS

SECTION 40 90 00– INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Contractor requirements for Instrumentation and control systems

2. Information for Owner's System Integrator

B. Related Sections

1. The Contract Documents are a single integrated document. As such, all Divisions and Sections are applicable. The Contractor and its Subcontractors are responsible to review all parts of the Contract Documents in order to provide a complete and coordinated project.

C. Complete I&C System

1. The requirements for the I&C System shall be the responsibility of a single company hereafter referred to as the Instrumentation Supplier (IS). The IS shall be responsible for all parts of this Section and Sub-Sections as well as all other related sections that may pertain to the I&C System.
2. The Contractor, through the IS and qualified electrical and mechanical installers, shall be responsible to the Owner for the implementation of a complete I&C System. The IS shall provide all necessary coordination, material and labor such that the entire system be complete and functional. This includes but is not limited to the proper operation and monitoring of electrical power systems, process systems, mechanical equipment, instrumentation, control panels, programmable controller modifications, and communications/networking
3. The Owners System Integrator (SKM Engineering, LLC.) Will be providing the PLC, OIT, and SCADA programming as outlined in the Proposal at the end of this specification. The Contractor is required to include this cost in their bid as part of this project, and shall contract SKM Engineering, LLC. To perform the programming services per the attached Scope of work and proposal.
4. The overall I&C system design is based upon non-certified information that has been furnished by various equipment manufacturers and vendors. It is the Contractor's responsibility to include in the bid and installation all labor and material to provide a complete system based upon actual information from equipment being supplied for the project. Any changes or additions due to non-certified manufacturer or vendor information shall be provided at no additional cost to the Owner.

1.2 REFERENCES

A. The installation and commissioning of the I&C System shall conform to all applicable codes, regulations, standards and specifications, including, but not limited to those listed below. These

publications are referenced to by designation but not by edition. The latest edition accepted by the Authority Having Jurisdiction in effect at the time of bid shall govern.

1. State and Local Codes and Authority Having Jurisdiction (AHJ)
2. American National Standards Institute (ANSI)
3. American Petroleum Institute (API)
4. Federal Communications Commission (FCC)
5. Federal Occupational Safety and Health Act (OSHA)
6. International Society of Automation (ISA)
7. Institute of Electrical and Electronic Engineers (IEEE)
8. National Electric Code (NEC).
9. National Electrical Manufacturers Association (NEMA)
10. National Fire Protection Association (NFPA)
11. Underwriters Laboratories, Inc. (UL)

1.3 DEFINITIONS

A. The following definitions may be used throughout this section and subsections:

1. CTC: Communications termination cabinet.
2. FAT: Factory acceptance test.
3. HMI: Human machine interface.
4. I&C: Instrumentation and control for process systems
5. IS: Instrumentation supplier.
6. LAN: Local area network.
7. LCP: Local control panel.
8. NC: Normally closed.
9. NO: Normally open.
10. OIT: Operator interface terminal.
11. OSI: Owner's System Integrator.
12. PC: Personal computer.
13. PID: Control action, proportional plus integral plus derivative.
14. PLC: Programmable logic controller.
15. P&ID: Process and instrumentation diagram
16. RIO: Remote input/output
17. SCADA: Supervisory control and data acquisition.
18. SI: System Integrator.
19. UPS: Uninterruptible power supply.
20. VCP: Vendor control panel.
21. WAN: Wide area network

1.4 I&C SYSTEM REQUIREMENTS

A. Work provided by the OSI and to be included in the Contractor's scope:
   1. Scope of work and proposal from the OSI is included at the end of this specification section.

B. The Work is to provide a complete and operational I&C System as described by the Contract Documents. This includes but is not limited to the following:

   1. Before providing a bid as the IS, coordinate with all bidders such that all costs associated with a complete I&C System are accounted for. The Owner shall not be responsible for any additional costs for scope items that have been excluded from the bid as a result of not coordinating with all bidders.

2. The IS shall submit a statement of qualifications verifying that it meets the requirements of 409000.1.8. The IS must be approved by the Engineer before proceeding with the Work.

3. Oversee and coordinate with all equipment and services being provided by the Contractor but outside of the IS's scope.
   a. Inform all vendors and suppliers providing equipment related to the I&C System the requirements of Division 40.
   b. The Owner is not responsible for any additional costs incurred by requiring vendors and/or subcontractors to meet the requirements of Division 40.
   c. If a vendor or supplier is unable to meet the requirements of Division 40, the Contractor may submit in writing to the Engineer the reasons for non-compliance. The Engineer will then evaluate the reasons and determine whether a solution may be determined or if a different vendor or supplier is required.
   d. The Contractor and IS are responsible for coordinating with vendors and suppliers the FAT, installation, commissioning, calibration and scheduling for the associated I&C equipment.
   e. The IS is responsible to ensure that panel and loop drawings be supplied for vendor and subcontractor equipment. If the vendors and/or subcontractors are preparing the panel and/or loop drawings, they shall comply with the requirements of Division 40 and shall match those provided by the IS.

4. The IS shall conduct a Pre-Submittal Conference before producing any submittals. The conference should include all parties involved with the I&C System including the Engineer and Owner. The purpose of the conference shall be to review the project as a whole, make sure all parties understand their roles and responsibilities and to go over submittal requirements.

5. Prepare I&C System Submittals which includes the following:
   a. Instrumentation hardware submittal (including TR20 forms).
   b. Control panels design and submittal except for PLC-NW & RIO-NB to be provided by OSI
   c. Loop drawings design and submittal.
   d. Recommended spare parts submittal.

6. Following submittal approvals, do the following:
   a. Procure all instrumentation hardware and accessories.
   b. Procure hardware for and fabricate all control panels being provided.

7. Programming and integration shall be supplied by the OSI per the attached scope and proposal. Oversee and coordinate the programming and integration with the OSI for a complete I&C System.

8. Oversee the installation of the I&C System.

9. Perform bench and field calibrations of instruments as required.

10. Oversee and document loop testing.

11. Oversee and document commissioning.

12. Maintain record drawings.

a. Maintain on the construction site a set of the Instrumentation Drawings that shall be continuously marked up during construction.
b. The drawings should be updated at least weekly and will be checked monthly by the Owner's representative.
c. Upon completion of startup, submit the marked-up drawings to the Engineer for review and for drafting.

13. Prepare O&M manuals.
    a. Provide O&M manuals in accordance with Section 01 78 23.
    b. Prepare an O&M manual for each major process area or building. Each of these manuals shall be divided into the following categories:
        1) Table of Contents/Index.
        2) Process & Instrumentation Diagrams
        3) Control Panel Record Drawings, Bill of Materials and Design Data.
        4) Record Loop Drawings
    c. Prepare O&M manuals that cover comprehensive information for the I&C System. These manuals shall include the following:
        1) Table of Contents/Index.
        2) Finalized Instrument Summary
        3) Finalized TR20 Instrument Forms
        4) Instrumentation Installation Details
        5) Instrument Operational Manuals
        6) Recommended Spare Parts List

14. Provide training.

1.5 ACTION SUBMITTALS

A. General
1. Submittals for Division 40 shall meet the requirements of Section 01 33 00 Submittal Procedures. In addition, the following requirements shall be met:
    a. Submittals shall include bills of materials with quantities, makes, models, exact part numbers and descriptions.
    b. Edit all submittals such that only pertinent information is submitted. Neatly cross out information that does not apply, options that are not being supplied, etc.
    c. Show product dimensions, construction and installation details, wiring diagrams, and specifications.
    d. If there are exceptions to the Contract Drawings and Specifications, provide a list of exceptions with detailed explanations for the exceptions. The Engineer will review the list of exceptions and determine whether a solution may be determined or if the exception(s) will not be allowed.
2. Furnish submittal required by each Section within Division 40.
3. When submitting on equipment, use the equipment and instrumentation tags depicted in the Contract Drawings.

B. Instrumentation hardware submittal
1. Provide a comprehensive submittal that includes all instrumentation being supplied by the IS. Divide the submittal into the following:
    a. Table of Contents/Index.
    b. Instrument summary.
    c. Instrument TR20 Forms.
    d. Instrument Cut Sheets.
    e. Instrument Installation Drawings.

2. Provide an instrument summary (sorted by tag number) that has the following information:
    a. Tag number.
    b. Make, model and description.
    c. Associated process.
    d. Location.
    e. Calibrated range.
    f. Referenced loop drawing number and P&ID.
    g. Associated PLC.
3. Furnish TR20 instrumentation forms for each instrument using the forms outlined in ISA-TR20.00.01-2007. This requirement includes all instruments that are being installed as part of the project, whether they are Contractor, Owner and/or Vendor supplied. Show on each sheet who is the responsible party for supplying the instrument. The TR20 sheets should be provided electronically in Microsoft Word or Excel as well.
4. Provide instrument cut sheets for each instrument make and model being supplied for the project. Each cut sheet should have a list of instrument tag numbers that pertain to that particular cut sheet. The cut sheets should have enough information to verify that the instrument conforms to the Contract Drawings and Specifications.
5. Instrument installation drawings
    a. Provide instrument installation drawings for each make and model of instrument being supplied.
    b. Delineate what is being supplied by the IS and what is being supplied by other installers.
    c. Show overall dimensions, mounting locations and elevations.
    d. Show all cabling, conduit and piping locations.
    e. Show the ambient conditions of the location where the instrument is being installed which includes ambient temperature and humidity extremes, whether or not the atmosphere is corrosive and the area classification.
    f. Show mounting requirements, brackets, stands and anchoring.
    g. Show means for sun protection where required.

C. Control panels submittal
1. Provide a comprehensive submittal that includes all control panels supplied by the IS. The submittal should show that the panels are in conformance with the requirements of Section 40 95 13. Divide the submittal into the following:
    a. Table of Contents/Index.
    b. Panel Bill of Materials and Design Data.
    c. Panel Shop Drawings.
    d. Panel Hardware Cut Sheets.
2. The Panel Bill of Materials and Design Data shall include the following:
    a. Each panel will have its own Bill of Materials and Design Data information presented in association with the panel drawings. The Bill of Materials shall include all hardware inside or on the enclosure. The design data will include UPS and/or battery load calculations to show that the UPS is sized appropriately for load and for backup time. The design data will show panel weight, materials and finishes. HVAC design data shall be shown. Seismic criteria shall be shown if required by the Contract Documents.
3. Panel Shop Drawings:
    a. Each control panel shall be designed to perform its function(s) as shown in the Contract Drawings. The control panel designs shall take into account information shown throughout the Contract Drawings and Specifications.
    b. Show every internal wire and connection diagrammatically. Show all interfaces between the control panel and external equipment to be connected for power, controls, signal, communications, etc.

c. All shop drawings shall include a title block with the name of the firm designing the control panels. The title block shall also include project information, Owner information and/or logo, drawing number and description, revision fields and date.
d. All shop drawings shall be developed utilizing AutoCAD version 2008 or later. All shop drawings should be submitted in PDF and AutoCAD formats and as required by Section 01 33 00.
e. Panel layout drawing(s):
    1) Each control panel shall have shop drawing(s) which depict the front, back, sides and top/bottom of the panel. This includes showing any hardware mounted on the inside or outside of the panel.
    2) Layout drawings should include subpanel and swing-out panel layouts.
    3) Layout drawings should show locations of panel penetrations for cutouts, conduit entry and/or access plates.
    4) Layout drawings should show all of the components and provide a reference to the bill of materials.
    5) Show the elevations of door devices from the finished floor.
f. AC and/or DC power distribution diagrams:
    1) Each panel shall show power distribution schematics that show how the panel receives power and feeds all of its internal loads as well as associated external loads.
g. Communications and/or Network diagrams:
    1) For panels that utilize any means of communications both internally and externally, provide a diagram depicting each communication connection.
h. Input/Output and/or Internal wiring diagrams
i. Terminal block diagrams

4. Provide panel hardware cut sheets for each make and model of equipment being supplied for the project. The cut sheets should have enough information to verify that the equipment conforms to the Contract Drawings and Specifications.

D. Recommended Spare Parts Submittal
1. Submit a list of spare parts for all of the equipment associated with the I&C System. The list of spare parts shall include list pricing for each item.
2. Provide the name, address and phone number for each manufacturer and manufacturer's local sales representative.
3. Indicate whether or not the spare parts are being provided under this contract or not.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.8 QUALITY ASSURANCE

A. All equipment supplied for this project shall meet the requirements of the National Electric Code (NEC) and shall be listed by and bearing the label of the Underwriters' Laboratories (UL).

B. The IS shall be a company that has been actively involved in the installation and commissioning of I&C Systems for a minimum period of five years.

C. The IS shall have adequate facilities, manpower and technical expertise to perform the Work associated with the I&C System and as outlined by the Contract Documents.

D. The IS shall have similar project experience of at least four successfully completed projects for a similar waster system. The IS company must have performed similar work for these projects as required herein.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All materials provided under this Contract shall be new and free from defects.

2.2 MANUFACTURERS

A. All equipment provided for the I&C System shall be the most recent field-proven models marketed by their manufacturers at the time of submittal of the Shop Drawings unless otherwise required to match existing equipment.

B. Instruments which utilize a common measurement principle (for example, float switches) shall be furnished by a single manufacturer. Panel mounted instruments shall have matching style and general appearance. Instruments performing similar functions shall be of the same type, model, or class, and shall be from a single manufacturer.

2.3 OPERATING CONDITIONS

A. The I&C System shall be designed and constructed for satisfactory operation and long, low maintenance service under the following conditions:
   1. Environment: Water Well & Booster
   2. Temperature Extremes: 40°F to 104°F (Indoors);
   3. Relative Humidity: 20% to 90%, non-condensing.

B. Indoor and outdoor control panels and instrument enclosures shall be suitable for operation in the ambient conditions associated with the locations designated in the Contract Documents. Heating, cooling, and dehumidifying devices shall be provided in order to maintain instrumentation devices 20 percent within the minimums and maximums of their rated environmental operating ranges. The Contractor shall provide power wiring for these devices. Enclosures suitable for the environment shall be furnished. Instrumentation in hazardous areas shall be suitable for use in the particular hazardous or classified location in which it is to be installed.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE AND HANDLING

A. After completion of shop assembly, factory test, and approval, equipment, cabinets, panels, and consoles shall be packed in protective crates and enclosed in heavy duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust, and moisture.

Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving without removing protective covering. Boxed weight shall be shown on shipping tags together with instructions for unloading, transporting, storing, and handling at the Site.

B. Special instructions for proper field handling, storage, and installation required by the manufacturer shall be securely attached to each piece of equipment prior to packaging and shipment.

C. Each component shall be tagged to identify its location, instrument tag number, and function in the system. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, as given in the tabulation, shall be provided on each piece of equipment in the PCIS. Identification shall be prominently displayed on the outside of the package.

D. Equipment shall not be stored outdoors. Equipment shall be stored in dry permanent shelters, including in-line equipment, and shall be adequately protected against mechanical injury. If any apparatus has been damaged, such damage shall be repaired by the Contractor. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through tests as directed by the Engineer. If such tests reveal defects, the equipment shall be replaced.

3.2 INSTALLATION

A. Instrumentation shall be installed per the Instrument Installation Drawings that have been submitted and approved and per the requirements of Division 40. This includes all instrumentation for the I&C System, regardless of who the supplier is. Instrumentation shall be mounted so that it is easily accessible and viewable and such that it does not restrict access to other equipment. Mount instrumentation to pipe stands or wall mounts if they are not directly mounted or if the Contract Drawings indicate otherwise.

B. The I&C System indicated throughout the design are diagrammatic and therefore locations of equipment are approximate. The exact locations and routing of wiring and cables shall be governed by structural conditions and physical interferences and by the location of electrical terminations on equipment. Equipment shall be located and installed so that it will be readily accessible for operation and maintenance. Where job conditions require reasonable changes in approximated locations and arrangements, or when the Owner exercises the right to require changes in location of equipment which do not impact material quantities or cause material rework, the Contractor shall make such changes without additional cost to the Owner.

C. The I&C System is integrally connected to electrical, mechanical and structural systems. Coordinate with these other disciplines the installation of these related components. All conduit, cables and field wiring shall be as required by Division 26.

D. Instruments, control panels and all other I&C System related equipment shall be anchored by methods that comply with seismic requirements applicable to the Site.

E. Each existing instrument to be removed and reinstalled shall be cleaned, reconditioned, and recalibrated by an authorized service facility of the instrument manufacturer. The Contractor shall provide certification of this Work prior to reinstallation of each instrument.

F. The Contract Documents show necessary conduit and instruments required to make a complete instrumentation system. The Contractor shall be responsible for providing any additional or different type connections as required by the instruments and specific installation requirements.

Such additions and such changes, including the proposed method of installation, shall be submitted to the Engineer for approval prior to commencing that Work. Such changes shall not be a basis of claims for extra Work or delay.

G. Instrumentation, control panels, wiring and all other I&C equipment shall be properly tagged and/or labeled.

H. Installation of the I&C System shall be according to the finalized Loop Drawings

3.3 FIELD QUALITY CONTROL

A. Allow for inspections by the Engineer and/or Owner of the I&C System at any time during the construction. Inspections shall be conducted to verify that the installation is per the requirements of the Contract Documents.

3.4 CALIBRATION

A. Devices provided under Division 40 shall be calibrated according to the manufacturer's recommended procedures to verify operational readiness and ability to meet the indicated functional and tolerance requirements.

B. Each instrument shall be calibrated at 0, 25, 50, 75, and 100 percent of span using test instruments to simulate inputs. The test instruments shall have accuracies traceable to National Institute of Standards and Testing.

C. Instruments that have been bench-calibrated shall be examined in the field to determine whether any of the calibrations are in need of adjustment. Such adjustments, if required, shall be made only after consultation with the Engineer.

D. Instruments which were not bench-calibrated shall be calibrated in the field to ensure proper operation in accordance with the instrument loop diagrams or specification data sheets.

E. For each instrument calibration, provide a calibration sheet and update the corresponding TR20 Instrument Form with the new calibration data. The Calibration sheet shall include the following as a minimum:
1. Date of calibration
2. Project Name.
3. Tag Number.
4. Manufacturer, model and serial number.
5. Calibration data including range, input, output and measurement at each calibration point.
6. Space for comments.
7. Space for sign-off by party performing calibration.

F. A calibration and testing tag shall be attached to each piece of equipment or system at a location determined by the Engineer. The IS shall sign the tag when calibration is complete. The Engineer will sign the tag when the calibration and testing has been accepted.

3.5 LOOP TESTING

A. Each control loop shall have been installed according to the finalized loop drawing. Prior to the commencement of loop testing, the following pre-requisites should have been met:

1. All associated equipment, conduit and wire has been permanently installed, terminated and inspected.
2. All wiring has been properly pulled, terminated and labeled.
3. Each wire has been tested with a point-to-point test.
4. All control panels and electrical equipment have been checked out and tested as required by Division 26.
5. All instrumentation has been appropriately installed and calibrated.
6. Loop Test Forms for each loop to be tested have been created and will be available during the loop testing.

B. Each loop test shall have a Loop Test Form prepared and ready prior to each loop test. The loop test form shall have the following:
   1. Loop Number and Description
   2. Check-Off List with room for sign-off and dated by the IS, Programmer, and Owner's Witness as well as room for comments. The list of items to be checked off for each loop should include but is not limited to the following:
      a. Each power distribution circuit.
      b. Each control circuit.
      c. Each alarm circuit.
      d. Each PLC input/output point.
      e. Each Local Manual, Local Auto, SCADA Manual & SCADA Auto function.
      f. Each hard-wired and software interlock.

C. Upon completion of the above pre-requisites for loop testing, the IS shall oversee and coordinate each loop test. The IS is responsible to be present for all loop testing, whether the equipment was supplied by the IS or not. The IS is responsible to have all responsible parties associated with each loop present. This includes but is not limited to manufacturer representatives, vendor technicians, electrical installers, mechanical installers, and programmer. The IS shall coordinate with the Owner and Engineer to allow for witnessing of loop testing as deemed necessary by the Owner and Engineer.

D. Issues that arise during loop testing should be addressed and fixed immediately. If it is not feasible to immediately fix the issues, the loop testing should be re-scheduled as soon as possible to avoid delays. Any costs associated with re-testing and requiring all parties to return to the site shall in no way be incurred to the Owner.

E. Following a successful loop test, the appropriate parties should sign and date the Loop Test Forms. All Forms shall be certified and submitted to the Engineer as part of the O&M Manuals.

F. Following loop testing, in no way should any parts of the loop be modified. In no way shall any wiring be re-routed or re-terminated. If any such work occurs, all affected loops shall be re- tested at no expense to the Owner.

3.6 COMMISSIONING

A. The IS shall oversee, coordinate and be present during all commissioning activities. The IS shall be responsible for obtaining the assistance of the Contractor and Subcontractors as may be required for commissioning activities.

B. Commissioning shall commence after acceptance of wire test, calibration tests and loop tests, and inspections have demonstrated that the instrumentation and control system complies with Contract requirements. Pre-commissioning shall demonstrate proper operation of every system

with process equipment operating over full operating ranges under conditions as closely resembling actual operating conditions as possible.

C. Commissioning and test activities shall follow detailed test procedures and check lists accepted by the Engineer. Test data shall be acquired using equipment as required and shall be recorded on test forms accepted by the Engineer, which include calculated tolerance limits for each step. Completion of system commissioning and test activities shall be documented by a certified report, including test forms with test data entered, delivered to the Engineer with a clear and unequivocal statement that system commissioning and test requirements have been satisfied.

D. Where feasible, system commissioning activities shall include the use of water to establish service conditions that simulate, to the greatest extent possible, normal final control element operating conditions in terms of applied process loads, operating ranges, and environmental conditions. Final control elements, control panels, and ancillary equipment shall be tested under startup and steady state operating conditions to verify that proper and stable control is achieved using motor control center and local field mounted control circuits. Hardwired and software control circuit interlocks and alarms shall be operational. The control of final control elements and ancillary equipment shall be tested using both manual and automatic (where provided) control circuits. The stable steady state operation of final control elements running under the control of field mounted automatic analog controllers or software-based controllers shall be assured by adjusting the controllers as required to eliminate oscillatory final control element operation. The transient stability of final control elements operating under the control of field mounted, and software-based automatic analog controllers shall be verified by applying control signal disturbances, monitoring the amplitude and decay rate of control parameter oscillations (if any), and making necessary controller adjustments as required to eliminate excessive oscillatory amplitudes and decay rates.

E. Electronic control stations incorporating proportional, integral or differential control circuits shall be optimally tuned, experimentally, by applying control signal disturbances and adjusting the gain, reset, or rate settings as required to achieve a proper response. Measured final control element variable position/speed setpoint settings shall be compared to measured final control element position/speed values at 0, 25, 50, 75, and 100 percent of span and the results checked against indicated accuracy tolerances.

3.7 TRAINING

A. Provide training in accordance with Section 40 90 00.

B. Develop a Training Plan for the training requirements of Division 40 and submit it to the Engineer for approval. Coordinate with the Engineer and Owner the time and locations of each training session. Schedule the trainings for after the equipment has been pre-commissioned.

C. As part of the Training Plan, submit a résumé for each individual to be providing training. Training shall be performed by qualified representatives of the equipment manufacturers and shall be specific to each piece of equipment.

D. Each training session shall include a written agenda.

E. The Contractor shall train the Owner’s personnel on the maintenance, calibration and repair of instruments provided.

F. Within 10 days after the completion of each session, the Contractor shall submit the following:
1. A list of Owner personnel who attended the training.

2. A copy of the training materials used during the session with notes, diagrams and comments.

END OF SECTION

SECTION 40 91 23 – MISCELLANEOUS PROPERTIES PROCESS MEASUREMENT DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Flow Process Measurement Devices.
   2. Level Process Measurement Devices.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Instrumentation TR20 forms.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Equipment to be furnished under this section shall be the product of firms regularly engaged in the design and manufacturing of this type of equipment. Manufacturer shall assume responsibility for, and guarantee performance of equipment furnished. However, this shall not be construed as relieving the Contractor from responsibility for the proper installation and functionality of the work.

B. Examine the Contract Documents and verify that instruments being provided are compatible with the physical and process conditions associated with the instrument. This includes compatibility with liquids, gases, pressures, temperatures, flows, materials, locations and mounting requirements. Provide all necessary accessories to the instrument for a complete and operable system.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver the process measurement equipment as a complete system. Each system shall be properly tagged and identified with its corresponding instrument tag as shown on the P&ID’s. Each system shall be factory calibrated and certified prior to delivery.

PART 2 - PRODUCTS

2.1 GENERAL

A. Each process measurement system shall typically consist of a sensor and an analyzer/transmitter. Where shown on the drawings, the analyzer/transmitter may be utilized for multiple sensors. When an analyzer/transmitter is used for multiple sensors, it shall be capable of displaying simultaneously each process measurement.

B. Each analyzer/transmitter shall be equipped with means to transmit process measurement information to the plant SCADA system.

1. For hardwired signals, unless otherwise indicated on the drawings, provide the following:
    a. 4-20mA output signal for each process measurement (for up to 500 Ohm loads)
    b. Two programmable SPDT relay outputs, rated at 5A up to 230VAC, for each process measurement

C. Each analyzer/transmitter shall be powered by 115VAC (+/- 10%) at 60Hz unless specifically shown on the drawings as being powered by 24VDC (+/- 15%). Each analyzer/transmitter shall retain its programmable settings in non-volatile memory.

D. Each sensor and corresponding analyzer/transmitter shall be supplied as a complete and operable system. This includes all cabling, mounting hardware and fasteners. When installed outdoors, the analyzer/transmitter shall be protected from the sun such that direct sunlight will not shine on the display.

E. All analyzers/transmitters shall be waterproof and made from corrosion resistant materials.

F. All sensors to be immersed in liquids shall be rated for permanent submersion and shall be corrosion resistant.

G. MAGNETIC FLOW METER

1. Materials

    a. All mounting hardware shall be 316 stainless steel, the instrument enclosure and the spool mag shall be rated NEMA 4X, the flow sensor liner shall be hard rubber, and the electrode material shall be hastelloy.

    b. Spool size shall be as specified on the drawings.

    c. All applications with flow element below grade where no de-watering means or in submersible applications shall provide the flow element as NEMA 6P (IP-68).

    d. Transmitter shall be integral or remote to the flow element as shown on the P&ID's.

2. Design and fabrication

a. Utilize characterized field principle of electromagnetic induction to produce signal directly proportional to flow rate. The meter shall use a pulsed DC magnetic field excitation.

b. Provide flanged end connections per ANSI B16 rated for piping system operating and test conditions.

c. Operating pressure: 150 psi.

d. Operating temperature: 122°F.

e. Grounding requirements: per manufacturer requirements. Typically, inlet and outlet grounding rings of same material as electrode.

f. When the transmitter is remote to the flow element, provide cable between flow element and transmitter. Coordinate with the installer the length of the cable required. No splices in any way will be allowed.

g. Complete zero stability shall be inherent to the meter system. The system shall have a programmable low flow cutoff.

h. Empty pipe detection to prevent false measurement when pipe is empty or partially filled.

i. Forward and reverse flow measurement and totalization as well as net flow totalization.

j. 4-20mA DC isolated output into maximum 800 ohms. Signal shall be programmable to indicate forward and/or reverse flow.

k. Provide a dry contact output for flow direction indication.

l. Provide a programmable frequency output for flow totalization.

m. +/- 0.5% accuracy for flow rates above 1 fps.

3. Acceptable Manufacturers
   a. Siemens SITRANS F 5100W.
   b. Endress+Hauser Promag 53.
   c. Rosemount 8700.
   d. Or Approved Equal.

2.2 PRESSURE PROCESS MEASUREMENT DEVICES

A. General

1. All inline pressure instruments shall be supplied with isolation ball valve and bleed needle valve for each measurement point. Valve materials shall be selected based upon the properties of the liquid or gas and the atmosphere.

2. Unless otherwise indicated on the Contract Drawings, pressure process measurement devices shall measure process pressure relative to atmospheric pressure (gauge pressure).

3. Pressure process measurement devices which are to measure differential pressure shall have the appropriate inlet and outlet ports and isolation and bleed valves for each port.

4. All pressure instrumentation shall be properly mounted, ideally in locations that are easily accessible and viewable. Supply all appropriate mounting poles, plates and accessories such that each instrument is properly supported and mounted.

B. Inline Pressure Diaphragm Seals

1. Diaphragm seals shall consist of bottom housing, lower ring, diaphragm capsule, fill screw, flushing connection, and a top housing.

2. The diaphragm seal shall attach to the inlet connection of a pressure instrument to isolate its measuring element from the process fluid. The space between the diaphragm and the pressure element shall be completely filled with a suitable liquid. Displacement of the liquid fill in the pressure element through the movement of the diaphragm shall transmit process pressure changes directly to a gauge, transmitter, switch, or other pressure instrument. The diaphragm seal shall have a removable bottom housing to permit servicing. The diaphragm seal shall be factory assembled to the corresponding pressure instrument and be factory-filled. The assembly shall be shipped with a tag reading "Do not disassemble for installation."

3. For sewage, sludge, liquids containing solids, corrosive gases, provide seals with 316SS diaphragm and housing. Nuts, bolts, fill connection and valved flush components shall also be 316SS.

4. For chemical solutions and for liquids or gases that will corrode 316SS, provide seals with PVC body and Viton FKM (for vacuum and up to 15 PSI) or PTFE (for above 15 psi) diaphragm material.

5. Acceptable Manufacturers
   a. Ashcroft model 101 (for 316SS diaphragm seals).
   b. Plast-O-Matic Valves Inc. Series GGS (for PVC body diaphragm seals).
   c. Or Approved Equal.

C. Flanged Large Diaphragm Seals

1. Flanged type diaphragm seals shall be used where clogging and/or high accuracy is required. The flanged housing shall be constructed of 316SS.

2. The diaphragm seal shall consist of a flange with flush or extended diaphragm such that the diaphragm surface is flush with the walls of the pipe surface. It shall have a direct mount, coplanar, welded connection for connection of the pressure sensor to the seal.

3. The diaphragm seal shall attach to the inlet connection of a pressure instrument to isolate its measuring element from the process fluid. The space between the diaphragm and the

pressure element shall be completely filled with a suitable liquid that is rated for the environmental conditions. Displacement of the liquid fill in the pressure element through the movement of the diaphragm shall transmit process pressure changes directly to a gauge, transmitter, switch, or other pressure instrument.

4. Acceptable Manufacturers
   a. Rosemount Series 1199.
   b. Or Approved Equal.

D. Pressure Transmitters

1. Electronic gauge or differential pressure transmitters shall consist of a capsule assembly, bottom works, vent plug, drain plug, cover flange, ½" NPT process connector and connection, amplifier unit, integral indicator, terminal box with cover, block and bleed valves, and conduit connections.

2. Transmitter shall be rated NEMA 4X. For hazardous locations, it shall be installed with an appropriate intrinsically safe barrier to guarantee the circuit may not abnormally create an ignition.

3. Transmitter shall be of a two-wire, 24VDC loop powered, producing 4 to 20 mA output proportional to the calibrated range of the instrument, capable of driving a 600-ohm load.

4. Static pressure rating shall be a minimum of 500 psig. The maximum over range pressure limit shall be a minimum of 150% of the range. Span shall be adjustable over a minimum of 5:1 range.

5. The 4 to 20 mA signal shall be capable of being calibrated electronically. Output signal damping shall be provided as an internal adjustment. Equipment shall be suitable for an ambient operating range of minus 40-degree F to plus 212 degrees F. The transmitter shall be equipped with the Hart protocol.

6. Accuracy, including linearity and repeatability, shall be a plus or minus 0.2 percent of span. Gauge pressure transmitters used for flow service shall include square root extraction to produce an output signal linearly proportional to flow. Wetted parts, including block and bleed valve parts, shall be constructed of 316 stainless steel.

7. Acceptable Manufacturers
   a. Rosemount 2051.
   b. Or Approved Equal.

E. Pressure Switches

1. For unclassified locations, pressure switches shall be housed in a NEMA 4X enclosure. For classified locations, pressure switches shall be housed in a NEMA 7 enclosure.

2. Gauge and Differential pressures switches shall be diaphragm-actuated, dual adjustable, with SPDT snap action switch. Contacts shall be rated for a minimum of 5 Amps at 120 VAC. The dead band shall be adjustable up to 60 percent of full scale. Set points shall fall between 20 and 80 percent of the adjustable range. The diaphragm shall be Buna-N,

unless otherwise indicated, and the lower housing shall be brass with a 1/4-inch bottom sensing connection, unless otherwise indicated.

3. Acceptable Manufacturers
   a. Ashcroft Series B (Gauge) and D (Differential).
   b. Or Approved Equal.

F. Pressure Gauges

1. Pressure gauges shall be 4-1/2 inches in diameter with white laminated dials and black graduations. Windows shall be shatterproof glass acrylic. Gauges shall have a blowout disc and be encased in phenolic, steel, or cast iron. Measuring element shall be a stainless-steel bourdon tube with welded, stress-relieved joints. Socket shall have wrench flats. Movement shall be rotary geared stainless-steel material. Gauges shall perform as a liquid-filled gauge in a dry gauge and fight against vibration and pulsations. Gauges shall be calibrated to read in applicable units. Accuracy shall be plus and minus 1/2 percent range to 150 percent of the working pressure or vacuum of the pipe or vessel to which they are connected.

2. Acceptable Manufacturers
   a. Ashcroft 1279.
   b. Or Approved Equal.

2.3 LEVEL PROCESS MEASUREMENT DEVICES

A. FLOAT SWITCHES

1. Float switches shall consist of a mechanical switch, hermetically sealed in a plastic casing, freely suspended at the desired height from its own cable. When the liquid level reaches the float switch, the casing will tilt and the mechanical switch will change state.

2. The casing shall be constructed of polypropylene with the sheathed cable extruding from the casing. The cable shall be three conductors, made specifically for underwater use and heavy flexing service.

3. The float switch shall have a 10A resistive rating up to 250VAC.

4. Weight and buoyancy shall be such that contaminants like a cake of grease will not result in the float switch changing operating level more than one inch.

5. A NEMA 4X 316SS junction box shall be supplied for termination of the float cable(s) allowing for conventional wiring and conduit to be run from the junction box to a control panel. It shall have terminal blocks for the required number of circuits and shall accept sealed fittings.

6. Float switch cables shall be suspended in a manner that provides minimum strain to the cable and will not damage it. This is typically achieved with a stainless-steel cord support grip or strain relief grip as manufactured by Kellems. When support grips are

used, a stainless-steel hook shall be installed for hanging the support. All screws, fasteners, boxes and grips shall be 316SS. In no way are any steel or galvanized steel components allowed.

7. The float cable length shall be long enough for easily removing the float from the water for testing and long enough to reach its termination junction box.

8. If the float switch is to be installed in a classified area, an appropriate intrinsically safe barrier shall be utilized to guarantee the circuit may not abnormally create an ignition.

9. Manufacturers:
   a. Flygt ENM-10.
   b. Or Approved Equal.

B. FLOOD SWITCHES

1. High level flood switches shall be the type that is suspended on a column. A ¼" NPT connection with flying leads allows the column and float assembly to be attached to a junction box. The junction box shall be rated NEMA 4X and be nonmetallic. The flood switch shall be CPVC and shall be made for use with liquid chemicals and corrosive liquids. Switch contacts shall be SPST N.O. with 20VA rating minimum.

2. If the flood switch is to be installed in a classified area, an appropriate intrinsically safe barrier shall be utilized to guarantee the circuit may not abnormally create an ignition.

3. Manufacturers:
   a. GEMS LS-74780.
   b. Or Approved Equal.

C. SUBMERSIBLE LEVEL TRANSMITTERS

1. The submersible level transmitter shall consist of a submersible transducer, electronic transmitter, support cable, and interconnecting cable with cable shield and vent tube for atmospheric reference. The vent tube shall be provided with a replaceable moisture barrier. The submersible transducer shall be the strain gauge type suitable for sensing pressure equivalent to the liquid level range indicated.

2. The transducer shall have 316 stainless steel process wetted parts and shall be provided with a waterproof interconnecting cable. The transducer shall be suspended by a corrosion resistant cable as recommended by the manufacturer. The installation shall allow easy removal of the transducer and cable assembly for maintenance purposes. The electronic level transmitter shall be remote mounted and shall produce a 4 - 20 mA DC signal linearly proportional to the level range indicated and be capable of driving a load of 700 ohms.

3. The interconnecting cable shall have a pull strength of 200 pounds, be factory attached to the transducer, and shall be terminated in a NEMA 4X 316SS enclosure. The enclosure shall house the vent tube moisture barrier and local indication.

4. The measurement system shall be suitable for the area classification and operation over a temperature range of 32 to 122 degrees Fahrenheit with an accuracy of plus or minus 0.5 percent of span.

5. Acceptable Manufacturers
   a. KPSI model 330.
   b. Or Approved Equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment and materials specified in this section shall be installed, connected, and tested in accordance with the manufacturers' recommendations and as required by these specifications and contract drawings. Contractor shall coordinate with other trades to insure proper connection to piping and other mechanical equipment.

B. Install all analyzers/transmitters five feet off of floor level. Install in a location that is easily accessible while as near to the sensor(s) as possible.

3.2 CALIBRATION AND COMMISSIONING

A. A manufacturer representative shall field calibrate the process measurement system as required by section 40 90 00 and per the manufacturer's documented calibration procedure. The system shall be calibrated to the proper ranges as required by the Owner and the Engineer. Where analog signals are connected to local or remote monitoring equipment, verify that the calibrated ranges and scaling of the local and remote indicators are correct.

B. Prior to final acceptance of the work, the Contractor shall certify the equipment and installation included under this section to be free of defects, and suitable for trouble-free operation.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Visually inspect the installation of the process measurement systems. Verify that the incoming power is within the required range. Verify the functionality of all output signals and communications connections.

2. Test the process measurement system for proper operation at low, mid and high process conditions.

B. Document data for each measurement and for system calibration. Update the TR20 instrument forms following testing and calibration.

3.4 TRAINING

A. Provide a minimum of four hours of training for each type of process measurement system provided. Provide training in accordance with section 40 90 00.

END OF SECTION

SECTION 40 95 13 – PROCESS CONTROL PANELS AND HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the requirements for all control panels and associated hardware for the project. This includes, but is not limited to, vendor control panels, PLC panels, local control panels and instrumentation panels.

B. Related Requirements:
   1. The requirements of Division 26 shall apply to this section.

1.2 ACTION SUBMITTALS

A. Submit the Control Panels Submittal as required by Section 40 90 00.

1.3 CLOSEOUT SUBMITTALS

A. Submit the operation and maintenance data, including record control panel drawings for all control panels as required by Section 40 90 00.

1.4 QUALITY ASSURANCE

A. Referenced Standards:

   1. National Electric Code (NEC).
   2. American Society for Testing and Materials (ASTM).
   3. Joint Industrial Council (JIC).
   4. National Electrical Manufacturers Association (NEMA):
      a. ICS 4, Terminal Blocks for Industrial Use.
      b. ICS 6, Enclosures for Industrial Controls and Systems.
      c. 250, Enclosures for Electrical Equipment (1000 V Maximum).
   5. Underwriters Laboratories Inc. (UL):
      a. 50, Enclosures for Electrical Equipment.
      b. 508, Industrial Control Equipment.
      c. 508A, Standard for Industrial Control Panels.

B. Hardware to be furnished under this section shall be the product of firms regularly engaged in the design and manufacturing of this type of equipment. Manufacturer shall assume responsibility for, and guarantee performance of equipment furnished. All panels shall be assembled in and labeled by a listed UL 508A panel shop. However, this shall not be construed as relieving the Contractor from responsibility for the proper installation and functionality of the work.

C. Examine the Contract Documents and verify that control panel hardware being provided is compatible with the requirements. Provide all necessary accessories to the control panels for a complete and operable system.

D. The Contractor shall not place any conduit feeds for any control panel until the Control Panel Submittal has been approved. Once approved, conduits shall be placed strategically to best suit the layout of the control panel. Power entry and separation of power, controls and signal shall be considered.

E. All painted control panels shall have matching paint colors and tones.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver the control panel hardware as required by Section 40 90 00.

PART 2 - PRODUCTS

2.1 GENERAL

A. All control panels shall have an overall NEMA rating suitable for withstanding the mechanical, electrical, thermal stresses, humidity and corrosion that the panel will be subjected to in its installed location.

B. The following rules shall be followed when determining the NEMA rating requirement for each control panel:

1. NEMA 1, 3 & 3R shall not be allowed for control panels.
2. NEMA 4 shall be utilized for outdoor or wet locations in non-corrosive, unclassified areas. NEMA 4 control panels shall be painted steel.
3. NEMA 4X shall be utilized in corrosive, unclassified areas. NEMA 4X enclosures shall be 316SS except for the following exceptions with which the enclosure shall be polycarbonate or fiberglass reinforced polyester (FRP):
    a. Chemical areas or rooms.
    b. Locations where stainless steel is incompatible.
    c. Where specifically noted on the Contract Drawings.
4. NEMA 7 shall be utilized for classified areas as required by NEC. NEMA 7 enclosures shall be constructed of cast aluminum.
5. NEMA 12 shall be utilized in dry, non-corrosive, unclassified areas. NEMA 12 control panels shall be painted steel.

C. Each source of foreign voltage shall be isolated by providing disconnecting or pull-apart terminal blocks or a disconnect operable from the control panel front. Each control panel shall be provided with identified terminal strips for the connection of external conductors. The SUPPLIER shall provide sufficient terminal blocks to connect 30 percent additional conductors for future use.

D. PLC Discrete outputs from the control panel shall be provided by electrically-isolated contacts rated for 10 amps at 120 VAC. Analog inputs and outputs shall be isolated 4 to 20 mA, 2 wire signals with power supply.

E. Control panel mounted devices shall be mounted a minimum of 3-feet above finished floor elevation. Touchscreens shall be mounted at a height of 66" from the finished floor to the center of the touchscreen. All control panels will be situated on housekeeping pads, this is not considered the finished floor elevation.

2.2 ENCLOSURES

A. Enclosures shall be either freestanding, pedestal-mounted or equipment skid-mounted, as indicated. Internal control components shall be mounted on an internal back-panel or side-panel as required.

B. Enclosure dimensions indicated on the Contract Drawings are based upon non-certified information and shall be considered the minimum panel size. It is the responsibility of the Contractor to design the size of all control panels. When sizing the control panels, adhere to the following criteria:
   1. Maximum panel depth is 24". If there are special reasons for a deeper enclosure, approval must first be obtained from the Engineer.
   2. The panel size shall provide space for all equipment, wire-ducts, wire, terminations, and space for future expansion.
   3. If the panel size needs to be enlarged, coordinate with the installing Contractor that there is adequate space for the larger size. If there is not space, coordinate with the Engineer to come up with a solution.

C. Materials
   1. Steel panel section faces shall be 12-gauge minimum thickness for free standing panels and 14-gauge minimum thickness for wall-mounted or pedestal-mounted panels. Materials shall be selected for levelness and smoothness.
   2. Structural shapes and strap steel shall comply with ASTM A 283 - Low and Intermediate Tensile Strength Carbon Steel Plates, Grade C.
   3. Bolting Material: For outdoor, wet or corrosive areas, all bolting materials shall be 316SS. In dry, non-corrosive locations, carbon stell may be used. Commercial quality bolts, nuts, and washers shall be 1/2-inch diameter with UNC threads. Carriage bolts shall be used for attaching end plates. Other bolts shall be hex end machine bolts. Nuts shall be hot pressed hex, American Standard, heavy. Standard wrought washers shall be used for foundation bolts and attachments to building structures. Other bolted joints shall have SAE standard lock washers.
   4. Control panels shall be structurally designed such that the completed and installed control panels shall safely withstand seismic requirements for the project. All equipment mounted within the panel shall be properly braced to prevent damage during a seismic event.

D. Acceptable Manufacturers
   1. Hoffman.
   2. Saginaw.
   3. Or Approved Equal.

2.3 CONTROL PANEL ASSEMBLY

A. General

1. The following requirements must be met when mounting to the back panels or side panels of the control panel:
   a. Holes shall be drilled and tapped with less than 50% diminishment in thread.
   b. Backpan shall be cleaned front and back after any drilling and tapping.
   c. Tek Screws are not acceptable.
   d. Any component mounted to a back panel or side panel shall be mounted at an exact square to the vertical and horizontal planes.
   e. Any duct running between back panels and side panels shall align horizontally with no overlaps.
   f. All DIN rail mounted to the panels shall have ½" stand-offs allowing for wires and other equipment to be routed beneath the rail if necessary.
2. Enclosure doors shall be flush fitting, gasketed, and be of the hinged lift-off type with lockable door handles. A common key shall be provided for the doors on each panel assembly. Removable access panels shall be provided with dished handle fasteners. Screw driver 1/4 turn or Dzus type fasteners are not acceptable.
   a. The flanged edges of panels shall be straight and smooth. Corners shall be welded and ground smooth.
   b. The face of the panel shall be true and level after flanging.
   c. Panel cutouts and holes may be cut or drilled by any standard method that does not cause deformation. Burrs shall be ground smooth.
   d. Adjacent panels shall assemble with faces flush. Gaps or cracks shall not be visible from the front of the assembled instrument board.
   e. Panels shall be self-supporting.
3. Control panels that are supplied with three phase power and/or are powering motor loads shall be supplied with a main feeder disconnect that is door operated. The door operator for the disconnect shall be defeat-able with a screwdriver. If the upstream overcurrent protection device feeding the control panel is not in the same room as the control panel, provide a main circuit breaker as part of the main disconnect assembly. Fused disconnects shall not be used unless specifically shown on the Contract Drawings.

B. Preparation of Bare Metal Panel Surfaces

1. Grind high spots, burrs, and rough spots.
2. Sand or sandblast to a smooth, clean, bright finish.
3. Every trace of oil shall be removed with a solvent.
4. Apply the first coat of primer immediately.

C. Panel Finishing

1. Repair damaged primer on inside surfaces.
2. Apply primer to the entire panel surface.
3. Apply 2 coats of satin finish lacquer enamel over the entire surface.
4. Colors shall match original paint color.

D. Instrument Finishing: The final coat applied to painted surfaces of instrument cases, doors, or bezels which are visible from the front of panels shall be manufacturer's standard unless otherwise indicated. Black japan or "crinkle" finishes on instrument cases are not acceptable.

E. Mounting of Instruments

1. The panel shop shall provide cutouts and shall mount instrument items indicated to be panel mounted, including any instruments indicated to be furnished by other vendors but installed in the panel.
2. The panel shop shall also mount behind the panels other instrument accessory items as required.
3. Equipment mounted at the rear of panel shall be installed to allow for commissioning adjustments, servicing requirements, and cover removal
4. Spare space shall be kept clear of wiring, etc., to give maximum space for future additions.
5. All equipment mounted with fasteners shall be mounted with grade 5 or greater Phillips head fasteners.

F. Electrical Requirements

1. Each panel shall be serialized with its own UL serial number and label.
2. Each terminal block shall have a printed label as shown on the panel drawings. Hand written labels in any location of the panel will not be accepted. Wiring shall be identified with printed tubular wire end markers.
3. Back panels and side panels shall have visible machine printed adhesive labels that detail the following items:
    a. Terminal block torque ratings for field connections.
    b. Terminal block sections as detailed in the panel drawings.
    c. All equipment within the panel including, but not limited to, PLCs, switches, circuit breakers, UPS, Power Supplies, and any other piece of equipment.
4. Screw torque shall not exceed 0.4 N*M (4.4 Lb*In) (7 Lb-In).
5. Wire duct for AC signals and wiring shall be light grey. All duct for DC signals shall be white. Wiring for AC circuits and DC circuits must be kept within their respective ducts.
6. Freestanding panels shall be provided with switched lighting as indicated in the panel drawings.
7. Freestanding panels shall be provided with a 15-amp, 120-volt, service outlet circuit within the back-of-panel area as shown in the panel drawings.
8. Wall-mounted or pedestal-mounted panels shall be sized to adequately dissipate heat generated by equipment mounted in or on the panel.
9. Outdoor panels shall be provided with thermostatically-controlled heaters to maintain inside temperatures between above 40°F.
10. Any panel with heat producing equipment such as a PLC, UPS or VFD shall have cooling capabilities to maintain the inside temperature below 104°F.
11. All outdoor panels equipped with heating and/or cooling shall be insulated with a minimum R value of 2.0.
12. Provide a laminated fuse list matrix detailing fuse numbers and sizes mounted on the inside of the enclosure door. The fuse list matrix must be easily visible and at minimum size 14 font. Hand written fuse matrices will not be accepted. See panel drawings for approximate locations.
13. Provide a pocket mount on the inside of each panel door large enough to hold type 8.5 x 11 size paper. See panel drawings for approximate locations. Pockets must be accessible with no equipment obstructing the entrance of the pocket for at least ten inches above the pocket. The pocket mount shall be fastened. No adhesive type pockets allowed.
14. Where required crimped fork or ring terminals will be properly installed on the conductors for connection integrity.
15. Signal and Control Circuit Wiring

a. Wire type and sizes: Conductors shall be flexible stranded tin machine tool wire, UL 1015 listed Type MTW, and shall be rated 600 volts. Wires for instrument signal circuits and alarm input circuits shall be 14 AWG. Other wires, including shielded cables, shall be 16 AWG minimum.
b. Wire Insulation Colors: Conductors supplying 120 VAC power on the line side of a disconnecting switch shall have a black insulation for the ungrounded conductor. Grounded circuit conductors shall have white insulation. Insulation for ungrounded 120 VAC control circuit conductors shall be red. Wires energized by a voltage source external to the control panel shall have yellow insulation. Insulation for DC conductors shall be blue.
c. Wire Marking: Wire numbers shall be marked using white numbered wire markers made from plastic-coated cloth, Brady Type B 500 or equal, or shall be heat shrink plastic. Wire labels must be machine printed. All conductors within the control panel are to be permanently marked with wire labels at each end. Wire labels are to correspond to the labels on the approved shop drawings.
d. For case grounding, panels shall be provided with a ground lug complete with solderless connector for one no. 1 AWG bare stranded copper cable.
e. Panel doors shall be connected to panel ground.
f. Wire Fastening: Provision shall be made utilizing cable tie bases such as type CTM1 or equivalent, fastened inside the wire duct to allow for the fastening of the shop wire harnesses upon final installation.

16. Power Supply Wiring
    a. Unless otherwise indicated, control power shall be 120 VAC. Where the electrical power supply to the control panel is something other than 120 VAC, the control panel shall be provided with a control panel transformer. Control conductors shall be provided in accordance with the indicated requirements.
    b. At a location near the top of the panel (or bottom), the panel fabricator shall provide terminal box connections for the main power supply entry.
17. Signal Wiring
    a. Signal wire shall be shielded twisted pair or triads. Cable shall be 18 AWG copper signal wires.
    b. Color code for instrument signal wiring shall be as follows:
        1) Positive (+) – Red or Clear
        2) Negative (-) – Black
    c. Multiconductor cables where indicated shall consist of no. 16 AWG copper signal wires twisted in pairs with 90-C, 600 V fault insulation. A copper drain wire shall be provided for the bundle with a wrap of aluminum polyester shield. The overall bundle jacket shall be PVC.
    d. RTD cabling shall be Belden 8770 cabling or equal.
    e. Multi-conductor cables, wireways, and conduit shall be sized to allow for 25 percent spare signal wire.
18. Wiring run to control devices on the front panels shall be tied together at short intervals with nylon wire ties and be secured to the inside face of the panel using adhesive mounts.
19. Wiring to rear terminals on panel-mount instruments shall be in plastic wireways secured to horizontal brackets above or below the instruments in about the same plane as the rear of the instruments.

G. Labor and Workmanship: Panels shall be fabricated, piped, and wired by fully qualified workmen who are properly trained, experienced, and supervised.

2.4 CONTROL PANEL COMPONENTS

A. Nameplates and labels

1. All control components within the control panel shall be labeled with adhesive labels that have a thermal transfer type ink system on a UL-508A approved label. Labels shall be provided for marking wire ducts, terminal block sections, PLC modules, networking modules, signal isolators, intrinsic barriers, relays, breakers, power supplies, surge suppressors and all other pertinent components within the control panel.
2. All components on the exterior of the control panel shall have nameplates fabricated from black-letter, white-face laminated plastic engraving stock, Rowmark Ultramatte or equal. Engraved characters shall be block style with no characters smaller than 1/8 inch. Adhesive shall be high strength, low profile double strength, double sided as produced by Bron or Tessa or approved equal. Stainless steel fasteners shall be used in addition to the adhesive on all equipment where the fasteners do not derate the NEMA rating of the enclosure.

B. Pilot Devices

1. Provide pilot devices from a single manufacturer.
2. Pilot devices shall have NEMA ratings that match the overall control panel rating. They shall be 30mm in diameter and heavy duty.
3. All pilot devices shall have an associated nameplate that clearly describes the function of the device.
4. Pilot lights shall be LED and shall have colors as follows:
    a. The Contract Drawings shall take precedence for light colors. Refer to the P&ID's and schematics.
    b. On/Running/Opened: Green.
    c. Off/Stopped/Closed: Red.
    d. Power: White.
    e. Alarm/Fail: Red.
5. Acceptable Manufacturers
    a. Square D Types K (for NEMA 4 or 12) or Types SK (NEMA 4X).
    b. Allen-Bradley Types 800T (NEMA 4/12) or Types 800H (NEMA 4X, 7).
    c. Or Approved Equal.

C. Door Mounted Meters

1. Digital Process Meters
    a. Provide digital process meters to display a numeric process value as required by the Contract Drawings.
    b. The meter shall accept and re-transmit an analog input signal which is in proportion with the process value. The meter shall be capable of receiving the following signals:
        1) 0 or 4 to 20 mA current.
        2) 0 to 5 or 10 DC volts.
        3) RTD and Thermocouple type inputs.
    c. The meter shall be programmable to scale the numeric display to process engineering units. It shall be capable of showing up to three decimal points.
    d. The meter shall be capable of powering the input and re-transmitted signal.
    e. Acceptable Manufacturers:

1) Precision Digital Trident Series.
2) Red Lion PAX Series.
3) Or Approved Equal.

2. Elapsed Time Meters (ETM)
   a. Provide ETM's for each motor and/or machine provided for the project. Each ETM shall accumulate hours in tenths of an hour.
   b. The ETM enclosure shall be panel mount, polycarbonate, shock resistant and totally sealed.
   c. Acceptable Manufacturers:
      1) Hobbs 20000 Series.
      2) Or Approved Equal.

D. Terminal Blocks

1. Terminal blocks shall mount on standard DIN rail, and be of the size required for conductors therein. A minimum of 25 percent spares shall be provided in each terminal box. No more than 2 conductors shall be allowed per termination. Jumper bar assemblies shall be installed for interconnecting terminal blocks, distributing power and signal commons. Terminal blocks shall be U.L. rated for 600 Volts, and 30 Amps, minimum.
2. Grounding terminal blocks shall be provided for instrumentation cable shields. The terminal blocks shall have distinctive 2-color bodies yellow and green, and shall be mounted to the DIN rail with metal screw down type clamps, providing a positive ground connection. One grounding terminal block shall be installed for every 2 instrument cables terminated. Grounding terminal blocks shall be U.L. rated for 600 Volts, and 20 Amps, minimum.
3. Terminal blocks shall be available in a variety of colors, including red, green, blue, gray, black, yellow, and orange.
4. DIN mount fuse holders shall have blown fuse indicators for DC and AC circuits. Fuse holders shall be of the compression clamp type. Fuse holders shall be U.L. listed, and rated for 600 Volts. Fuse sizes shall not exceed the U.L. current rating for the fuse holders.
5. Terminal blocks for 4 to 20 milliamp signals shall have knife disconnect switches, and accessible test points for testing and measurement of current loop signals, without the need for removing wire terminations.
6. Approved Manufacturers
   a. Phoenix Contact UT Series.
   b. Allen-Bradley 1492 Series.
   c. Or Approved Equal.

E. DIN Rail

1. DIN rail shall be prepunched, RoHS compliant, treated with galvanic zinc plating and passivation. Symmetrical DIN rail shall be 35 mm X 15 mm.
2. Acceptable Manufacturers
   a. Iboco Omega 3AF.
   b. Or Approved Equal.

F. Wire Ducts

1. Wire ducts shall have narrow slots (approximately every ½") to accommodate high-density terminal blocks and other hardware.
2. Wire ducts shall be made of lead-free PVC, shall be UL rated for continuous use up to 122°F, and shall be flame retardant.
3. Wire duct colors shall be as follows:
    a. Light grey for all wiring 120V and higher.
    b. White for all wiring 48V and lower.
    c. Blue for all intrinsically safe wiring.
4. Acceptable Manufacturers
    a. Panduit Type F Series.
    b. Or Approved Equal.

G. Surge Protection Devices

1. Provide a Surge Protection Device (SPD) for power feeds which feed power to the control panel.
2. Each SPD shall have a short circuit current rating that exceeds the rating of the power feed that it is protecting.
3. All SPD's shall be properly grounded to the ground grid per NEC and per the SPD manufacturer's recommendations.
4. Three phase power feeds and single-phase power feeds for non-sensitive loads.
    a. Provide a parallel, DIN rail mountable, SPD whose location is immediately downstream of the main panel disconnect or circuit breaker.
    b. Capable of handling a 10kA surge current.
    c. Acceptable Manufacturers
        1) Transtector 12R Series.
        2) Or Approved Equal.
5. Single phase power feeds for control panels with sensitive electronics
    a. Provide an inline, DIN rail mountable, SPD that also provides EMI filtering.
    b. The SPD shall be capable of handling a 10kA surge current.
    c. The inline SPD shall have a set of dry contacts that indicate when the unit is healthy and operating correctly.
    d. Acceptable Manufacturers
        1) Phoenix Contact SFP Series.
        2) Or Approved Equal.
6. Low Voltage Signals
    a. Provide surge protection for low-voltage signals where shown on the Contract Drawings.
    b. Acceptable Manufacturers
        1) Phoenix Contact Termitrab.
        2) Or Approved Equal.
7. Coaxial Transmission Lines
    a. For radio type systems, provide surge/lightning protection for all coaxial lines leaving the control panel.
    b. Surge/lightning protectors shall be rated for the frequency at which signals are to be transmitted on the cabling.
    c. Acceptable manufacturers
        1) Polyphaser.
        2) Or Approved Equal.

H. Circuit Breakers

1. Circuit breakers shall meet the requirements of Division 26.
2. Provide a main circuit breaker with panel disconnect if required as described in 2.3.A.
3. All control panels fed by 120VAC shall have a main DIN rail mounted circuit breaker.
4. The following types of loads shall be individually fed by circuit breakers:
   a. Panel mounted receptacles.
   b. UPS equipment.
   c. DC Power Supplies.
5. Circuit breakers shall be sized according to the loads they are powering.
6. Acceptable Manufacturers
   a. Square D.
   b. Cutler Hammer.
   c. Or Approved Equal.

I. Motor Controllers

1. All motor controllers shall meet the requirements of Division 26.

J. Uninterruptible Power Supplies (UPS)

1. All UPS equipment shall meet the requirements of Division 26.
2. UPS equipment intended to be installed in control panels shall meet the following criteria:
   a. The UPS shall be UL listed and shall maintain the UL listing of the control panel.
   b. The UPS shall be properly mounted to withstand vibration and seismic requirements for the project.
   c. The UPS shall be sized for 200% of the calculated panel load.
   d. The UPS shall have a minimum backup time of 30 minutes unless specifically stated as otherwise on the Contract Drawings.
   e. For PLC panels, the UPS shall be equipped with dry contacts for monitoring the UPS for any alarm conditions and low battery.
3. Where specifically shown on the Contract Drawings, an industrial DC UPS may be used as backup power for the control panel. This will typically be the case where all critical loads are at 24VDC.
4. Unless indicated as otherwise on the Contract Drawings, the UPS equipment shall be the line-interactive type and operate at 120VAC.
5. UPS equipment shall provide surge, EMI
6. Acceptable Manufacturers
   a. Powerware 5000 series (line-interactive) or 9000 series (online).
   b. Sola SDU Series (24VDC UPS).
   c. Or Approved Equal.

K. Power Supplies

1. Provide 24VDC Power Supplies or other DC voltages as required for the application.
2. All power supplies shall be oversized for a minimum 150% of the calculated load.
3. All power supplies shall be properly protected by a DIN rail mount circuit breaker whose trip rating is per the manufacturer's recommendation.
4. All power supplies shall have a set of dry contacts that indicate when the power supply is operating normally.

5. Where shown on the Contract Drawings, provide redundant power supplies and corresponding diodes.
6. Power supplies shall meet the following criteria:
    a. Input Voltage: 100 to 240VAC.
    b. Output Voltage: ±1% of rated output.
    c. Operating Temperature: 0°C to 60°C.
    d. Built in transient surge protection.
    e. DIN rail mountable, metal housing.
7. Acceptable Manufacturers
    a. Phoenix Contact Quint Series.
    b. Or Approved Equal.

L. Signal Isolators/Converters

1. Furnish signal isolators as required that optically isolate the input signal from the output signal. If output signal is to be a different type of signal than the output than the isolator shall convert the signal as required.
2. Isolators output shall be adjustable for zero and span.
3. If input signal is part of a Hart system, the isolator shall be made specifically to pass on the Hart signal.
4. Acceptable Manufacturers
    a. Phoenix Contact.
    b. Action Instruments.
    c. Or Approved Equal.

M. Intrinsically Safe Barriers

1. Provide intrinsically safe barriers wherever analog or discrete input signals are coming from classified areas.
2. Intrinsically safe barriers shall be located in their own enclosure whose assembly is UL rated. Install the barriers and field wiring as per the requirements of NEC and the manufacturer's installation guidelines.
3. If input signal is part of a Hart system, the isolator shall be made specifically to pass on the Hart signal.
4. Acceptable Manufacturers
    a. Phoenix Contact.
    b. Pepperl Fuchs.
    c. Or Approved Equal.

N. Relays

1. Provide relays whose contact ratings are sized according to the load requirements and size of the protection device associated with the circuit in which the contacts are wired. As a minimum contact ratings shall be 10A resistive up to 250VAC.
2. Provide relays whose coil voltage is as required by the application.
3. Relays with DC rated coils shall have a freewheel diode installed across the coil.
4. Relays with AC rated coils shall have a surge suppressor installed across the coil.
5. Relays shall have based with relays which plug into the base. Bases shall have screw-type connections.
6. Relays shall have an LED indicating when the relay is coil is energized.

7. Provide enough relay contacts for each relay as required by the application. If the number of contacts required exceeds the number of contacts on the relay, provide additional relay(s) to provide enough sets of contacts.
8. Acceptable Manufacturers
    a. Idec R Series.
    b. Allen-Bradley 700H Series.
    c. Or Approved Equal.

O. Time Delay Relays

1. Provide time delay relays to control on and off delay times as required by the application.
2. Time delay relays shall meet the requirements of relays as listed above with the following additional requirements:
    a. Time delay shall be adjustable from 0.1 seconds to 600 hours.
    b. Timers shall be multi-function and shall be capable of providing on-delay, off-delay, cycle timing and one-shot type timing control.
3. Acceptable Manufacturers
    a. Idec RTE Series.
    b. Phoenix Contact ETD Series.
    c. Or Approved Equal.

P. Panel HVAC Components
1. Provide heating, ventilation, and air conditioning, devices in order to maintain all components within the control panel within the acceptable range as specified in Section 40 90 00.
2. HVAC equipment shall maintain the required NEMA rating for the control panel assembly.
3. Externally mounted HVAC equipment (such as air-to-air exchangers or air conditioners) shall be housed in an enclosure whose material matches the material of the control panel. Where in corrosive environments, all components that will come in contact with outside air shall be corrosion resistant for that environment.
4. All HVAC equipment shall be UL rated. For equipment mounted on the control panel, the equipment shall have a corresponding NEMA rating.
5. Provide power as required for the HVAC equipment. HVAC loads shall be included in feeder and control power transformer sizing calculations.
6. Panel Heating
    a. Heating shall be provided when ambient temperatures are expected to fall below the allowed range as specified in Section 40 90 00. As a minimum, heating shall be sized to keep the panel temperature at or above 50°F.
    b. Except for small anti-condensating heaters, heating equipment shall have fans which distribute the heat throughout the enclosure. Heaters shall be installed according to the manufacturer's installation instructions. Provide enough space between the heating equipment and other components such that the other components to not experience abnormally high temperatures.
    c. Provide anti-condensating heaters for all outdoor enclosures which house electronics, instrumentation and/or motor controllers.
    d. All heaters shall be thermostatically controlled by a DIN rail mounted thermostat.
    e. Acceptable Manufacturers
        1) Hoffman.
        2) Or Approved Equal.

7. Panel Ventilation
    a. Where ventilation is determined to maintain the control panel's maximum temperature as required by Section 40 90 00, the following requirements shall be adhered to:
        1) Ventilation shall maintain the required NEMA rating for the control panel assembly.
        2) For indoor, non-corrosive locations (panels with NEMA 12 ratings), conventional ventilation with fans and vents may be used.
        3) For corrosive or outdoor locations, side or top mounted air-to-air heat exchangers shall be used.
    b. The fan(s) and corresponding vents or air-to-air heat exchangers shall be properly sized and located to move enough air through the panel to remove the generated heat as well as allow air flow across all heat generating equipment.
    c. All ventilation shall be thermostatically controlled by a DIN rail mounted thermostat.
    d. Acceptable Manufacturers
        1) Hoffman.
        2) Pfannenberg.
        3) Or Approved Equal.
8. Panel Air Conditioning
    a. Where it is deemed necessary to air condition a control panel to maintain the control panel's maximum temperature as required by Section 40 90 00, the following requirements shall be adhered to:
        1) Air conditioners shall be side or top mounted and shall be sized based upon the heat generated within the control panel, the maximum outside air temperature, and the amount of sunlight the control panel may be exposed to. Air conditioners shall be oversized by a safety factor of 25%.
        2) Air conditioners shall be thermostatically controlled by a DIN rail mounted thermostat. In addition, the air conditioner shall turn off if the panel door(s) are not closed.
    b. Acceptable Manufacturers
        1) Hoffman.
        2) Pfannenberg.
        3) Thermal Edge.
        4) Kooltronics.

PART 3 - EXECUTION

3.1 FACTORY ACCEPTANCE TESTING

A. All control panels shall be factory acceptance tested (FAT) as required by Section 40 90 00.

3.2 INSTALLATION

A. All control panels shall be installed according to the requirements of Section 40 90 00.

B. All control panels shall be installed so that their surfaces are plumb and level.

C. All control panels shall be properly mounted so as to withstand the seismic requirements for the Site. Anchor panels securely to the wall or floor at each corner as a minimum.

D. Control panels shall have been designed according to locations for conduit entry. Floor mounted panels in electrical rooms shall have cutouts in the bottom of the enclosure that were cutout by the panel shop. All conduit holes shall be cut in the field.

E. Field wiring
   1. Wires that are terminated in control panels after permanent panel installation are deemed as field wires. Field wiring shall be installed in the allocated wire ducts and shall be properly labeled and terminated.
   2. All field wires shall be long enough to reach each corner of the enclosure. Neatly coil up extra wire length at the bottom of the enclosure. Do not use the wire ducts for storing extra wire length.

3.3 FIELD QUALITY CONTROL

A. Refer to Section 40 90 00.

END OF SECTION

DIVISION 46 – WATER AND WASTEWATER EQUIPMENT

SECTION 46 53 65

PACKED-BED MEDIA FILTER

WASTEWATER TREATMENT SYSTEM

PART 1 - GENERAL

1.1 DEFINITIONS

A. Wherever used in these specifications and printed with initial bold capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof.

1. *Bid* – The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the work to be performed.
2. *Bidder* – The individual or entity who submits a Bid directly to the Owner.
3. *Contractor* – The individual or entity with whom Owner has entered into the agreement.
4. *Engineer* – The individual or entity named as such in the agreement.
5. *Inspector* - The specific individual designated by the Owner, Engineer, Contractor, and Manufacturer to ensure quality control by inspecting and certifying that the installation of the packed-bed media wastewater treatment system is in compliance with the Manufacture's recommendations and requirements.
6. *Manufacturer* – A supplier, fabricator, distributor, material man, or vendor having a direct contract with Contractor or Owner to furnish materials or equipment to be incorporated in the work by contractor.
7. *Owner* – The individual or entity with whom Contractor has entered into the agreement and for whom the work is to be performed.
8. *Operator* – The individual or entity with whom the owner has entered into an agreement and for whom operation and maintenance shall be performed.

1.2 GENERAL DESCRIPTION

The **MANUFACTURER** shall furnish a complete advanced treatment package(s), consisting of a pump, discharge assembly, ball valve, check valve, splice box, treatment system, and controls.

1.3 SUBMITTALS

The **MANUFACTURER** shall furnish shop drawings and technical data sheets. The submittals shall clearly specify the materials of construction, equipment compatibility, along with drawings for each unique package being supplied.

1.4 OR-EQUAL EVALUATIONS

A. Throughout the equipment specifications you will find the term "or approved equal." For this project, this term "approved equal" shall mean equal in the judgment of the **ENGINEER**. Should the **CONTRACTOR** seek approval of a product other than the brand or brands named in the specifications, it shall furnish written evidence that such product conforms in all respects to the specified requirements, and that it has been used successfully elsewhere under similar conditions. It will not be the responsibility of the **MANUFACTURER** specified within these specifications to provide research, documentation, or data supporting the

difference between the "or equal" and the specified product. This will be the sole responsibility of the **CONTRACTOR** seeking the approval.

B. Where the specified requirements involve conformance to recognized codes or standards, the **BIDDER** shall furnish evidence of such conformance in the form of test or inspection reports, prepared by a recognized agency, and bearing an authorized signature. Manufacturer's standard data and catalog cut sheets will not be considered sufficient in themselves, and the engineer will not be responsible for seeking further data from the manufacturer, or for otherwise researching the product. Failure to provide complete data will be cause for rejection of the product. The submission shall include any impacts that could be expected from the alternative product and shall also indicate any product that would require a license or royalty, the actual fees, and a note that these fees would be handled by the **BIDDER**. The **BIDDER** shall provide submissions; meeting the above parameters no less than ONE WEEK prior to **BID** opening for review by the **ENGINEER** for **CONTRACTORS** seeking approval of "or equal" products or systems shall provide, at minimum, the following.

C. Product/System submittals, including, but not limited to;

1. The number of years the **MANUFACTURER** has been in business of manufacturing relevant products/systems
    a. Size of company, including
        1) Number of employees related to relevant products/systems
        2) Number of engineers on staff related to relevant products/systems
    b. Product specifications and a detailed description of how each product or component is "equal" to the specified product, system, or component. A side-by-side comparison is required.
        1) Equipment/system warranty along with exclusions
        2) Performance claims, including, but not limited to;
            a) Treatment design
                - Surface area
                - Maintenance frequency
            b) Pump motor description
                - Manufacturer and origin
                - Length of service
                - Number of units in operation
                - Life-cycle cost (repair and replacement frequency)
                - Warranty
            c) Pump liquid end description
                - Manufacturer and origin
                - Length of service
                - Number of units in operation

- Life-cycle cost (repair and replacement frequency and cost). Note liquid ends must be remove-able and repairable and cleanable.
- Warranty

d) Corrosion resistance

e) Pump Lead description

- Lead must be SOOW, extra heavy duty cord (600V) CSA approved.

f) Control panel components

- Manufacturer and origin
- Length of service
- Number of units in operation
- Warranty
- Enclosure description

c. Evidence of successfully obtaining approval for a system with similar permit requirements with the regulating authority

d. Summary of product/system track record and history, including, but not limited to;

1) Number of similarly sized systems

2) Detailed summary of, at minimum, ten (10) similarly sized systems, at least five (5) years old, including, but not limited to;

a) Project name, location, and application

b) Years in operation

c) Current average daily flows and design flows

d) Operator name and contact information

2. **BIDDER** shall specify and furnish documentation related to manufacturer (or representative) support services, including, but not limited to;

a. Installation training program and support material

b. Installation oversight program and support material

c. Operator training program and support material

d. Startup services program and support material

1.5 EXPERIENCE CLAUSE

The equipment furnished shall be manufactured and supplied by a company experienced in the design and manufacture of advanced treatment systems. **MANUFACTURERS** shall have a minimum ten (10) years experience in the design and manufacturer of advanced treatment systems of similar size and equipment specified. **MANUFACTURERS** shall have at minimum of twenty-five (25) successful installations of advanced treatment systems.

1.6 MANUFACTURER

The **MANUFACTURER** shall be Orenco Systems®, Inc. or approved equal. The **MANUFACTURER** shall furnish a complete factory built advanced treatment system, each

consisting of a pump vault, effluent screen, discharge assembly, ball valve, check valve, splice box, treatment system, recirculating splitter valve, and controls. The **MANUFACTURER** shall supply detailed installation, O&M instructions, and evidence of an adequate service provider network shall be submitted to the **ENGINEER.** The **MANUFACTURER** shall also submit evidence that the local supplier has spare parts, equipment repair ability, and experienced service personnel.

1.7 WARRANTY

The advanced treatment system **MANUFACTURER** shall provide a three (3) year warranty for the entire treatment system, including, but not limited to the pump, pump vault, hose and valve assembly, control panel, and splice box. Warranty term shall ensue after **OWNER'S** acceptance and system startup procedures are complete. The **MANUFACTURER** shall submit detailed exclusions from the warranty or additional cost items required to maintain the equipment in warrantable condition. The warranty shall be documented in product literature.

1.8 SERVICABILITY

The advanced treatment system components shall be completely serviceable, with easy access to the pump(s), effluent screen, treatment system, and floats. The pump shall be designed for removal without removing the effluent screen and floats.

1.9 PUMPS

The pump must be approved for use in the treatment unit as described in these specifications. Pump shall be 1/2 to 2.0 hp, 208 VAC, three phase, 60 Hz, three-wire motor, with 30 foot long extra heavy duty (SOOW) electrical cord with ground. The pumps must be submersible High-Head Effluent pumps. Pumps shall be UL and CSA listed for use with effluent. The pumps must have a minimum 24-hour run dry capability without water lubrication. The pumps shall have a 1/8-inch bypass orifice to ensure flow circulation for motor cooling and to prevent air bind. The pump shall have a floating impeller design to protect against up thrust and increase pump life. The pumps liquid ends must be repairable (by replacing impellers and/or diffusers) for better long-term cost of ownership. The motor must be rated for continuous use and frequent cycling, at least 100 cycles per day. The motor cable must be suitable for Class 1, Division 1 and 2 applications. The pumps shall be lightweight for easy removal and maintenance. The pump intake screen must be 1/8-inch mesh polypropylene. The pump shall have internal thermal overload protection and internal lightning protection. All pumps shall undergo 3-point (Dead head, Design Flow, and Design Flow + 30%) wet testing at the factory to confirm performance.

2 PRODUCTS

2.1 PUMPS / OPERATING CONDITIONS

A. PF30053200 – Pre-Anoxic Return (Rnox) Pump

Pump shall comply with general requirements set forth in section I (above). Orenco Systems®, Inc., Model PF30053200 series or approved equal 1/2Hp, 208 VAC, three phase, 60 Hz, three-wire motor, with 10 - 30 foot long extra heavy duty (SO) electrical cord with ground. Pump shall be UL and CSA listed as an effluent pump.

2.2 PACKED-BED MEDIA FILTER TREATMENT SYSTEM

A. The treatment system shall be an Orenco Systems®, Inc. AdvanTex® AX-MAX facility or approved equal. The facility shall be a complete, fully plumbed wastewater treatment system for receiving and processing septic tank effluent. The facility shall include the following units:

   a. AX-MAX275–42 Unit shall have an overall length of 42 ft, a width of 7.5 ft, and a height of 8ft. The structure shall be constructed of fiberglass-reinforced plastic with a thickness of 4 inches. The unit shall include a piping network that recirculates water from the recirculation tank atop the hanging textile media. The media shall be hanging textile media with a specific area of over 275 square feet.

2.3 VENTILATION SYSTEM

A ventilation system shall be provided in the AX-MAX Series Treatment Facility or approved equal. The fan shall be UL recognized, 0.8 Hp, 115/230VAC, 1.4A/0.7A, 3400 RPM, and provide up to 245 CFM at 0" H2O. The exhaust from the ventilation fan shall be forced through an enclosure with an adequate amount of activated carbon to remove any odors for a period of over one (1) year.

2.4 CONTROLS

A. Controls and alarms shall be listed per UL 508. Panels shall be repairable in the field without the use of soldering irons or substantial disassembly.

B. Panel shall be Orenco Systems, Inc. custom control panel or approved equal, meeting the following:

   1. Programmable Logic Unit: 115/230 VAC programmable logic unit with built-in LCD screen and programming keys. Provides control functions and timing for panel operation.

   2. Custom Control Panel integrated to control complete wastewater system, including the following component stages

      i. Anoxic Tank High Water Alarm

      ii. Aeration Tank Pumps, timer-based control

      iii. Clarification Tank EQ Duplex Pump Package, timer-based control

      iv. AX-MAX Treatment System

         1. Recirculation floats, & Pumps

         2. Pre-Anoxic Recycle Return Pump

         3. Discharge floats, & Pumps

         4. Ventilation Fan

1. Standard Components

   a. HOA 3- Way Toggle Switch: Single-pole switch, Hands (manual) Off, Auto ON. 20 amps, 1 hp.

   b. Controls Circuit Breaker: 10 amps, OFF/ON switch. Single-pole 120 VAC. DIN rail mounting with thermal magnetic tripping characteristics.

c. Pump Circuit Breaker: 20 amps, OFF/ON switch. Triple-pole for 208 VAC. DIN rail mounting with thermal magnetic tripping characteristics.

d. Audio Alarm: 80 dB at 24", warble-tone sound.

e. Current Sensor: 120 VAC with adjustable high & low alarm set points.

f. Visual Alarm: 7/8" diameter red lens, “push-to-silence.” NEMA 4, 1-watt bulb, 115 VAC.

g. Panel Enclosure: NEMA 4X rated, constructed of UV-resistant fiberglass or NEMA 4, constructed of steel; hinges and latch are stainless steel. Conduit couplings provided.

h. 4G Wireless Cellular modem to be installed in separate enclosure. Contractor responsible for fiber line connection from modem enclosure to wastewater control panel.

2. Optional Components

a. Pump Run Light: 7/8" green lens. NEMA 4, 1-watt bulb, 120 VAC.

b. Effluent Alarm: 95db at 24", warble-tone sound.

c. Flashing Light: Lexan lens, flanged base, red, UL-recognized.

d. Heater: Anti-condensation heater. Self-adjusting, radiates additional wattage as temperature drops.

e. Surge Arrestor: AG2401 120/230V, three 18” leads, rated for a maximum of 32,000amps, UL/CSA listed.

f. 3- Way (main, auto, off) manual transfer/disconnect switch

g. Event Counter: 120 VAC, 6-digit, non-resettable.

h. Elapsed Time Meter: 120 VAC, 7-digit, non-resettable. Limit of 99,999 hours; accurate to 0.01 hours

2.5 INSTALLATION

All treatment, pumping system, and electrical components shall be installed in accordance with the **MANUFACTURER’S** recommendations, the engineer’s plans, and all state and local regulations.

2.6 LOCATION

The pump control panel shall be mounted inside restroom building near the wastewater treatment system. The panel should be located at a convenient height (usually about five feet above the ground) and where it will be accessible for maintenance. Cellular modem to be located at a remote location (booster pump building at Bridger Bay Campground) where cellular signal strength is stronger. Contractor is responsible for fiber line and connections from cellular modem to wastewater control panel location.

A second cellular modem to be installed at Bridger Bay Campground and integrated into the existing Orenco control panel there.

3 EXECUTION

3.1 PRECONSTRUCTION CONFERENCE

Before any work at the site is started, a conference attended by the **OWNER**, **CONTRACTOR**, **ENGINEER, MANUFACTURER, OPERATOR** and others as appropriate will be held to establish a working understanding among the parties as to the work involved for installing each component of the treatment system. At this conference, the **OWNER**, **CONTRACTOR**, **ENGINEER**, and **MANUFACTURER** shall designate, in writing, a specific individual to act as **INSPECTOR** for the installation of the treatment system. Any cost or fees associated with the services of the **INSPECTOR** or the **ENGINEER** during construction will be the responsibility of the **OWNER.**

3.2 INSTALLATION AND FILED TESTING TRAINING

The **MANUFACTURER** shall provide the services of a trained representative to instruct the installing **CONTRACTOR'S** crew and **INSPECTOR** regarding the proper installation and field testing of each component per the **MANUFACTURER'S** recommendations and requirements. The **MANUFACTURER** shall have a trained representative provide installation and field testing training services for a minimum of one (1) visit of a minimum of one (1) eight-hour day at the beginning of construction.

3.3 QUALITY CONTROL

A. To ensure quality control, the **INSPECTOR** shall inspect and certify that an initial installation of the packed-bed media filter treatment system is in compliance with the **MANUFACTURER'S** recommendations and requirements.

B. Upon completion of the inspection, the **INSPECTOR**, in coordination with the **ENGINEER**, shall perform or direct the **CONTRACTOR** to perform any required adjustments to the equipment and place into operation under the supervision of the **ENGINEER**. All equipment and materials required to perform the testing shall be the responsibility of the **CONTRACTOR.** A letter of completion shall be signed by the **INSPECTOR** and copies faxed, emailed, or mailed to the **ENGINEER** and **MANUFACTURER** within one (1) week of the packed-bed media filter treatment system being installed and prior to System Commissioning.

C. The **MANUFACTURER** shall provide the services of a trained representative for a minimum of one (1) visit of a minimum of one (1) eight-hour day for the purpose of quality control during construction.

3.4 SYSTEM COMMISSIONING

A. The **MANUFACTURER** shall provide the services of a trained representative for training the **OWNER'S** service provider, and inspecting the packed-bed media filter treatment installation. The inspection will include items covered from the installation training. Upon system commissioning, the **MANUFACTURER'S** trained representative shall provide the **ENGINEER** a written report of findings. The **ENGINEER** should then perform or direct the **CONTRACTOR** to perform any required adjustments to the equipment and place into operation. All equipment and materials required to perform additional testing shall be the responsibility of the **CONTRACTOR.** The **MANUFACTURER** shall submit to the **ENGINEER** and **OWNER**, a detailed start-up checklist, according to the manufacturer's inspection and startup procedures.

B. The **MANUFACTURER** shall provide the services of a trained representative for a minimum of one (1) visit of a minimum of one (1) four-hour day for the purpose of system commissioning.

3.5 MANUFACTURER SITE VISITS

A. The **MANUFACTURE** shall provide the services of a manufacturer's representative for a minimum of three (3) visits of a minimum of one (1) four-hour day each. The visits shall be for the following:

1. INSTALLATION TRAINING
2. QUALITY CONTROL
3. SYSTEM COMMISSIONING

B. The visits shall be scheduled after the Pre-Construction Meeting and after an Inspector is designated.

3.6 OPERATION AND MAINTENANCE

The **MANUFACTURER** shall provide five (2) operation and maintenance manuals**.**

END OF SECTION

NEW BRIDGER BAY CAMPGROUND GEOTECHNICAL INVESTIGATION

AGEC
Applied GeoTech

GEOTECHNICAL INVESTIGATION

PROPOSED BRIDGER BAY CAMPGROUND

ANTELOPE ISLAND

DAVIS COUNTY, UTAH

PREPARED FOR:

ENSIGN ENGINEERING
45 WEST 1000 SOUTH, SUITE 500
SANDY, UTAH 84070

ATTENTION: ROBERT ROUSSELLE

PROJECT NO. 1200094

APRIL 16, 2020

600 West Sandy Parkway • Sandy, Utah 84070 • (801) 566-6399 • www.agecinc.com

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EXECUTIVE SUMMARY

1. Approximately ½ foot of topsoil overlying sandy lean clay or clayey sand was encountered in test pits. Bedrock was encountered below the clay in Test Pit TP-1 at approximately 1½ feet. Gravel was encountered below the clayey sand in Test Pit TP-2 and extends the full depth of the test pit, approximately 13 feet. Silty sand was encountered below the clay in Test Pit TP-3 at a depth of approximately 4 feet. The sand is underlain by gravel at a depth of approximately 6 feet, extending the full depth of the test pit, approximately 12 feet. Sand was encountered below the clay in Test Pit TP-4 at a depth of approximately 1½ feet, underlain by clay extending from approximately 4 to 5½ feet. Gravel was encountered below the clay and is underlain by sand at a depth of approximately 11 feet. The sand extends the full depth of the test pit, approximately 13 feet.

   Excavation refusal with a rubber-tired backhoe was encountered in the bedrock of Test Pit TP-1 at a depth of approximately 5 feet.

2. Water was encountered in the bedrock in Test Pit TP-1 at a depth of approximately 4½ feet. No subsurface water was encountered in the other test pits at the time of excavation. Water levels will fluctuate over time and perched water conditions can be expected due to snow melt and wet times of the year.

3. The proposed buildings may be supported on spread footings bearing on the undisturbed natural soil, bedrock or on compacted structural fill extending down to the undisturbed natural soil or bedrock and may be designed for a net allowable bearing pressure of 2,000 pounds per square foot. Footings bearing on at least 2 feet of compacted structural fill may be designed for a net allowable bearing pressure of 3,500 pounds per square foot.

4. The upper soil encountered in test pits consists of sandy lean clay to clayey sand and will be easily disturbed by construction traffic when the soil is very moist to wet such as in the winter and spring or at times of prolonged rainfall. Placement of 1 to 2 feet of gravel will provide limited support for construction equipment when the subgrade consists of very moist to wet clay or clayey sand.

5. Geotechnical information related to foundations, subgrade preparation, pavement design and materials is included in the report.

SCOPE

This report presents the results of a geotechnical investigation for the proposed Bridger Bay Campground planned to be constructed on the north end of Antelope Island in Davis County, Utah, just east of the current Bridger Bay Campground. The report presents the subsurface conditions encountered, laboratory test results and recommendations for foundations and pavement. The study was conducted in general accordance with our proposal dated March 10, 2020.

Field exploration was conducted to obtain information on the subsurface conditions. Samples obtained from the field investigation were tested in the laboratory to determine physical and engineering characteristics of the on-site soil. Information obtained from the field and laboratory was used to define conditions at the site for our engineering analysis and to develop recommendations for the proposed foundations and pavement.

This report has been prepared to summarize the data obtained during the study and to present our conclusions and recommendations based on the proposed construction and the subsurface conditions encountered. Design parameters and a discussion of geotechnical engineering considerations related to construction are included in the report.

SITE CONDITIONS

At the time of our field study, the site consisted of undeveloped hillside, except the area of Test Pit TP-1, which was in part of the current Bridger Bay Campground.

The ground surface at the site slopes gently down to the north and northwest.

Vegetation consists predominantly of grass.

There is undeveloped land to the north, south and east. The current Bridger Bay Campground is to the west (See Figure 1).

FIELD STUDY

The field study was conducted on April 2, 2020. Four test pits were excavated at the approximate locations indicated on Figure 1 using a rubber-tired backhoe. The test pits were logged and soil samples obtained by a representative of AGEC. Logs of the subsurface conditions encountered in the test pits are graphically shown on Figure 2 with legend and notes on Figure 3.

The test pits were backfilled with the excavated material and not compacted. The backfill should be removed and replaced with properly compacted fill where it will support proposed buildings, slabs, pavement or other settlement-sensitive features.

SUBSURFACE CONDITIONS

Approximately ½ foot of topsoil overlying sandy lean clay or clayey sand was encountered in test pits. Bedrock was encountered below the clay in Test Pit TP-1 at approximately 1½ feet. Gravel was encountered below the clayey sand in Test Pit TP-2 and extends the full depth of the test pit, approximately 13 feet. Silty sand was encountered below the clay in Test Pit TP-3 at a depth of approximately 4 feet. The sand is underlain by gravel at a depth of approximately 6 feet, extending the full depth of the test pit, approximately 12 feet. Sand was encountered below the clay in Test Pit TP-4 at a depth of approximately 1½ feet, underlain by clay extending from approximately 4 to 5½ feet. Gravel was encountered below the clay and is underlain by sand at a depth of approximately 11 feet. The sand extends the full depth of the test pit, approximately 13 feet.

Excavation refusal with a rubber-tired backhoe was encountered in the bedrock of Test Pit TP-1 at a depth of approximately 5 feet.

A description of the soil and bedrock encountered in the test pits follows:

Topsoil - The topsoil consists of sandy lean clay to clayey sand with gravel. It is moist, dark brown and contains organics.

Sandy Lean Clay - The clay contains small to moderate amounts of gravel and occasional cobbles. It is very stiff, moist and brown to dark brown.

Laboratory tests performed on samples of the clay indicate it has natural moisture contents of 18 and 22 percent and natural dry densities of 99 and 106 pounds per cubic foot. A consolidation test performed on a sample of the clay indicates the clay will compress a small amount with the addition of light to moderate loads. Results of the consolidation test are presented on Figure 4.

Clayey Sand - The sand contains some gravel and occasional cobbles. It is medium dense, moist and brown.

Laboratory tests performed on a sample of the sand indicate it has a natural moisture content of 8 percent and a natural dry density of 110 pounds per cubic foot.

Silty Sand - The sand is medium dense, moist and brown.

Poorly-graded Sand - The sand contains gravels. It is medium dense, moist and brown.

Laboratory tests performed on a sample of the sand indicate it has a natural moisture content of 3 percent and a natural dry density of 99 pounds per cubic foot.

Clayey Gravel with Sand - The gravel contains cobbles and occasional boulders. It is medium dense, moist and brown. The gravel is cemented between depths of 7 to 9 feet.

Poorly-graded Gravel with Sand - The gravel contains cobbles and occasional boulders up to approximately 2 feet in size. It is medium dense, moist and brown.

Bedrock - The bedrock consists of slate to argillite. It is moderately hard, moist to wet and gray with yellowish brown layers.

Results of the laboratory tests are summarized on Table I and are included on the logs of the test pits.

SUBSURFACE WATER

Water was encountered in the bedrock in Test Pit TP-1 at a depth of approximately 4½ feet. No subsurface water was encountered in the other test pits at the time of excavation. Water levels will fluctuate over time and perched water conditions can be expected due to snow melt and wet times of the year. An evaluation of such fluctuations is beyond the scope of this study.

PROPOSED CONSTRUCTION

We understand the property will be developed for a campground with tent and RV sites, and an RV dump area. Restrooms and restrooms with showers are planned for the new area and one for the existing campground. We have assumed maximum wall loads for structures on the order of 2.5 kips per lineal foot.

We anticipate that traffic for the access drive and pullouts will consist predominantly of car and RV traffic, occasional light service vehicles, and garbage and pump trucks.

If the proposed construction, building loads or traffic is significantly different from what is described above, we should be notified so that we can reevaluate the recommendations given.

RECOMMENDATIONS

Based on the subsurface conditions encountered, laboratory test results, and the proposed construction, the following recommendations are given:

A. Site Grading

1. Subgrade Preparation

   Prior to placing grading fill or base course, the topsoil, unsuitable fill, organics, debris and other deleterious materials should be removed. The upper soil consists predominantly of sandy lean clay to clayey sand and will be easily disturbed by construction traffic when the soil has a high moisture content. Placement of 1 to 2 feet of granular fill consisting predominantly of gravel and having less than 15 percent passing the No. 200 sieve will provide limited support for construction traffic when the subgrade consists of very moist to wet clay or clayey sand. Consideration may be given to placing a support fabric between the subgrade and granular fill to facilitate construction.

2. Excavation

   We anticipate excavation at the site can be accomplished with typical excavation equipment for most areas. Heavy-duty excavation equipment will be needed for areas of bedrock and possibly for areas of cemented soil.

3. Compaction

Compaction of materials placed at the site should equal or exceed the minimum densities as indicated below when compared to the maximum dry density as determined by ASTM D 1557.

Fill To Support	Compaction Criteria
Foundations	≥ 95%
Concrete Slabs	≥ 90%
Pavement	
Base Course	≥ 95%
Fill placed below Base Course	≥ 90%
Landscaping	≥ 85%
Retaining Wall Backfill	85 - 90%

To facilitate the compaction process, fill should be compacted at a moisture content within 2 percent of the optimum moisture content. Drying of the soil may not be practical during cold or wet periods of the year.

Fill and pavement materials should be frequently tested during construction for compaction.

4. Materials

Material placed as fill to support foundations should be non-expansive granular soil. The natural sand and gravel meeting the material recommendations given below for imported structural fill may be used as structural fill if the over-sized particles, organics, debris and other deleterious materials are removed. The clay and sand with a high clay content are not recommended for use as structural fill. The natural soil may be used as site grading fill below proposed pavement areas or as utility trench and building wall backfill if the organics, debris, over-sized particles and other deleterious materials are removed.

Listed below are materials recommended for imported structural fill.

Fill to Support	Recommendations
Footings	Non-expansive granular soil Passing No. 200 Sieve < 35% Liquid Limit < 30% Maximum size 4 inches
Floor Slab (Upper 4 inches)	Sand and/or Gravel Passing No. 200 Sieve < 5% Maximum size 2 inches
Slab Support	Non-expansive granular soil Passing No. 200 Sieve < 50% Liquid Limit < 30% Maximum size 6 inches

5. Drainage

The ground surface surrounding the proposed buildings should be sloped away from the buildings in all directions. Roof downspouts and drains should discharge beyond the limits of backfill.

The collection and diversion of drainage away from the pavement surface is important to the satisfactory performance of the pavement section. Proper drainage should be provided.

6. Subsurface Drains

A perched water condition was encountered in Test Pit TP-1 and could develop in other areas. Consideration should be given to providing subsurface drains or resistance to uplift from hydrostatic pressures where subsurface water could be a concern for the proposed construction.

B. Foundations

1. Bearing Material

With the proposed construction and the subsurface conditions encountered, the buildings may be supported on spread footings bearing on the undisturbed natural soil, bedrock or on compacted structural fill extending down to the undisturbed natural soil or bedrock. Where a footing would bear partially on bedrock and partially on soil, the footing should be extended down to bear entirely on bedrock or the footing supported on at least 2 feet of structural fill. Structural fill should extend out away from the edge of the footings at least a distance equal to the depth of fill beneath footings.

Unsuitable fill, topsoil, organics and other deleterious materials should be removed from below proposed foundation areas.

2. Bearing Pressure

Footings bearing on the natural, undisturbed soil, bedrock or compacted structural fill may be designed for a net allowable bearing pressure of 2,000 pounds per square foot. Footings bearing entirely on bedrock or on at least 2 feet of compacted structural fill may be designed for a net allowable bearing pressure of 3,500 pounds per square foot.

Footings should have a width of at least 1½ feet and a depth of embedment of at least 1½ feet.

3. Temporary Loading Conditions

The allowable bearing pressure may be increased by one-half for temporary loading conditions such as wind or seismic loads.

4. Settlement

Based on the subsurface conditions encountered and the assumed building loads, we estimate that total and differential settlement will be less than ½ inch.

Care will be required not to disturb the natural soil at the base of foundation excavations to maintain settlement within tolerable limits.

5. Frost Depth

Exterior footings and footings beneath unheated areas should be placed at least 30 inches below grade for frost protection.

6. Foundation Base

The base of footing excavations should be cleared of loose or deleterious material prior to structural fill or concrete placement.

7. Construction Observation

A representative of the geotechnical engineer should observe footing excavations prior to structural fill or concrete placement.

C. Concrete Slab-on-Grade

1. Slab Support

Concrete slabs may be supported on the undisturbed natural soil or on compacted structural fill extending down to the undisturbed natural soil.

Topsoil, unsuitable fill, organics and other deleterious materials should be removed from below proposed floor slabs.

2. Underslab Sand and/or Gravel

Free-draining sand and/or gravel (less than 5 percent passing the No. 200 sieve) should be placed below the floor slab to promote even curing of the concrete.

D. Lateral Earth Pressures

1. Lateral Resistance for Footings

Lateral resistance for spread footings placed on the natural soil or on compacted structural fill is controlled by sliding resistance between the footing and the foundation soils. A friction value of 0.35 may be used in design for ultimate lateral resistance.

2. Subgrade Walls and Retaining Structures

The following equivalent fluid weights are given for design of subgrade walls and retaining structures. The active condition is where the wall moves away from the soil. The passive condition is where the wall moves into the soil and the at-rest condition is where the wall does not move. The values listed below assume a horizontal surface adjacent the top and bottom of the wall.

Soil Type	Active	At-Rest	Passive
Clay & Silt	50 pcf	65 pcf	250 pcf
Sand & Gravel	40 pcf	55 pcf	300 pcf

3. Seismic Conditions

Under seismic conditions, the equivalent fluid weight should be increased by 25 pcf for the active condition, 10 pcf for the at-rest condition and decreased by 25 pcf for the passive condition. This assumes a peak ground acceleration of 0.42g for a 2 percent probability of exceedance in a 50 year period.

4. Safety Factors

The values recommended above assume mobilization of the soil to achieve soil strength. Conventional safety factors used for structural analysis for such items as overturning and sliding resistance should be used in design.

E. Liquefaction, Faulting and Seismicity

1. Liquefaction

Based on the subsurface conditions encountered and our understanding of the geology of the area, liquefaction is not considered a potential hazard at the site.

2. Faulting

There are no mapped active faults extending through the site. The closest mapped surface trace of an active fault is that of the Salt Lake fault zone located approximately 3 miles to the southwest (Utah Geological Survey, 2020).

3. Seismicity

Listed below is a summary of the site parameters that may be used with the 2018 International Building Code:

Description	Value[1]
Site Class	C[2]
S_s - MCE_R ground motion (period = 0.2s)	0.80g
S_1 - MCE_R ground motion (period = 1.0s)	0.29g
F_a - Site amplification factor at 0.2s	1.2
F_v - Site amplification factor at 1.0s	1.5
PGA - MCE_G peak ground acceleration	0.35g
PGA_M - Site modified peak ground acceleration	0.42g

[1] Values obtained from information provided by the Applied Technology Council at https://hazards.atcouncil.org.

[2] Site Class C is given based on the subsurface conditions encountered and our understanding of the geology of the area.

F. Water Soluble Sulfates

One sample of the natural soil was tested and found to have less than 0.1 percent water soluble sulfate. Based on the results of the test and published literature, the natural soil possesses negligible sulfate attack potential on concrete. No special cement type is required for concrete placed in contact with the natural soil. Other conditions may dictate the type of cement to be used in concrete for the project.

G. Pavement

Based on the subsoil conditions encountered, laboratory test results and the assumed traffic as indicated in the Proposed Construction section of the report, the following pavement support recommendations are given:

1. Subgrade Support

   We anticipate that the subgrade material will consist predominantly of sandy lean clay to clayey sand. We have assumed a California Bearing Ratio (CBR) value of 3 percent which assumes a clay subgrade.

2. Pavement Thickness

   Based on the subsoil conditions encountered, assumed traffic, a design life of 20 years for flexible pavement and 30 years for rigid pavement, and methods presented by AASHTO, a flexible pavement section consisting of 3 inches of asphaltic concrete overlying 6 inches of base course is calculated. Alternatively, a rigid pavement section consisting of 5 inches of Portland cement concrete may be used.

   Dumpster approach slabs may be constructed of 6½ inches of Portland cement concrete over 4 inches of base course.

Approximately 1 to 2 feet of granular borrow may be needed to provide equipment access and facilitate construction of the pavement if construction occurs when the subgrade consists of very moist to wet clay or clayey sand.

3. Pavement Materials and Construction

a. Flexible Pavement (Asphaltic Concrete)

The pavement materials should meet the specifications for the applicable jurisdiction. The use of other materials may result in the need for different pavement material thicknesses.

b. Rigid Pavement (Portland Cement Concrete)

The rigid pavement thickness assumes that the pavement will have aggregate interlock joints and that a concrete shoulder or curb will be provided.

The pavement materials should meet the specifications for the applicable jurisdiction. The pavement thicknesses indicated above assume that the concrete will have a 28-day compressive strength of 5,000 pounds per square inch. Concrete should be air entrained with approximately 6 percent air. Maximum allowable slump will depend on the method of placement but should not exceed 4 inches.

4. Jointing

Joints for concrete pavement should be laid out in a square or rectangular pattern. Joint spacings should not exceed 30 times the thickness of the slab. The joint spacings indicated should accommodate the contraction of the concrete and under these conditions steel reinforcing will not be required. The joints should be approximately one-fourth of the slab thickness.

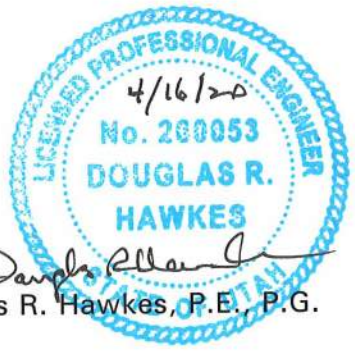
H. Preconstruction Meeting

A preconstruction meeting should be held with representatives of the owner, project architect, geotechnical engineer, general contractor, earthwork contractor and other members of the design team to review construction plans, specifications, methods and schedule.

LIMITATIONS

This report has been prepared in accordance with generally accepted soil and foundation engineering practices in the area for the use of the client for design purposes. The conclusions and recommendations included within the report are based on the information obtained from the test pits excavated at the approximate locations indicated on Figure 1 and the data obtained from laboratory testing. Variations in the subsurface conditions may not become evident until additional exploration or excavation is conducted. If the subsurface conditions or groundwater level is found to be significantly different from what is described above, we should be notified to reevaluate our recommendations.

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.



Douglas R. Hawkes, P.E., P.G.

Reviewed by Jay R. McQuivey, P.E.

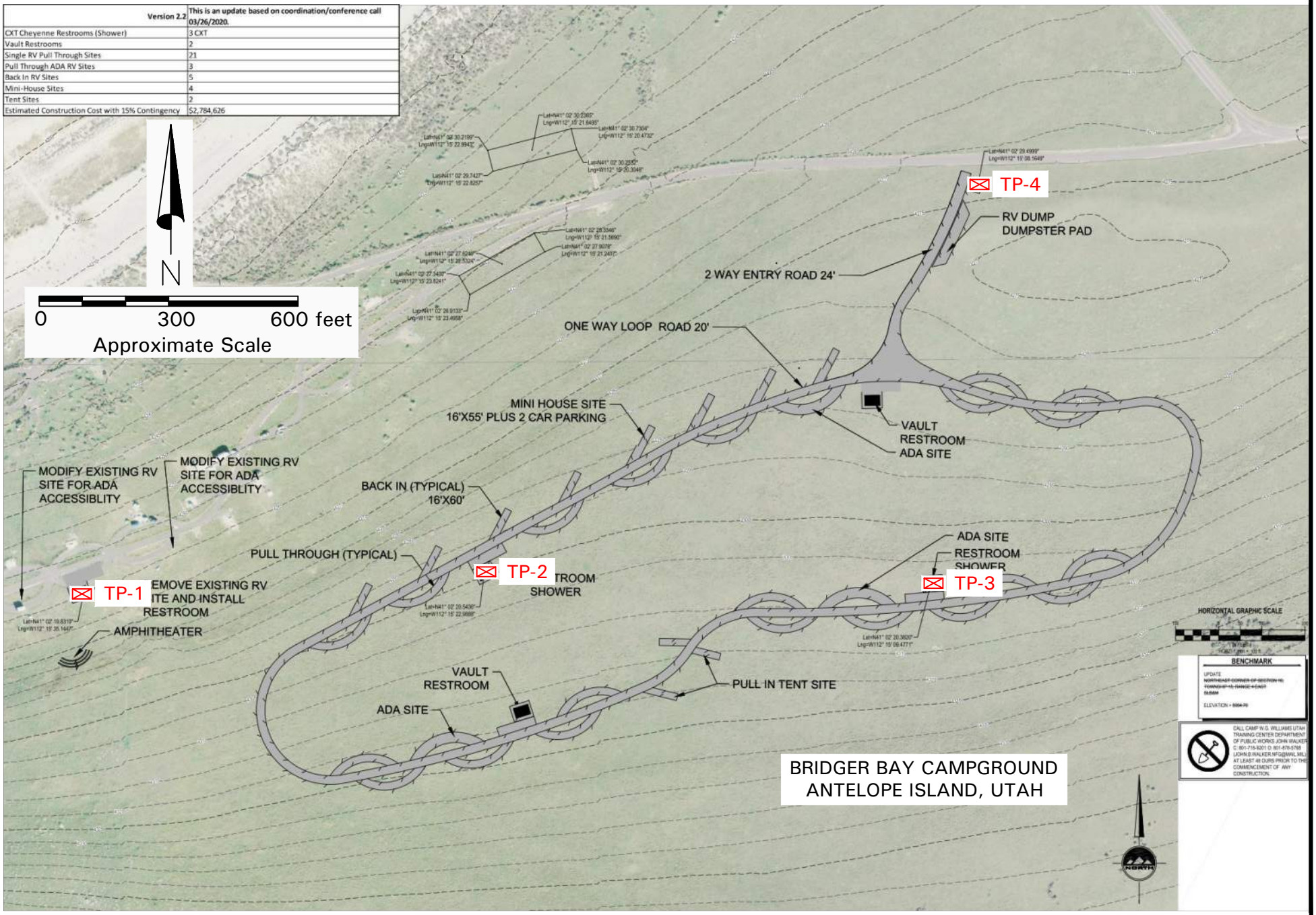
DRH/rs

REFERENCES

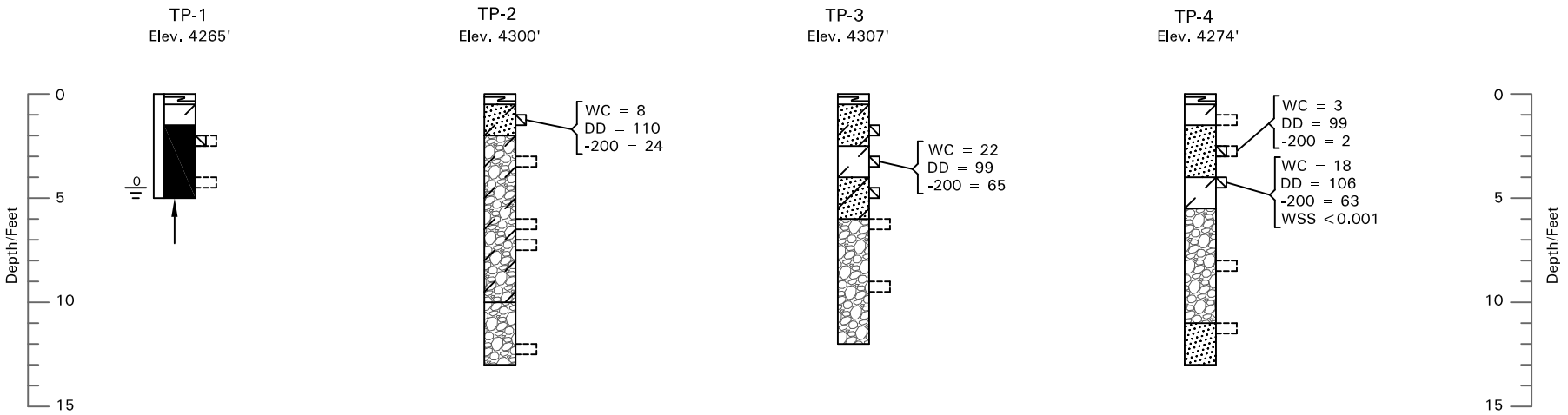
International Code Council, 2017; 2018 International Building Code, Falls Church, Virginia. City, Utah.

Salt Lake County, 2002; Surface Rupture and Liquefaction Potential Special Study Areas Map, Salt Lake County, Utah, adopted March 31, 1989, updated March 2002, Salt Lake County Public Works - Planning Division, 2001 South State Street, Salt Lake City, Utah.

Utah Geological Survey, 2020; Utah Quaternary Fault and Fold Database, http://geology.utah.gov/resources/data-databases/qfaults/ accessed March 14, 2020.



1200094	AGEC	Test Pit Locations	Figure 1



Approximate Vertical Scale 1" = 8'

See Figure 3 for Legend and Notes

1200094	AGEC	Test Pit Logs	Figure 2

LEGEND:

Topsoil; sandy lean clay to clayey sand, some gravels, moist, dark brown, organics.

Sandy Lean Clay (CL); small to moderate amount of gravels, occasional cobbles, very stiff, moist, brown to dark brown.

Clayey Sand (SC); some gravel, occasional cobbles, medium dense, moist, brown.

Silty Sand (SM); medium dense, moist, brown.

Poorly-graded Sand (SP); some gravels, medium dense, moist, brown.

Clayey Gravel with Sand (GC); cobbles, occasional boulders, medium dense, moist, brown, cemented from 7 to 9 feet.

Poorly-graded Gravel with Sand (GP); cobbles, occasional boulders up to approximately 2 feet in size, medium dense, moist, brown.

Bedrock; slate to argillite, moderately hard, moist to wet, gray with yellowish brown layers.

Indicates relatively undisturbed hand drive sample taken.

Indicates disturbed sample taken.

Indicates slotted 1½ inch PVC pipe installed in the test pit to the depth shown.

Indicates the depth to free water and the number of days after excavation the measurement was taken.

Indicates practical backhoe refusal.

NOTES:

1. The test pits were excavated on April 2, 2020 with a rubber-tired backhoe.
2. Locations of the test pits were measured approximately by pacing from features shown on the site plan provided.
3. Elevations of the test pits were determined by interpolating between contours shown on the site plan provided.
4. The test pit locations and elevations should be considered accurate only to the degree implied by the method used.
5. The lines between materials shown on the logs represent the approximate boundaries between material types and the transitions may be gradual.
6. The water level readings shown on the logs were made at the time and under the conditions indicated. Fluctuations in the water level will occur with time.
7. WC = Water Content (%);
   DD = Dry Density (pcf);
   -200 = Percent Passing the No. 200 Sieve;
   WSS = Water Soluble Sulfates (%).

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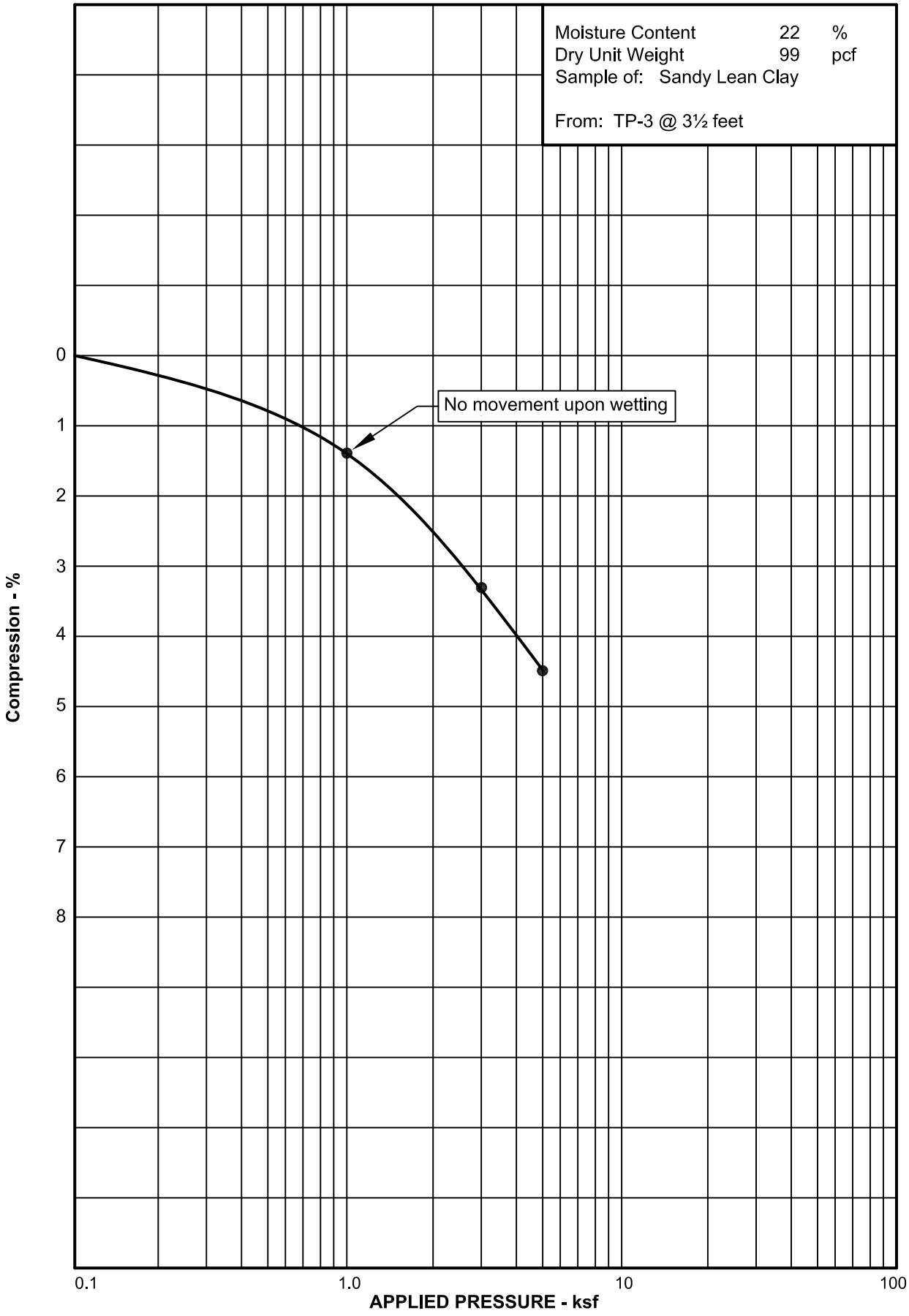

Project No. 1200094 **CONSOLIDATION TEST RESULTS** **Figure 4**

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

TABLE I
SUMMARY OF LABORATORY TEST RESULTS

PROJECT NUMBER: 1200094

SAMPLE LOCATION		NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (PCF)	GRADATION			ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	WATER SOLUBLE SULFATE (%)	SAMPLE CLASSIFICATION
TEST PIT	DEPTH (FEET)			GRAVEL (%)	SAND (%)	SILT/ CLAY (%)	LIQUID LIMIT (%)	PLASTICITY INDEX			
TP-2	1	8	110			24					Clayey Sand
TP-3	3½	22	99			65					Sandy Lean Clay
TP-4	2½	3	99			2					Poorly-graded Sand
	4	18	106			63				<0.001	Sandy Lean Clay

WHITE ROCK BAY CAMPGROUND GEOTECHNICAL INVESTIGATION

AGEC
Applied GeoTech

GEOTECHNICAL INVESTIGATION

PROPOSED WHITE ROCKS CAMPGROUND

ANTELOPE ISLAND

DAVIS COUNTY, UTAH

PREPARED FOR:

ENSIGN ENGINEERING
45 WEST 10000 SOUTH, SUITE 500
SANDY, UTAH 84070

ATTENTION: ROBERT ROUSSELLE

PROJECT NO. 1210572

OCTOBER 19, 2021

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FIGURES

TEST PIT LOCATIONS	FIGURE 1
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TEST PIT LEGEND AND NOTES	FIGURE 4
SUMMARY OF LABORATORY TEST RESULTS	TABLE I

EXECUTIVE SUMMARY

1. Approximately ½ foot of topsoil overlying sand was encountered in all but Test Pit TP-8 where gravel was encountered below the topsoil. Gravel layers were encountered in the sand in Test Pits TP-4, TP-5, TP-6 and TP-7 at depths of approximately 6, 4, 6 and 5 feet, respectively. Clay was encountered below the sand or gravel in Test Pits TP-1, TP-4 and TP-5 at depths of approximately 7½, 8 and 9 feet with the clay extending to the depth investigated in these test pits, approximately 11 feet.

   Excavation refusal with a rubber-tired backhoe at a depth of approximately 3½ feet was encountered in the cemented gravel of Test Pit TP-8. The gravel is cemented below a depth of approximately 2½ feet.

2. No subsurface water was encountered in the test pits. Water levels will fluctuate over time and perched water conditions can be expected during snow melt and wet times of the year.

3. The proposed buildings may be supported on spread footings bearing on the undisturbed natural soil or on compacted structural fill extending down to the undisturbed natural soil and may be designed for a net allowable bearing pressure of 1,500 pounds per square foot. Footings bearing on at least 2 feet of compacted structural fill may be designed for a net allowable bearing pressure of 2,500 pounds per square foot.

   The proposed water tank may be supported on the cemented gravel as found in Test Pit TP-8 if the cemented gravel extends a sufficient depth below the proposed tank bearing level. It may be that the cemented gravel overlies soil not cemented or possibly bedrock. The recommended net allowable bearing pressure for use in design of the tank foundation will depend on subsurface conditions below the proposed tank bearing level. A net allowable bearing pressure of 1,500 pounds per square foot could be assumed and subsurface conditions determined at the time of construction. Significantly higher allowable bearing pressures may be suitable depending on the actual subsurface conditions.

4. We anticipate excavation at the site can be accomplished with typical excavation equipment for the campground. Heavy-duty excavation equipment and possibly jack hammering or other rock excavation methods will be needed for the water tank site.

5. Geotechnical information related to foundations, subgrade preparation, pavement design and materials is included in the report.

SCOPE

This report presents the results of a geotechnical investigation for the proposed White Rocks Campground planned to be constructed on the west side of Antelope Island near the north end of the island in Davis County, Utah, just east of the current White Rocks Campground. The report presents the subsurface conditions encountered, laboratory test results and recommendations for foundations and pavement. The study was conducted in general accordance with our proposal dated June 30, 2021.

Field exploration was conducted to obtain information on the subsurface conditions. Samples obtained from the field investigation were tested in the laboratory to determine physical and engineering characteristics of the on-site soil. Information obtained from the field and laboratory was used to define conditions at the site for our engineering analysis and to develop recommendations for the proposed foundations and pavement.

This report has been prepared to summarize the data obtained during the study and to present our conclusions and recommendations based on the proposed construction and the subsurface conditions encountered. Design parameters and a discussion of geotechnical engineering considerations related to construction are included in the report.

SITE CONDITIONS

At the time of our field study, the site consisted of undeveloped ground northeast of the White Rocks Campground. There are some unpaved roads that extend through the area. There is a parking lot near the proposed tank site.

The ground surface at the site slopes gently down to the southwest. There is a steep slope south of the proposed tank site.

Vegetation consists predominantly of grass and some brush.

There is undeveloped land to the north, east and west. The current White Rocks Campground is to the south (See Figure 1). There are some corrals to the northeast.

FIELD STUDY

The field study was conducted on September 27, 2021. Eight test pits were excavated at the approximate locations indicated on Figure 1 using a rubber-tired backhoe. The test pits were logged and soil samples obtained by a representative of AGEC. Logs of the subsurface conditions encountered in the test pits are graphically shown on Figures 2 and 3 with legend and notes on Figure 4.

The test pits were backfilled with the excavated material and not compacted. The backfill should be removed and replaced with properly compacted fill where it will support proposed buildings, slabs, pavement or other settlement-sensitive features.

SUBSURFACE CONDITIONS

Approximately ½ foot of topsoil overlying sand was encountered in all but Test Pit TP-8 where gravel was encountered below the topsoil. Gravel layers were encountered in the sand in Test Pits TP-4, TP-5, TP-6 and TP-7 at depths of approximately 6, 4, 6 and 5 feet, respectively. Clay was encountered below the sand or gravel in Test Pits TP-1, TP-4 and TP-5 at depths of approximately 7½, 8 and 9 feet with the clay extending to the depth investigated in these test pits, approximately 11 feet.

Excavation refusal with a rubber-tired backhoe at a depth of approximately 3½ feet was encountered in the cemented gravel of Test Pit TP-8. The gravel is cemented below a depth of approximately 2½ feet.

A description of the soil encountered in the test pits follows:

Topsoil - The topsoil consists of silty sand except it is lean clay with gravel in Test Pit TP-8. The topsoil is slightly moist, dark brown and contains organics.

Lean Clay - The clay contains small to moderate amounts of sand. It is very stiff, moist and brown to reddish brown.

Laboratory tests performed on a sample of the clay indicate it has a natural moisture content of 28 percent.

Silty Sand - The sand contains some gravel. It is medium dense, slightly moist and brown.

Poorly-graded Sand - The sand contains some gravel lenses. It is medium dense, slightly moist and brown to gray.

Laboratory tests performed on samples of the sand indicate it has natural moisture contents of 1 to 2 percent and a natural dry density of 109 pounds per cubic foot.

Poorly-graded Gravel with Sand - The gravel contains some clay and cobbles in Test Pit TP-8. The gravel is medium dense, slightly moist and brown to gray.

Cemented Gravel with Sand - The cemented gravel is hard, slightly moist and gray.

Results of the laboratory tests are summarized on Table I and are included on the logs of the test pits.

SUBSURFACE WATER

No subsurface water was encountered in the test pits. Water levels will fluctuate over time and perched water conditions can be expected during snow melt and wet times of the year. An evaluation of such fluctuations is beyond the scope of this study.

PROPOSED CONSTRUCTION

We understand the property will be developed for a campground with tent and RV sites, and an RV dump area. Restrooms and restrooms with showers are planned for the campground. We have assumed maximum wall loads for structures on the order of 2.5 kips per lineal foot. A future water tank is planned at Test Pit TP-8 located west of the site.

We anticipate that traffic for the access drive and pullouts will consist predominantly of car and RV traffic, occasional light service vehicles, and garbage and pump trucks.

If the proposed construction, building loads or traffic is significantly different from what is described above, we should be notified so that we can reevaluate the recommendations given.

RECOMMENDATIONS

Based on the subsurface conditions encountered, laboratory test results, and the proposed construction, the following recommendations are given:

A. Site Grading

1. Subgrade Preparation

Prior to placing grading fill or base course, the topsoil, unsuitable fill, organics, debris and other deleterious materials should be removed. The subgrade should be scarified to a depth of approximately 8 inches, moisture conditioned to within 2 percent of optimum and compacted to at least 90 percent of the maximum dry density determined by ASTM D1557. The subgrade should be proof rolled to identify soft areas and soft areas replaced with granular fill with less than 15 percent passing the No. 200 sieve.

2. Excavation

We anticipate excavation at the site can be accomplished with typical excavation equipment for the campground. Heavy-duty excavation equipment and possibly jack hammering or other rock excavation methods will be needed for the water tank site.

3. Cut and Fill Slopes

We do not anticipate there will be significant changes in grade at the site for the proposed construction. There may be some grading for the proposed water tank. Permanent unretained cut and fill slopes may be constructed at 2 horizontal to 1 vertical or flatter. Steeper retained slopes may be suitable but should be evaluated on an individual basis. Temporary excavation slopes may be constructed at 1½ horizontal to 1 vertical or flatter.

Good surface drainage should be provided upslope of cut and fill slopes to direct surface runoff away from the face of the slopes. The slopes should be protected from erosion by revegetation or other methods.

4. Compaction

Compaction of materials placed at the site should equal or exceed the minimum densities as indicated below when compared to the maximum dry density as determined by ASTM D 1557.

Fill To Support	Compaction Criteria
Foundations	≥ 95%
Concrete Slabs	≥ 90%
Pavement	
Base Course	≥ 95%
Fill placed below Base Course	≥ 90%
Landscaping	≥ 85%
Retaining Wall Backfill	85 - 90%

To facilitate the compaction process, fill should be compacted at a moisture content within 2 percent of the optimum moisture content. Drying of the soil may not be practical during cold or wet periods of the year.

Fill and pavement materials should be frequently tested during construction for compaction.

5. Materials

Material placed as fill to support foundations should be non-expansive granular soil. The natural sand and gravel meeting the material recommendations given below for imported structural fill may be used as structural fill if the over-sized particles, organics, debris and other deleterious materials are removed. The clay is not recommended for use as structural fill. The natural soil may be used as site grading fill below proposed pavement areas or as utility trench and building wall backfill if the organics, debris, over-sized particles and other deleterious materials are removed.

Listed below are materials recommended for imported structural fill.

Fill to Support	Recommendations
Footings	Non-expansive granular soil Passing No. 200 Sieve < 35% Liquid Limit < 30% Maximum size 4 inches
Floor Slab (Upper 4 inches)	Sand and/or Gravel Passing No. 200 Sieve < 5% Maximum size 2 inches
Slab Support	Non-expansive granular soil Passing No. 200 Sieve < 50% Liquid Limit < 30% Maximum size 6 inches

6. Drainage

The ground surface surrounding the proposed buildings should be sloped away from the buildings in all directions. Roof downspouts and drains should discharge beyond the limits of backfill.

The collection and diversion of drainage away from the pavement surface is important to the satisfactory performance of the pavement section. Proper drainage should be provided.

B. Foundations

1. Bearing Material

The proposed buildings may be supported on spread footings bearing on the undisturbed natural soil or on compacted structural fill extending down to the undisturbed natural soil. The proposed water tank may be supported on the cemented gravel as found in Test Pit TP-8 if the cemented gravel extends a sufficient depth below the proposed tank bearing level. It may be that the cemented gravel overlies soil not cemented or possibly bedrock. The bedrock

in the area consists of quartzite and would be suitable to support the proposed tank.

Unsuitable fill, topsoil, organics and other deleterious materials should be removed from below proposed foundation areas.

2. Bearing Pressure

Building footings bearing on the natural, undisturbed soil or on compacted structural fill may be designed for a net allowable bearing pressure of 1,500 pounds per square foot. Footings bearing on at least 2 feet of the gravel or at least 2 feet of compacted structural fill may be designed for a net allowable bearing pressure of 2,500 pounds per square foot.

The recommended net allowable bearing pressure for use in design of the tank foundation will depend on subsurface conditions below the proposed tank bearing level. A net allowable bearing pressure of 1,500 pounds per square foot could be assumed and subsurface conditions determined at the time of construction. Significantly higher allowable bearing pressures may be suitable depending on the actual subsurface conditions.

Footings should have a width of at least 1½ feet and a depth of embedment of at least 1 foot.

3. Temporary Loading Conditions

The allowable bearing pressure may be increased by one-half for temporary loading conditions such as wind or seismic loads.

4. Settlement

Based on the subsurface conditions encountered and the assumed building loads, we estimate that total and differential settlement will be less than ½ inch.

Care will be required not to disturb the natural soil at the base of foundation excavations to maintain settlement within tolerable limits.

5. Frost Depth

Exterior footings and footings beneath unheated areas should be placed at least 30 inches below grade for frost protection.

6. Foundation Base

The base of footing excavations should be cleared of loose or deleterious material prior to structural fill or concrete placement.

7. Construction Observation

A representative of the geotechnical engineer should observe footing excavations prior to structural fill or concrete placement.

C. Concrete Slab-on-Grade

1. Slab Support

Concrete slabs may be supported on the undisturbed natural soil or on compacted structural fill extending down to the undisturbed natural soil.

Topsoil, unsuitable fill, organics and other deleterious materials should be removed from below proposed floor slabs.

2. Underslab Sand and/or Gravel

Free-draining sand and/or gravel (less than 5 percent passing the No. 200 sieve) should be placed below the floor slab to promote even curing of the concrete.

D. Lateral Earth Pressures

1. Lateral Resistance for Footings

Lateral resistance for spread footings placed on the natural soil or on compacted structural fill is controlled by sliding resistance between the footing and the foundation soils. A friction value of 0.45 may be used in design for ultimate lateral resistance.

2. Subgrade Walls and Retaining Structures

The following equivalent fluid weights are given for design of subgrade walls and retaining structures. The active condition is where the wall moves away from the soil. The passive condition is where the wall moves into the soil and the at-rest condition is where the wall does not move. The values listed below assume a horizontal surface adjacent the top and bottom of the wall.

Soil Type	Active	At-Rest	Passive
Clay & Silt	50 pcf	65 pcf	250 pcf
Sand & Gravel	40 pcf	55 pcf	300 pcf

3. Seismic Conditions

Under seismic conditions, the equivalent fluid weight should be increased by 26 pcf for the active condition, 11 pcf for the at-rest condition and decreased by 26 pcf for the passive condition. This assumes a peak ground acceleration of 0.44g for a 2 percent probability of exceedance in a 50 year period.

4. Safety Factors

The values recommended above assume mobilization of the soil to achieve soil strength. Conventional safety factors used for structural analysis for such items as overturning and sliding resistance should be used in design.

E. Liquefaction, Faulting and Seismicity

1. Liquefaction

Based on the subsurface conditions encountered and our understanding of the geology of the area, liquefaction is not considered a potential hazard at the site.

2. Faulting

There are no mapped active faults extending through the site. The closest mapped surface trace of an active fault is that of the Great Salt Lake fault zone located approximately 2 miles to the west (Utah Geological Survey, 2021).

3. Seismicity

Listed below is a summary of the site parameters that may be used with the 2018 International Building Code:

Description	Value[1]
Site Class	Default D[2]
S_s - MCE_R ground motion (period = 0.2s)	0.81g
S_1 - MCE_R ground motion (period = 1.0s)	0.29g
F_a - Site amplification factor at 0.2s	1.2
F_v - Site amplification factor at 1.0s	1.5
PGA - MCE_G peak ground acceleration	0.35g
PGA_M - Site modified peak ground acceleration	0.44g

[1]Values obtained from information provided by the Applied Technology Council at https://hazards.atcouncil.org.
[2]Site Class Default D is given based on the subsurface conditions encountered and the limited subsurface information for the site. Site Class C or B may be representative of the proposed tank site but deeper subsurface investigation would be needed to determine this.

F. Water Soluble Sulfates

One sample of the natural soil was tested and found to have less than 0.1 percent water soluble sulfate. Based on the results of the test and published literature, the natural soil possesses negligible sulfate attack potential on concrete. No special cement type is required for concrete placed in contact with the natural soil. Other conditions may dictate the type of cement to be used in concrete for the project.

G. Pavement

Based on the subsoil conditions encountered, laboratory test results and the assumed traffic as indicated in the Proposed Construction section of the report, the following pavement support recommendations are given:

1. Subgrade Support

   We anticipate that the subgrade material will consist predominantly of sand. We have assumed a California Bearing Ratio (CBR) value of 5 percent which assumes a silty sand subgrade.

2. Pavement Thickness

   Based on the subsoil conditions encountered, assumed traffic, a design life of 20 years for flexible pavement and 30 years for rigid pavement, and methods presented by AASHTO, a flexible pavement section consisting of 3 inches of asphaltic concrete overlying 6 inches of base course is calculated. Alternatively, a rigid pavement section consisting of 5 inches of Portland cement concrete may be used.

   Dumpster approach slabs may be constructed of 6½ inches of Portland cement concrete over 4 inches of base course.

We understand that an unpaved road may be used. Unpaved roads will require significant maintenance as rutting and loss of material occurs. With a sand subgrade, the unpaved road could consist of 6 inches of base course. A woven geotextile could be placed below the base course to help maintain the base course thickness and reduce rutting.

3. Pavement Materials and Construction

a. Flexible Pavement (Asphaltic Concrete)

The pavement materials should meet the specifications for the applicable jurisdiction.

b. Rigid Pavement (Portland Cement Concrete)

The rigid pavement thickness assumes that the pavement will have aggregate interlock joints and that a concrete shoulder or curb will be provided.

The pavement materials should meet the specifications for the applicable jurisdiction. The pavement thicknesses indicated above assume that the concrete will have a 28-day compressive strength of 5,000 pounds per square inch. Concrete should be air entrained with approximately 6 percent air. Maximum allowable slump will depend on the method of placement but should not exceed 4 inches.

4. Jointing

Joints for concrete pavement should be laid out in a square or rectangular pattern. Joint spacings should not exceed 30 times the thickness of the slab. The joint spacings indicated should accommodate the contraction of the concrete and under these conditions steel reinforcing will not be required. The joints should be approximately one-fourth of the slab thickness.

H. Preconstruction Meeting

A preconstruction meeting should be held with representatives of the owner, project architect, geotechnical engineer, general contractor, earthwork contractor and other members of the design team to review construction plans, specifications, methods and schedule.

LIMITATIONS

This report has been prepared in accordance with generally accepted soil and foundation engineering practices in the area for the use of the client for design purposes. The conclusions and recommendations included within the report are based on the information obtained from the test pits excavated at the approximate locations indicated on Figure 1 and the data obtained from laboratory testing. Variations in the subsurface conditions may not become evident until additional exploration or excavation is conducted. If the subsurface conditions or groundwater level is found to be significantly different from what is described above, we should be notified to reevaluate our recommendations.

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

Douglas R. Hawkes, P.E., P.G.

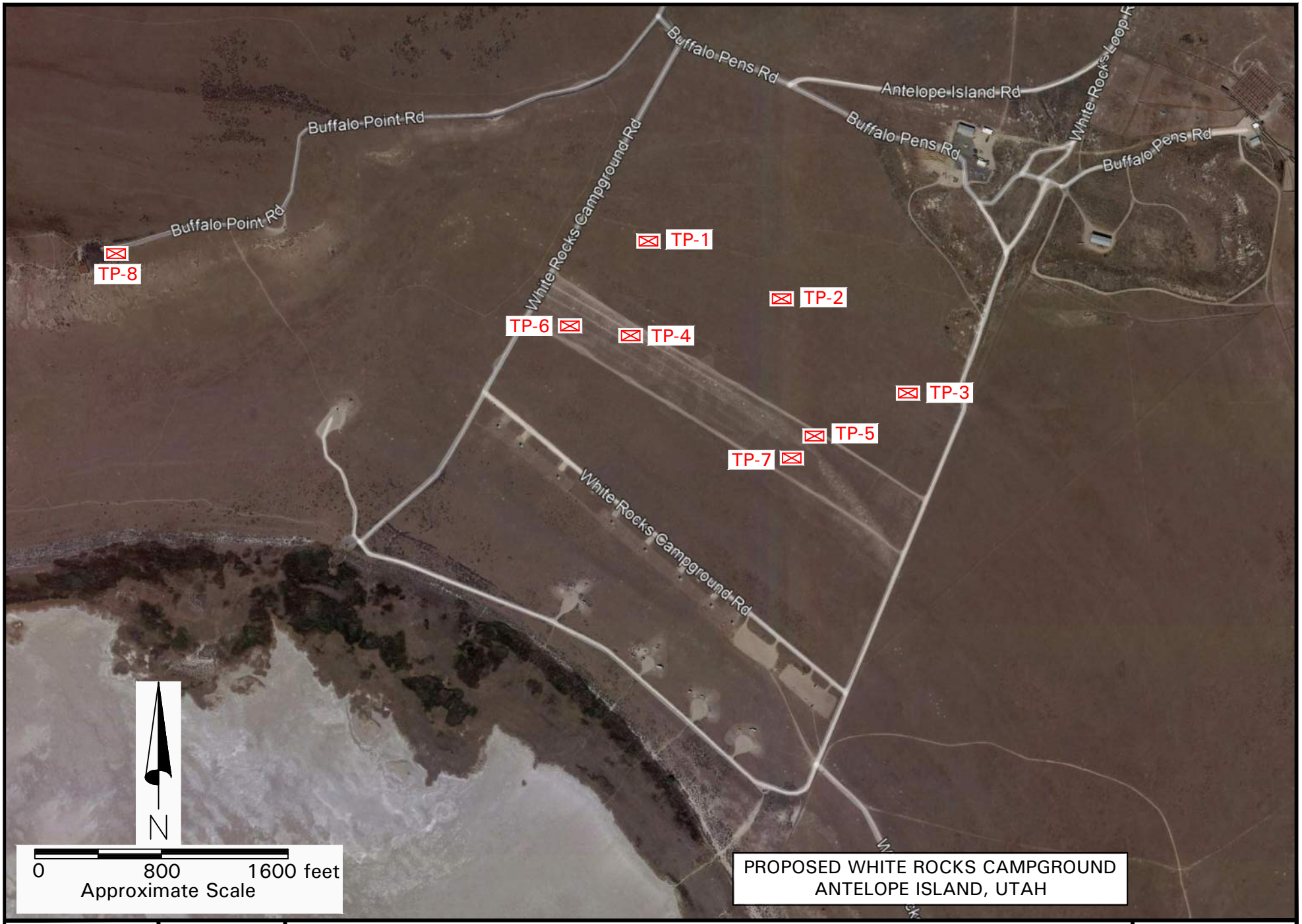
Reviewed by Jay R. McQuivey, P.E.

DRH/bw

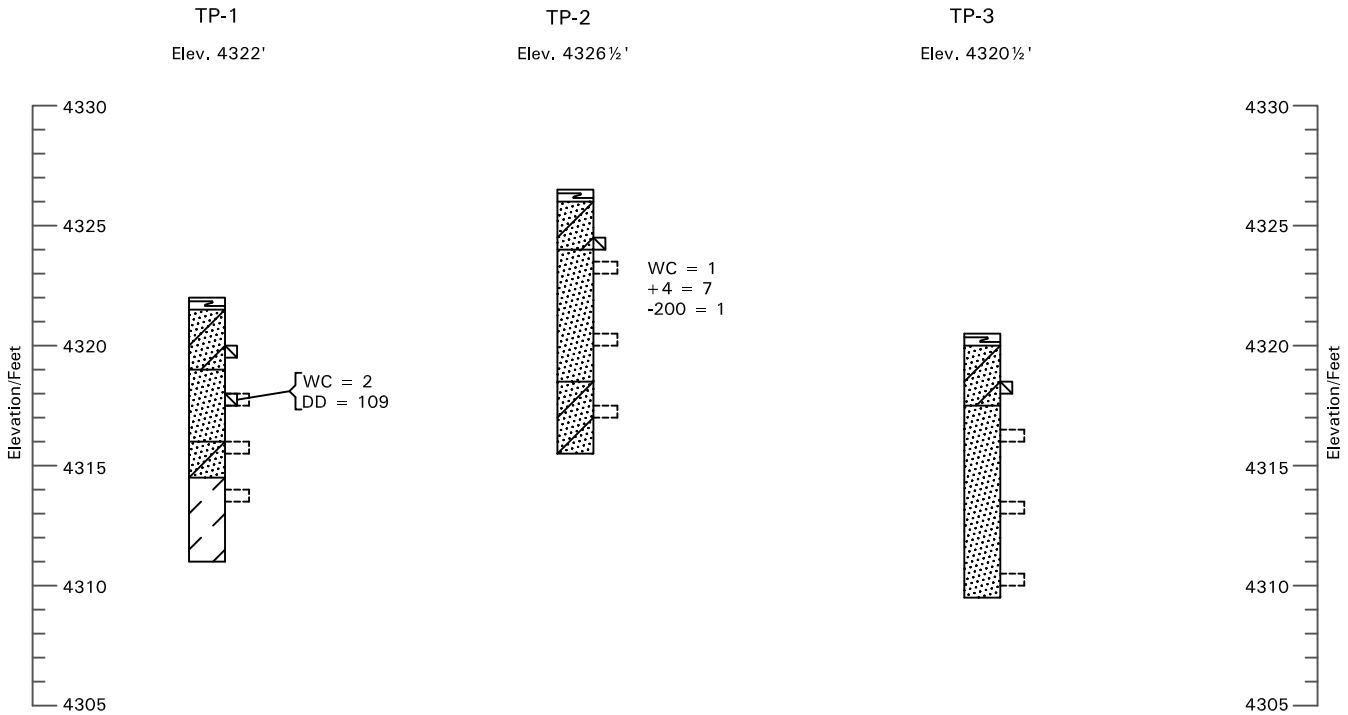
REFERENCES

International Code Council, 2017; 2018 International Building Code, Falls Church, Virginia. City, Utah.

Utah Geological Survey, 2021; Utah Quaternary Fault and Fold Database, https://geology.utah.gov/apps/hazards/ accessed October 8, 2021.



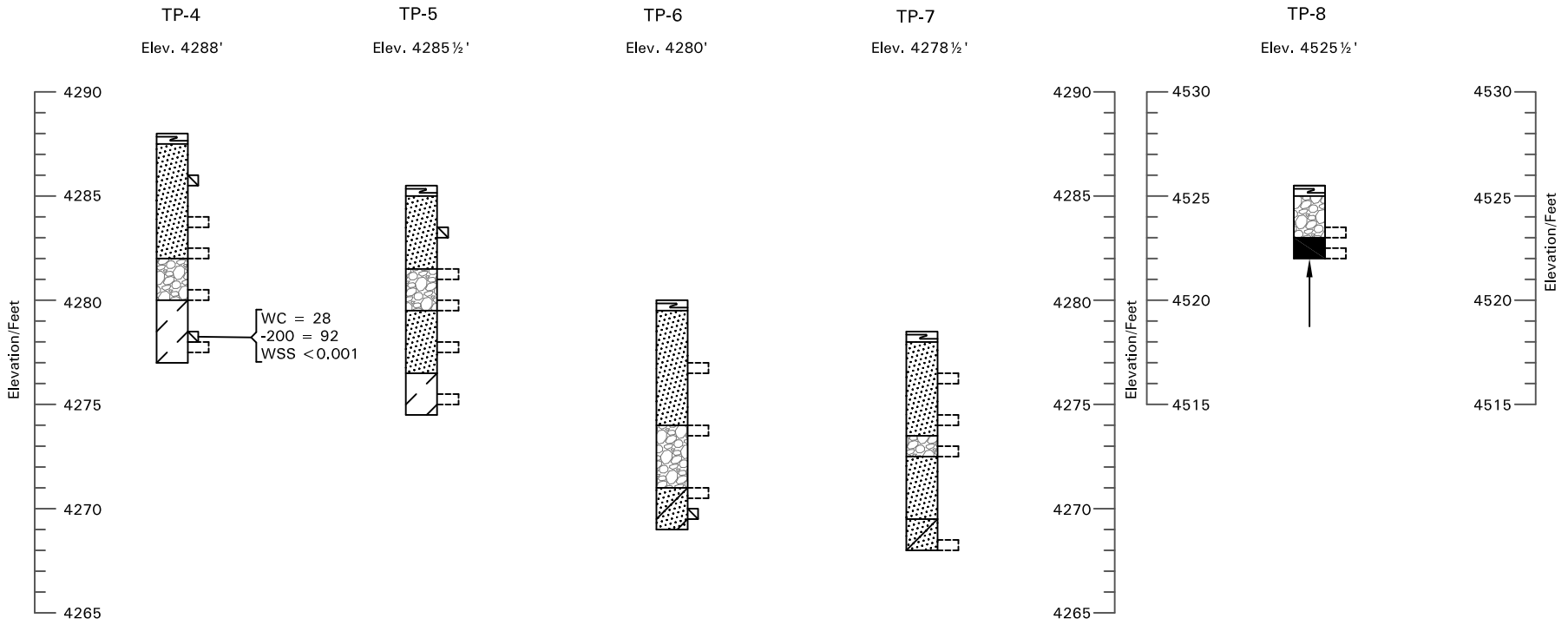
1210572	AGEC	Test Pit Locations	Figure 1



Approximate Vertical Scale 1" = 8'

See Figure 4 for Legend and Notes

1210572	AGEC	Test Pit Logs	Figure 2



Approximate Vertical Scale 1" = 8'

See Figure 4 for Legend and Notes

1210572	AGEC	Test Pit Logs	Figure 3

LEGEND:

Topsoil; silty sand except lean clay with sand and gravel in TP-8, slightly moist, dark brown, organics.

Lean Clay (CL); small to moderate amount of sand, very stiff, moist, brown to reddish brown.

Silty Sand (SM); some gravel, medium dense, slightly moist, brown.

Poorly-graded Sand (SP); some gravel lanses, medium dense, slightly moist, brown to gray.

Poorly-graded Gravel with Sand (GP); some clay and cobbles in TP-8, medium dense, slightly moist, brown to gray.

Cemented Gravel with Sand; hard, slightly moist, gray.

Indicates relatively undisturbed hand drive sample taken.

Indicates disturbed sample taken.

Indicates practical excavation refusal.

NOTES:

1. The test pits were excavated on September 27, 2021 with a rubber-tired backhoe.
2. Locations of the test pits were measured approximately by pacing from features shown on Figure 1.
3. Elevations of the test pits were provided by the client.
4. The test pit locations and elevations should be considered accurate only to the degree implied by the method used.
5. The lines between materials shown on the logs represent the approximate boundaries between material types and the transitions may be gradual.
6. No free water was encountered in the test pits at the time of excavation.
7. WC = Water Content (%);
   DD = Dry Density (pcf);
   +4 = Percent Retained on the No. 4 Sieve;
   -200 = Percent Passing the No. 200 Sieve;
   WSS = Water Soluble Sulfates (%).

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

TABLE I
SUMMARY OF LABORATORY TEST RESULTS

PROJECT NUMBER: 1210572

SAMPLE LOCATION		NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (PCF)	GRADATION			ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	WATER SOLUBLE SULFATE (%)	SAMPLE CLASSIFICATION
TEST PITS	DEPTH (FEET)			GRAVEL (%)	SAND (%)	SILT/ CLAY (%)	LIQUID LIMIT (%)	PLASTICITY INDEX			
TP-1	4	2	109								Poorly-graded Sand
TP-2	3	1		7	92	1					Poorly-graded Sand
TP-4	9½	28				92				<0.001	Lean Clay

WHITE ROCK BAY CAMPGROUND SUBSURFACE EXPLORATION SUMMARY LETTER

AGEC
Applied GeoTech

October 6, 2021

Ensign Engineering
45 West 10000 South, Suite 500
Sandy, Utah 84070

Attention: Robert Rousselle
EMAIL: rrousselle@ensignutah.com

Subject: Subsurface Exploration and Percolation Testing Summary Letter
Proposed White Rocks Bay Campground Septic System
Antelope Island, Utah
Project No. 1210584

Mr. Rousselle:

Applied Geotechnical Engineering Consultants, Inc. (AGEC) was requested to conduct subsurface exploration, percolation testing and provide a conventional, gravity-fed septic system design for the proposed White Rocks Bay campground located on the northwest side of Antelope Island in Davis County Utah. Septic system design is not provided because the subsurface conditions encountered are unsuitable for a conventional septic system.

PROPOSED CONSTRUCTION

We understand that the new campground will have five restrooms along with several RV camp sites. Consideration is being given to providing sewer connections at some, or all, of the RV camp sites. An on-site wastewater disposal (septic) system is planned to collect, treat and dispose of wastewater generated from the campground. (Figure 1). The site plan used in Figure 1 was provided by the client. We understand the maximum anticipated daily wastewater flow to the septic system is estimated to be between approximately 6,000 and 7,000 gallons if all of the proposed RV camp sites have sewer connections.

GEOTECHNCIAL STUDY

We are performing a geotechnical study for the proposed campground and will submit our conclusions and recommendations in a report addressed to Ensign Engineering under AGEC Project No. 1210572. The test pits for the geotechnical study were excavated on the same day as the septic system test pits summarized in this letter.

HEALTH DEPARTMENT COORDINATION

The Davis County Health Department requires that they perform site and soils evaluation for proposed septic systems in their jurisdiction. We coordinated with Carl Shupe with the Davis County Health Department to observe and document the test pits excavated at the site for the proposed restrooms and septic system drain fields. A further discussion of the Davis County Health Department participation is included below.

SITE CONDITIONS

The area proposed for construction of the septic system drain fields was identified by the client and consists of undeveloped ground extending northeast of the existing White Rocks Bay campground (Figure 1). There are no structures, pavements or utilities present in the area investigated. Two un-paved roads extend through the center portion of the site. The area is relatively flat and slopes gently down to the southwest, towards the existing White Rocks Bay campground and the Great Salt Lake. Vegetation consists of low grass and occasional sage brush. To the north, east and west is a continuation of the undeveloped hillside comprising the site. Farther northeast are buffalo roundup pens.

SURFACE WATER INFORMATION

There were no intermittent or year-round streams, ditches, watercourses, ponds or other surface water identified within 100 feet of the proposed on-site wastewater system during the field study. The Great Salt Lake is currently several hundred feet to the west-southwest with the high-water line greater than 100 feet to the southwest.

SUBSURFACE CONDITIONS

A representative of AGEC visited the site on September 27, 2021 to observe and document the subsurface soil profile in the areas of the proposed restrooms and septic system drain fields and to perform percolation testing. Five test pits (TP-1 to TP-5) were excavated in the areas of the proposed restrooms. Two test pits (TP-7 and TP-8) were excavated in the area proposed for construction of the septic system drain fields. The test pit locations were identified by the client. The test pits were excavated to depths of approximately 10 to 11 feet below the surrounding ground surface using a rubber-tired excavator. The subsurface soils encountered in the test pits generally consist of approximately ½-foot of topsoil consisting of loamy sand overlying 4½ to 5½ feet of fine to coarse sand. The upper sand is oolitic (formed around brine shrimp eggs), slightly moist to moist and light brown with a single-grain structure. Approximately 1 to 3 feet of very gravelly coarse sand with occasional small cobbles extends below the loamy sand. The sand is moist, light brown light grayish brown and exhibits a single-grain structure. Moist sandy loam with a massive structure was encountered below the sand in Test Pit TP-7. Moist silty clay with a platy structure was encountered below the sand in Test Pit TP-8.

The approximate locations of the test pits were measured in the field using a hand-held GPS device and are shown on Figure 1. Logs of Test Pits TP-7 and TP-8 are presented in the appendix. The test pits were backfilled using the excavated material without significant compaction effort.

SUBSURFACE WATER

No subsurface water was encountered in the test pits to the maximum depth investigated, approximately 12 feet. Perched layers of groundwater may develop during periods of snow melt and/or precipitation.

PERCOLATION TESTING

Percolation Tests P-1 and P-2 were performed adjacent Test Pits TP-7 and TP-8, respectively, on September 27, 2021. The percolation tests were performed in excavations extended approximately 3 feet below the existing ground surface near the test pits. Results of the percolation tests indicate that the soil tested has percolation rates faster than 1 minute per inch. Percolation test results are presented in the appendix.

Utah Rule R317-4 indicates that soils with percolation rates faster than one minute per inch are not suitable for design of conventional septic system drain fields. We anticipate percolation rates for the subsurface soils encountered in Test Pits TP-1 to TP-5 would be similar to the result of Percolation Tests P-1 and P-2.

Davis County Health Department representative Carl Shupe arrived on site to observe and document the subsurface soil conditions in Test Pits TP-1, TP-2, TP-7 and Percolation Test P-1. Based on Mr. Shupe's review of the subsurface soils encountered in the test pits and the results of Percolation Test P-1, he verbally indicated that design of a conventional septic system drain field in the area investigated will not be permitted based on the relatively free draining nature of the sand layers encountered. Mr. Shupe indicated that he will provide a septic feasibility letter to the client indicating that an alternative type of septic system will be required, likely using UV light disinfection.

OPINION

Based on Utah Administrative Rule R317-4, Davis County Health Department guidelines, the subsurface conditions encountered in the test pits excavated in the areas of the proposed restrooms and septic system drain fields, results of percolation tests performed at the site and information provided by the client our professional opinion is that the area investigated is not suitable for design and construction of conventional septic system drain fields.

We agree with the Davis County Health Department's initial indication that design and construction of an alternative type of septic system drain field may be possible in the area investigated.

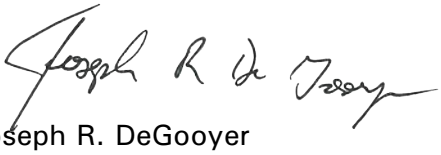
LIMITATION

This letter has been prepared in general accordance with the Utah Department of Environmental Quality, Division of Water Quality, On-site Wastewater Disposal System Administrative Code (R317-4) and Davis County Health Department guidelines. The opinion included in the letter is based on information obtained from the site, information provided by the Davis County Health Department and the client and our understanding of the proposed construction.

If you have any questions or if we can be of further service, please call.

Sincerely,

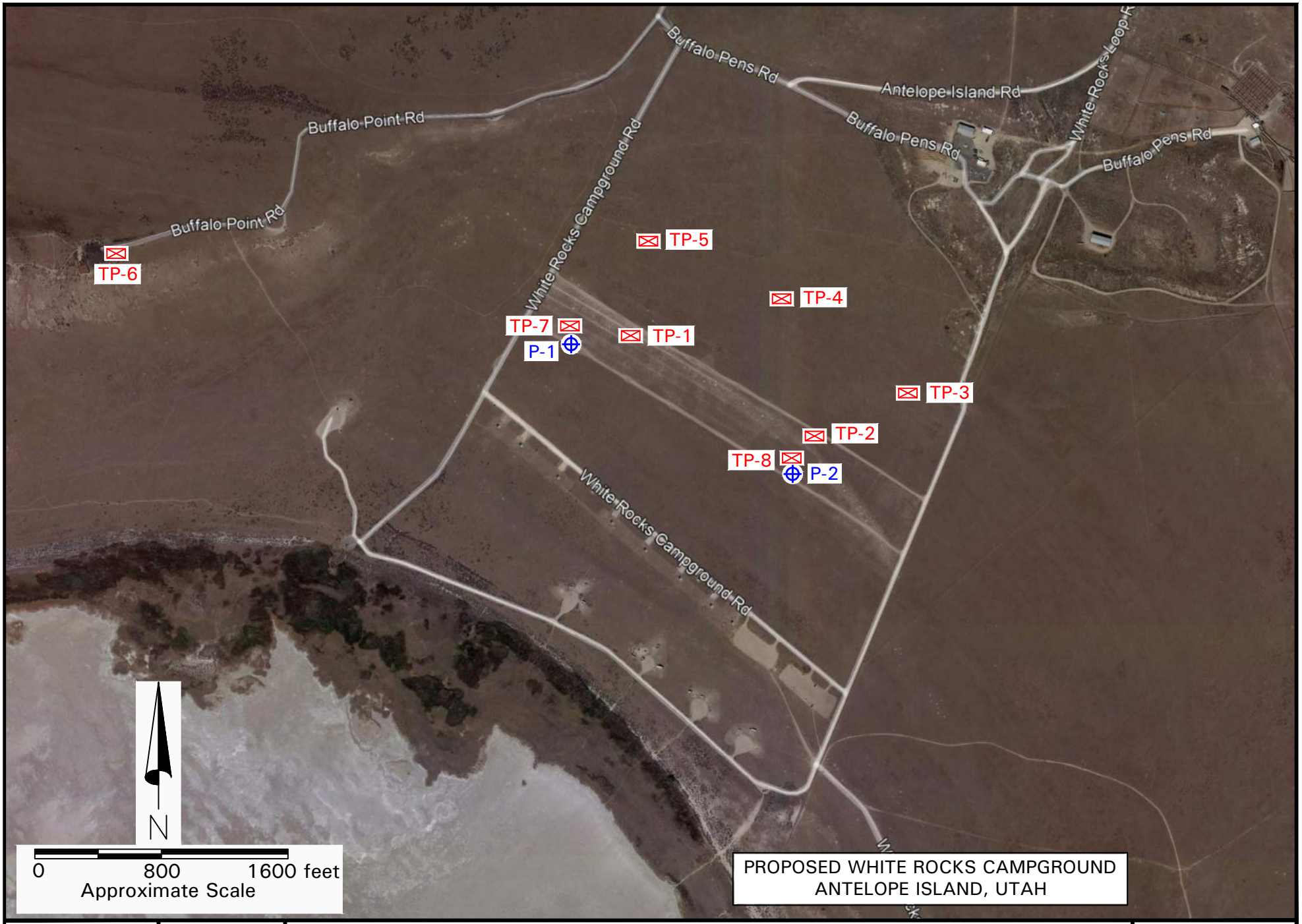
APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.



Joseph R. DeGooyer
DEQ Certificate # 00214-OSP-2

Reviewed by DRH, P.E., P.G.
JRD/rs
Enclosures

cc: Carl Shupe (Davis County Health Dept., EMAIL: cshupe@co.davis.ut.us)



1210584	AGEC	Test Pit and Percolation Test Locations	Figure 1

APPENDIX

PERCOLATION TEST RESULTS

Project No. 1210584

AGEC
Applied GeoTech

Applied Geotechnical Engineering Consultants, Inc.

UTAH DEPARTMENT OF HEALTH
PERCOLATION TEST CERTIFICATE AND SOIL EXPLORATION RESULTS
(Information required for Determining Soil Suitability for Individual Wastewater Disposal Systems)

Project/Property Location: White Rocks Bay Campground
Antelope Island State Park, Utah

Prepared for: Ensign Engineering

I certify that percolation tests have been conducted on the above property, in accordance with requirements specified in the **On-site Wastewater Systems Rule R317-4**, adopted by the Utah Department of Health, and that percolation rate, calculated as specified by said regulations, is as follows (use reverse side or additional sheets if necessary):

Test Hole No.	Test Hole Depth (feet)	Saturation Period (hours)	Swelling Period (hours)	Time Interval / Final Water Level Drop (inches)	Final Stabilized Percolation Rate ** (Minutes per Inch)
P-1	3	NA	NA	2 / > 6	< 1
P-2	3	NA	NA	2 / > 6	< 1

Statement of soil conditions obtained from soil explorations to a depth of 10 feet. In the event that absorption systems will be deeper than 6 feet, soil explorations must extend to a depth of at least 4 feet below the bottom of the proposed absorption field, seepage trench, seepage pit, or absorption bed. A descriptive log of each exploration hole should be given: **See attached letter for test pit logs.**

Date soil exploration(s) conducted: September 27, 2021.

Statement of present and maximum anticipated groundwater table throughout the property and area of the proposed soil absorption: Ground water, or evidence of groundwater, was not observed in the test pits excavated at the property to the maximum depth investigated, approximately 12 feet.

Date groundwater table determined: September 27, 2021.

I hereby certify that, to the best of my knowledge, the foregoing information is correct.

Date Oct 4, 2021 Signed by: Joseph R DeVey

(Unsigned test certificates will not be accepted.)

* Five and fifteen minute time intervals between percolation test measurements may be used only for certain circumstances—see detailed instruction for conducting percolation tests as referenced above. If a 5 or 10 minute time interval is used for tests, so indicate.

** Percolation rate is equal to period of time used in minutes, divided by distance water dropped in inches and/or fractions thereof.

RECORD SHEET FOR CONDUCTING SOIL PERCOLATION TESTS
Utah Division of Water Quality

Name of Project or Development:	White Rocks Bay Campground	Date of Test:	September 27, 2021
Location of Property:	Antelope Island State Park	Project No.:	1210584
Name of Person Performing Test:	Joe DeGooyer	Depth to top of percolation hole:	3′
Percolation Test No.	P-1		

Period of time hole was saturate	NA	Time interval used for measuring water drop	2 min.	Hole width or diameter	8"
Total depth of hole	14"	Period of time soil permitted to swell	NA	Depth of water table	>11'

Successive Percolation Tests	Initial Depth to Water (inches)	Beginning Time	Final Depth to Water (inches)	Ending Time	Distance Water Dropped in Inches	Elapsed Time in Minutes	Perc Rate in Min./ Inch
1	6	9:48 AM	> 12	9:50 AM	> 6	2	< 1
2	6	9:52 AM	> 12	9:54 AM	> 6	2	<1
3	6	9:56 AM	> 12	9:58 AM	> 6	2	< 1

Final Stabilized Percolation Rate: < 1 minutes/inch

Descriptive log of soil exploration hole No. TP-7

Thickness of Each Stratum			Description and Texture of Each Stratum
Surface	to:	½'	Topsoil, loamy sand, moist, brown, roots and organics, weak granular structure.
½'	to:	6'	Sand with occasional gravel, slightly moist, brown to light brown, fine and medium grained, single grain structure.
6'	to:	9'	Very gravelly coarse sand, slightly moist to moist, light gray, single-grained structure.
5'	to:	10'	Sandy loam, moist, brown, massive structure.

RECORD SHEET FOR CONDUCTING SOIL PERCOLATION TESTS
Utah Division of Water Quality

Name of Project or Development:	White Rocks Bay Campground	Date of Test:	September 27, 2021
Location of Property:	Antelope Island State Park	Project No.:	1210584
Name of Person Performing Test:	Joe DeGooyer	Depth to top of percolation hole:	3′
Percolation Test No.	P-2		

Period of time hole was saturate	NA	Time interval used for measuring water drop	2 min.	Hole width or diameter	8"
Total depth of hole	14"	Period of time soil permitted to swell	NA	Depth of water table	>11'

Successive Percolation Tests	Initial Depth to Water (inches)	Beginning Time	Final Depth to Water (inches)	Ending Time	Distance Water Dropped in Inches	Elapsed Time in Minutes	Perc Rate in Min./ Inch
1	6	1:33 PM	> 12	1:35 PM	> 6	2	< 1
2	6	1:37 PM	> 12	1:39 PM	> 6	2	<1
3	6	1:41 PM	> 12	1:43 PM	> 6	2	< 1

Final Stabilized Percolation Rate: < 1 minutes/inch

Descriptive log of soil exploration hole No. TP-7

Thickness of Each Stratum			Description and Texture of Each Stratum
Surface	to:	½'	Topsoil, loamy sand, moist, brown, roots and organics, weak granular structure.
½'	to:	5'	Sand with occasional gravel, slightly moist, brown to light brown, fine and medium grained, single grain structure.
5'	to:	6'	Very gravelly coarse sand, slightly moist to moist, light gray, single grain structure.
6'	to:	9'	Sand, slightly moist, light grayish brown, mostly fine and medium grained, single grain structure.
9'	to:	10'	Silty clay, moist, brownish gray, platy structure.