CITY OF GRESHAM

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TECHNICAL SPECIFICATIONS
FOR
CITY OF GRESHAM
STANDARD SUBMERSIBLE PUMP STATION

PREPARED BY:

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August 2005

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CITY OF GRESHAM

STANDARD SUBMERSIBLE PUMP STATION

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1.01 QUALITY ASSURANCE

A. Titles of sections and paragraphs: Captions accompanying specification sections and paragraphs are for convenience of reference only, and are not to be used to define the limits of subcontracts.

B. Applicable publications: Whenever in these Specifications references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is specified, only the latest specifications, standards, or requirements of the respective issuing agencies which have been published as of the date that the Work is advertised for bids, shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes. No requirements set forth herein or shown on the Drawings shall be waived because of any provision of, or omission from, said standards or requirements.

C. Without limiting the generality of other requirements of the Specifications, all work specified herein shall conform to or exceed the requirements of applicable codes 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 these Specifications nor the applicable codes.

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

E. 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).

F. 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.

G. 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.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. The following documents or agencies may be referenced in the Contract Documents.

AA	Aluminum Association
AABC	Associated Air Balance Council
AAMA	Architectural Aluminum Manufacturer's Association
AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ACI	American Concrete Institute
ADC	Air Diffusion Council
AEIC	Associated Edison Illumination Companies
AFBMA	Anti-Friction Bearing Manufacturer's Association, Inc.
AGA	American Gas Association
AGC	Associated General Contractors of America
AGMA	American Gear Manufacturer's Association
AHAM	Association of Home Appliance Manufacturer's
AI	The Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
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AMCA	Air Moving and Conditioning Association
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ANSI	American National Standards Institute, Inc.
APA	American Plywood Association
API	American Petroleum Institute
APWA	American Public Works Association
AREA	American Railway Engineering Association
ARI	Air-Conditioning and Refrigeration Institute
ASA	Acoustical Society of America
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ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASLE	American Society of Lubricating Engineers
ASME	American Society of Mechanical Engineers
ASPA	American Sod Producers Association

ASQC	American Society of Quality Control
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BBC	Basic Building Code, Building Officials and Code Administrators International
BHMA	Builders Hardware Manufacturer's Association
CBM	Certified Ballast Manufacturers
CDA	Copper Development Association
CEMA	Conveyors Equipment Manufacturer's Association
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CLPCA	California Lathing and Plastering Contractors Association
CLFMI	Chain Link Fence Manufacturer's Institute
CMA	Concrete Masonry Association
COE	Corp of Engineers
CRSI	Concrete Reinforcing Steel Institute
CSI	Construction Specifications Institute
DCDMA	Diamond Core Drill Manufacturer's Association
DOE	Department of Ecology
EEI	Edison Electric Institute
EIA	Electronic Industries Association
EJCDC	Engineer's Joint Contract Documents Committee
EJMA	Expansion Joint Manufacturer's Association
EPA	Environmental Protection Agency
ETL	Electrical Test Laboratories
FGMA	Flat Glass Marketing Association
FM	Factory Mutual
FS	Federal Specification
GA	Gypsum Association
ICBO	International Conference of Building Officials
ICC	Interstate Commerce Commission
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IME	Institute of Makers of Explosives
IMIA	International Masonry Industry All-Weather Council
IP	Institute of Petroleum (London)
IPC	Institute of Printed Circuits
IPCEA	Insulated Power Cable Engineers Association
ISA	Instrument Society of America
ISO	International Organization for Standardization
ITE	Institute of Traffic Engineers
MBMA	Metal Building Manufacturer's Association

MFMA	Maple Flooring Manufacturer's Association
MIL	Military Specification
ML/SFA	Metal Lath/Steel Framing Association
MPTA	Mechanical Power Transmission Association
MTI	Marine Testing Institute
NAAMM	National Association of Architectural Metal Manufacturer's
NACE	National Association of Corrosion Engineers
NBS	National Bureau of Standards
NCCLS	National Committee for Clinical Laboratory Standards
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NESC	National Electric Safety Code
NFPA	National Fire Protection Association
NGLI	National Lubricating Grease Institute
NMA	National Microfilm Association
NWMA	National Woodwork Manufacturers Association
OAC	Oregon Administrative Code
ODOT	Oregon Department of Transportation
OSEPA	Oregon State Environmental Protection Agency
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PS	Product Standard
RCO	Revised Code of Oregon
RIS	Redwood Inspection Service
RVIA	Recreational Vehicle Industry Association
RWMA	Resistance Welder Manufacturer's Association
SAE	Society of Automotive Engineers
SAMA	Scientific Apparatus Makers Association
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SIS	Swedish Standards Association
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B. Standard Specifications

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2. All work shall be in accordance with the "City of Gresham Public Works Standards".

3. Pump station design shall be in accordance with the "State of Oregon, Department of Environmental Quality, Oregon Standards for the Design and Construction of Wastewater Pump Stations.

4. In case of conflict between standards and these specifications, refer to paragraph 1.01.D of this section.

5. References to Engineer, department, secretary, State or other similar terms in the Standard Specifications shall mean Owner.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

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B. Standard Specifications

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2. The Specifications of these Contract Documents shall supersede any provisions of the Standard Specifications in conflict herewith.

3. Reference to measurements and payment in the Standard Specifications do not apply to this Contract.

4. References to Engineer, department, secretary, State or other similar terms in the Standard Specifications shall mean Owner.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01730
OPERATION AND MAINTENANCE MANUAL

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Write a pump station operations and maintenance manual in accordance with City and DEQ requirements. Obtain DEQ approval of manual.

B. Compile manufacturers operations and maintenance information, bound separately, for Owner’s maintenance and operation of products furnished under the contract.

C. Instruct Owner's personnel in the maintenance of products and in the operation of equipment and systems.

1.02 QUALITY ASSURANCE

A. Preparation of manual and equipment data shall be done by personnel:

1. Trained and experienced in maintenance and operation of the described products.

2. Completely familiar with requirements of this section.

3. Skilled as a technical writer to the extent required to communicate essential data.

4. Skilled as a draftsman competent to prepare required drawings.

1.03 SUBMITTALS

A. Draft manual to be submitted to DEQ and City at least 60 days prior to start up of pump station. Provide 5 copies of approved manual prior to pump station startup.

1.04 CONTENT OF MANUAL

A. Manual to contain the following information. Refer to DEQ Guidelines for Writing Pump Station O&M Manuals for additional detail.

1. Table of Contents

2. Introduction and use of manual

3. General description including plan view of station and design data

4. Diagrams for electrical and mechanical controls

5. Pump operation and control
6. Operation and control of mechanical systems
7. Utilities
8. Safety Requirements
9. Emergencies
10 Maintenance of Equipment
11. Spare parts inventory

1.05 MANUFACTURERS EQUIPMENT AND PRODUCT DATA INFORMATION

A. Submit 5 copies of material organized into 3-ring binders.

B. Content, for each unit of equipment and system, as appropriate:

1. Description of unit and component parts.

a. Function, normal operating characteristics, and limiting conditions.

b. Performance curves, engineering data and tests.

c. Complete nomenclature and commercial number of all replaceable parts.

2. Operating procedures:

a. Start-up, break-in, routine and normal operating instructions.

b. Regulation, control, stopping, shutdown and emergency instructions.

c. Summer and winter operating instructions.

d. Special operating instructions.

3. Maintenance procedures:

a. Routine operations.

b. Guide to "trouble-shooting."

c. Disassembly, repair and reassembly.

d. Alignment, adjusting and checking.

4. Servicing and lubrication schedule:

a. List of lubricants required.

5. Manufacturer's printed operating and maintenance instructions.

6. Description of sequence of operation by control manufacturer.

7. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.

   a. Predicted life of parts subject to wear.

   b. Items recommended to be stocked as spare parts.

8. As-installed control diagrams by controls manufacturer.

9. Each contractor's coordination drawings.

   a. As-installed color-coded piping diagrams.

10. Charts of valve tag numbers, with the location and function of each valve.

11. List of original manufacturer' s spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.

12. Other data as required under pertinent sections of specifications.

C. Content, for each electric and electronic system, as appropriate.

1. Description of system and component parts.

   a. Function, normal operating characteristics, and limiting conditions.

   b. Performance curves, engineering data and tests.

   c. Complete nomenclature and commercial number of replaceable parts.

2. Circuit directories of panel boards.

   a. Electrical service.

   b. Controls.

   c. Communications.

3. As-installed color-coded wiring diagrams.

4. Operating procedures:

a. Routine and normal operating instructions.

b. Sequences required.

c. Special operating instructions.

5. Maintenance procedures:

a. Routine operations.

b. Guide to "trouble-shooting."

c. Disassembly, repair and reassembly.

d. Adjustment and checking.

6. Manufacturer's printed operating and maintenance instructions.

7. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.

8. Other data as required under pertinent sections of specifications.

D. Provide complete information for products specified in:

1. Section 08305 - Access Hatches

2. Section 09900 - Painting

3. Section 15030 - Motors

4. Section 15100 - Valves

5. Section 15140 - Pumps

6. Section 15170 - Gages

7. Section 15800 - Ventilating

8. Section 16400 - Service and Distribution

9. Section 16500 - Lighting

10. Section 16900 - Motors and Controls

END OF SECTION

SECTION 02200
EARTHWORK

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work covered in this section consists of excavating material, stockpiling, blending, material handling, crushed surfacing, structural excavation and fill, gravel under slabs and footings and testing necessary to construct this project as shown on the drawings as specified. No borrow sources have been designated for this project.

1.02 RELATED SECTIONS

A. Section 02221 - Trenching, Backfilling and Compacting

B. Section 03300 – Cast-In-Place Concrete

C. Section 02270 – Erosion Control

1.03 SUBMITTALS

A. Submittals shall be required on pit run materials, impermeable materials, structural backfill, crushed rock and riprap.

B. Contractor shall submit material samples in addition to grain size analyses and permeability test results on materials requiring such.

1.04 PROTECTION OF ADJACENT WORK

A. Properly slope cuts to provide stability.

B. Cuts in soil shall be no steeper than 1 vertical to 2 horizontal. Cuts in fracture basalt shall be no steeper than 1 vertical to 1 horizontal.

PART 2 - PRODUCTS

2.01 EXCAVATION MATERIAL

A. Contractor shall make his own deductions and conclusions as to the nature of materials to be excavated and the difficulties that may arise from subsurface conditions.

2.02 CRUSHED SURFACING/STRUCTURAL FILL

A. Crushed surfacing material shall conform to Oregon Standard Specifications for Construction, Section 2630.00.

	Material
Top Course/structural fill	3/4"-0 (19.0 mm)
Bottom Course	1-1/2"-0 (37.5 mm)

PART 3 - EXECUTION

3.01 EXCAVATION

A. Common excavation consists of removal of all materials of whatever nature, including boulders smaller than 1 cubic yard in volume, required for the construction of various structures. The method of excavation shall be at Contractor's option, but he shall exercise care as he approaches the final grade to leave it in undisturbed condition. If the final grade is disturbed, it shall be restored to requirements and satisfaction of Engineer.

B. Rock excavation is defined as the removal of rock by systematic and continuous drilling and blasting. Rock is defined as material that, by actual demonstration, cannot be reasonably excavated with suitable power excavation equipment. Suitable equipment is defined as track mounted hydraulic excavator of the 45,000 to 55,000 pound class equipped with a heavy-duty bucket and rock teeth. The engineer may waive the demonstration if the material is well-defined rock. The term "rock excavation" shall be understood to indicate a method of removal and not a geological formation. If the material that would be classified as rock by the above definition is mechanically removed with equipment of larger size than specified, it shall be understood that the added costs for the removal of material by this method shall be included in the unit price for common excavation.

C. Soil conditions

1. If the final grade, supporting structures, is disturbed or becomes wet or dried out during the course of construction, Contractor shall remove and replace the material at no cost to Owner. Contractor is advised that footings should be poured on native material as soon as possible to minimize these conditions.

D. Frozen ground

1. Frost protection shall be provided for all structural excavation work. Foundation work shall not be placed on frozen ground.

E. Shoring

1. Where shoring, sheet piling, sheeting, bracing, lagging or other supports are necessary to prevent cave-ins or damage to existing structures, it shall be the responsibility of Contractor to design, furnish, place,

maintain and remove such supports in accordance with applicable ordinances and safety requirements. The design, planning, installation and removal of all sheeting, shoring, sheet piling, lagging and bracing shall be accomplished in such a manner as to maintain the undisturbed state of soil below and adjacent to the excavation.

F. Removal of unsuitable material

1. Cross-sectional dimensions and depths shown shall be subject to such changes as may be found necessary by the Engineer to secure foundations free from soft, weathered, shattered and loose material or other objectionable materials. The unsuitable materials encountered shall be removed and replaced with materials as indicated in this section.

G. Disposal of excavated material

1. Suitable excavated material may be used in fills and in backfills. Excess material and unsuitable material as determined by the Engineer shall be disposed of offsite and shall be the Contractor's responsibility for disposal.

H. Compaction

1. Contractor shall provide compaction equipment as required to do the compaction specified herein.

2. Fill shall be compacted for the full depth, length and width to at least 95% relative compaction for silty soils and 95% for granular fill material (AASHTO T-180). This criteria may be reduced to 85% in landscaping or planter areas.

3. Tests for density of compacted material shall be made by the Contractor at a minimum of 1 test every 500 square yards per lift. This frequency may be increased at the option of the engineer if a high frequency of tests fail. Deficiencies shall be corrected by the Contractor at his own expense.

4. Testing shall be done at no additional cost to the Owner.

3.02 EXCAVATION FOR STRUCTURES

A. All structures shall bear on suitable foundation material and shall be excavated to the depth required to construct the slabs and substructure elements. Where existing grade is below finished grade, the Contractor shall remove the layer of topsoil and replace it with structural fill material to the proper level.

3.03 BACKFILL FOR STRUCTURAL EXCAVATION

A. When structural fill is placed adjacent to walls, footings, and the like, heavy equipment for spreading and compacting shall not be operated closer to any wall than a distance equal to the height of the backfill above the top of the footing. Structural fill adjacent to walls shall be compacted to 92% of the maximum dry density as determined by ASTM D 1557 with small vibratory or hand compactors to within 3 feet of subgrade and to 95% for the upper 3 feet.

3.04 PREPARATION OF EARTH SUBGRADE FOR CONCRETE

A. When excavating for bottom mat slabs to be cast on native soil, final excavation to grade shall be done in a manner so as not to disturb the existing soil. If the soil is disturbed, the Contractor will be required to remove the disturbed material and replace it with structural backfill material. Concrete shall not be placed on surfaces that are muddy, frozen or dried out. If during the course of construction bottom surfaces becomes saturated with water, muddy, disturbed or dried out, the Contractor shall remove the undesirable material and replace with compacted structural backfill as indicated above.

3.05 GRAVEL UNDER SLABS AND FOOTINGS

A. Crushed surfacing top course shall be placed and well compacted under cement concrete slabs, footings, where shown on the drawings.

3.06 FINAL TRIMMING AND CLEAN-UP

A. All irregularities shall be made smooth, washouts shall be filled, slopes made uniform, slightly rounded at top and bottom, and the entire area of the fill compacted and completed to the required lines, grades and cross sections within 1/10 foot above or below the established grade.

B. Where additional material is required for filling, it shall be similar to that used in fill and may be obtained from source acceptable to Engineer.

C. When work is completed, Contractor shall remove and dispose of all surplus material including stumps, trees and brush, and leave premises in condition acceptable to the Engineer.

END OF SECTION

SECTION 02221
TRENCHING, BACKFILLING AND COMPACTING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work covered in this section includes but is not limited to site inspection, utility location, excavating, dewatering, shoring, pipe bedding, trench backfilling and compaction, grading, cleaning and testing of all water lines and direct burial electrical cables and conduit for the project.

1.02 RELATED SECTIONS

A. Section 02200 - Earthwork

B. Division 15 - Mechanical

C. Division 16 - Electrical

1.03 LABOR AND SAFETY STANDARDS

A. All work to be done in accordance with these specifications and the requirements of the State of Oregon Department of Labor and OSHA standards.

PART 2 - PRODUCTS

2.01 GENERAL

A. Determination of the source of materials for bedding and backfill shall be the responsibility of Contractor, but use of materials shall be subject to satisfaction of the Engineer. Native material may be used for any or all of the material classifications, provided it conforms to the specified requirements and the satisfaction of Engineer. Similarly, approved imported material may be used for all material classifications.

B. Prohibited materials

1. All native or imported foundation, bedding, and backfill material shall be free from wood, roots, bark, sod, frozen lumps, expansive soils, organic soils or other extraneous material which may result in loose or incomplete backfill, inadequate compaction, or related problems.

2.02 BEDDING MATERIAL

A. Bedding material shall have such characteristics of particle size and shape that it will compact readily to a firm, stable course. Bedding material shall be classified as 3/4” – 0 (19 mm) conforming to Standard Specifications, Section 00405.12.

2.03 PIPE ZONE MATERIAL

A. Pipe zone material shall be classified as 3/4" – 0 (19 mm) conforming to Standard Specifications Section 00405.13.

2.04 BACKFILL MATERIAL

A. Under roadways, structural slabs and other areas where native material is deemed unsuitable by Engineer, use Class B Backfill (3/4"-0) in accordance with Standard Specifications Section 00405.14.

2.05 FOUNDATION MATERIAL

A. Where additional excavation is required due to groundwater or other unstable conditions so that native material cannot support the pipe, selected 3"-0 backfill or other appoved material may be used for trench foundation.

PART 3 - EXECUTION

3.01 SITE INSPECTION AND UTILITY LOCATION

A. Contractor shall inspect the site before starting work. The documents shall be examined and checked with the field layout to correct any and all discrepancies that may exist.

1. The general location of all known underground utilities and other property likely to be encountered in excavation has been shown on the plans. This data has been compiled from the best available sources but is to be used for informational purposes only and accuracy is not guaranteed. Contractor shall be responsible for contacting and working with Owner of the particular utility or property involved to determine its exact location during construction and the failure to locate such utilities or property or failure to show them on the plans shall not relieve Contractor of responsibility for their damage. Contractor shall repair all damage to existing utilities or property at his own expense. Adequate provisions shall be made for maintaining the flow of existing sewers, drains and watercourses encountered during construction.

2. Contractor will be required to make excavations to determine the exact location, horizontal and invert elevation, of underground pipes or other features that may be encountered during construction a maximum of 50 feet ahead of pipe laying operations, and at locations upstream where possible conflicts exist as specified by the Engineer, in order to verify no conflict in grade between the existing underground feature and the new pipeline. He shall support and protect pipes or other services where they cross the trench and shall be responsible for all damages incidental to interruptions of service that may be due to his operations.

a. All costs to rectify conflicts due to a failure to verify possible conflicts shall be the Contractor's responsibility.

3.02 EXCAVATION AND TRENCHING

A. General

1. Contractor shall do all excavation of whatever substance is encountered to the lines and grades shown on the drawings. Where unexpected objects, such as stumps are encountered in the trench excavation, they shall be removed and disposed of by Contractor. In cases where they can be removed by the same equipment or method at hand for excavation, and where it is unnecessary to employ special equipment, install shoring or bracing, or to increase the trench width or depth more than 2 feet for anyone object, then, in that event, the removal of such obstructions shall be considered as an incidental part of the Contractor's work and no additional payment will be made therefore. Except where specifically approved by the Engineer, no more than 25 feet of open trench shall be excavated in advance of laying of pipe.

B. Excavation dimensions and trench sections

1. The bottom of the trench shall be carried to the lines and grades shown on the drawings with proper allowance for thickness of pipe, and bedding used. Trench walls shall be vertical from the trench bottom to at least 6 inches above the top of the pipe. Trench width shall be as shown on the drawings. In all cases, trenches must be of sufficient width to permit proper jointing of the pipe and backfilling and compacting of material along the sides of the pipe. Trench width at the surface of the ground shall be kept to the minimum amount necessary to install the pipe in a safe manner using boxes, shoring, sheeting or other means that may be necessary.

C. Excavation support systems

1. Support systems shall be designed, fabricated, installed, maintained, and removed in such a manner as to protect workers, the required excavation section, existing property, structures, utilities, and pavements, and to maintain the undisturbed state of soils adjacent to excavation and at and below the excavation bottom. Support systems shall also be adequate to support static and dynamic loads incident to structures, traffic and construction activity adjacent and proximate to the work.

2. If the Contractor elects he may use a combination of shoring, sliding trench shields or other methods of accomplishing the work provided the method meets with the approval of all applicable local, state and federal safety codes.

3. Contractor shall be solely responsible for determining the nature and extent of excavation support required in any and all portions of the project, and any damage resulting from inadequate excavation support shall be restored at the expense of the Contractor.

4. That portion of the excavation support system extending below the spring line of rigid pipe, or below the crown elevation of flexible pipe, shall be left in place unless satisfactory means of recompacting bedding or side support, disturbed by support system removal, can be demonstrated. If a movable box is used in lieu of cribbing or sheeting, and the bottom cannot be kept above the spring line of rigid pipe or the crown elevation of flexible pipe, the bedding or side support shall be carefully recompacted behind the movable box, prior to placing backfill.

D. Temporary storage of excavated materials

1. All excavated material shall be piled in an orderly manner at a sufficient distance from the trench to prevent overloading, sliding into the trench, or other occurrences which could endanger the excavation. Material shall be placed in such a manner as will cause minimum inconvenience to public travel and will not impede the flow in natural and man-made drainage courses and/or structures.

2. Contractor shall use reasonable care to prevent contamination of usable excavated material with unsuitable material.

3.03 UNSUITABLE MATERIAL REMOVAL AND REPLACEMENT

A. Unsuitable materials include but are not limited to peat, and other soft, loose, saturated, and disturbed soils. Removal of unsuitable material shall not be authorized without prior approval of Engineer.

B. When unsuitable material is encountered at or below the trench bottom, it shall be excavated to a depth specified by the Engineer and backfilled as shown in the plans with foundation material. Foundation material shall be placed in lifts of 8 inches maximum thickness and compacted to at least 95% of the maximum dry density as determined by ASTM D 1557. Each layer shall be fully compacted prior to placement of subsequent layers. The Engineer reserves the right to specify an alternate trench section in lieu of the over-excavation procedure described above.

C. Unsuitable material shall be disposed of by the Contractor within 5 working days of the time of excavation, except in or adjacent to roadways or other improved areas where it shall be disposed of within 24 hours of excavation.

3.04 ROCK EXCAVATION

A. Rock excavation is defined in Section 02200, Article 3.01.

B. Any irregular over-excavations resulting from excavation of rock materials shall be replaced with foundation material or other suitable material approved by the engineer.

3.05 PIPE ZONE

A. Bedding

1. After the bottom of the trench or excavation has been excavated to the proper depth and grade and the bottom is brought to a reasonably flat surface the bedding material shall be placed as shown on the drawings.

2. During bedding operations, all necessary measures shall be taken to prevent damage to the pipe and to maintain the pipe within the line and grade tolerances specified on the drawings. Bedding shall be placed in loose lifts of 6-inch maximum depth and compacted to the maximum dry density as shown on the drawings as determined by ASTM D 1557. Each layer shall be fully compacted before subsequent layers are placed. Bedding shall be placed, compacted, and shaped to conform to the barrel of the pipe, with allowance for bells and other appurtenances, to ensure firm and continuous support for the entire length of pipe. Additional bedding required because of unauthorized excavation outside the limits specified shall be provided at the Contractor's expenses.

3. Bedding shall be handled and placed in the trench or excavation in such a manner as to prevent cave-in of trench or excavation walls or contamination with excavated material. Bedding that becomes contaminated by these or similar occurrences such that it contains prohibited substances or does not meet gradation requirements, shall be removed, disposed of, and replaced by Contractor at his own expense.

B. Backfill

1. After pipe has been installed, alignment and grade checked and the inside checked or possible obstructions, Contractor shall backfill and compact trenches using backfill material up to the elevation shown in the plans, making sure the backfill is in contact with entire periphery of pipe. Backfill shall be placed in loose lifts with a maximum thickness of 6 inches and compacted to the maximum dry density shown on the drawings as determined by ASTM D 1557. Side fill shall be brought up evenly on both sides of pipe to prevent lateral movement. Each lift shall be fully compacted before subsequent fill is placed.

3.06 BACKFILL ZONE

A. Material shall be carefully placed to prevent damage to pipe. In roadway areas (including roads, shoulders, parking lots), areas under structures and foundations, backfill shall be placed in loose lifts of 10 inches maximum thickness and compacted to at least the percentage of maximum dry density shown on drawings as determined by ASTM D 1557. In non-roadway areas, backfill shall be placed in loose lifts of 12-inch maximum thickness and compacted to at least the percentage of maximum dry density shown on the drawings as determined by ASTM D 1557. Backfill shall be neatly and

uniformly mounded over the excavation as shown in the plans to compensate for future settlement. In all areas, each lift shall be fully compacted before subsequent fill is placed.

3.07 FINAL TRIMMING, CLEANUP, AND REPAIR

A. Work includes but is not limited to the following: grading, cleaning, disposal of excess excavated material including rock and repair of utilities, structures, culverts, pavements, and private property damaged or disturbed by Contractor during construction or associated activities.

B. All irregularities shall be made smooth, washouts shall be filled, slopes made uniform, slightly rounded at top and bottom, and the entire area of the fill compacted and completed to required lines, grades, and cross sections. Erosion control devices shall be installed as specified.

C. Contractor shall clean up as the work progresses, and shall maintain his operations in a neat and orderly manner. Surplus excavated material, stumps; trees, brush, excavated rock, unsuitable material and other debris shall be disposed of promptly. Roadway surfaces shall be thoroughly cleaned.

D. Underground utilities which are unearthed, undermined, or damaged as a result of Contractor's operations shall be repaired or, if necessary, replaced by Contractor at his own expense.

E. All trimming, cleanup, and repair shall be accomplished within 10 working days from the time that the trench was initially excavated.

F. If Contractor fails to comply with these requirements within 24 hours after receiving written notice from Engineer, others will be engaged to do such work and the total expense involved shall be deducted from the Contractor's payment.

3.10 TESTING

A. The Owner will test for compaction. In the event that original tests do not comply with requirements of the specifications, additional compaction shall be performed or the fill shall be replaced with fill that will comply. This process shall be repeated until the compaction complies with the specifications.

END OF SECTION

SECTION 02270
EROSION CONTROL

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Erosion and Sediment control during construction shall conform to the City of Gresham “Erosion Prevention & Sediment Control manual” current edition.

END OF SECTION

SECTION 02830
CHAIN LINK FENCE AND GATES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Work consists of furnishing all labor, materials, and incidentals necessary to erect all chain-link fence and gates in locations and to heights as shown on drawings. Construction to provide a rigid, taut fence closely conforming to the surface of the ground.

B. Work included:

1. Fabric, line posts, end, corner and pull posts, gateposts, gate frames, top rails and post braces and accessories.

2. Attachment to concrete.

1.02 RELATED WORK

A. Section 03001 - Concrete Work

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. A 120 Standard Specification for Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses.

2. A 121 Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire.

3. A 153 Standard Specification for Zinc-Coating (Hot-Dip) on Iron and Steel Hardware.

4. A 392 Standard Specification for Zinc-Coated Steel Chain Link Fence Fabric.

1.04 Submittals

A. Three samples, approximately 6 inches long, or 6 inches square, of fabric material, post section and typical accessories.

B. Submit shop drawings showing fence height, type of fabric, and location and size of posts and gates, including details of posts tops, rails, braces, foundations, footings, gate posts, hinges, frames, latches, ties and other accessories.

1.05 QUALIFICATION OF INSTALLER

A. Installer must be experienced in fence installations and must examine conditions under which fence and gates are to be installed. The Contractor shall notify the Engineer in writing of improper conditions of work, and shall not proceed with work until unsatisfactory conditions have been corrected.

PART 2 - PRODUCTS

2.01 FENCE, POSTS, RAILS AND BRACES

A. All tubular members shall comply with provisions of ASTM A 120, Schedule 40, for weight and coating.

2.02 FABRIC

A. Chain link fabric to conform to ASTM A 392, No. 9 gage wire, 2-inch mesh, Class II galvanizing; 8 feet in height.

B. Fabric galvanized after weaving.

C. Fabric knuckled at bottom selvage and twisted and barbed at top.

2.03 LINE POSTS

A. Posts galvanized steel.

B. Posts round in section, 2.375-inch outside diameter and weighing 3.65 lb/ft.

2.04 END, CORNER PULL POSTS

A. Posts galvanized steel.

B. Posts round in section, 2.875-inch outside diameter and weighing 5.79 lb/ft.

2.05 GATE POSTS

A. Posts galvanized steel.

B. Gage leaves over 6 feet 0 inch and up to and including 13 feet 0 inch wide: 4 inches O. D. Schedule 40 pipe and weighing 9.1 lb/ft.

C. Gate leaves over 13 feet 0 inch and up to and including 18feet 0 inch: 6-5/8 inch O.D. Schedule 40 pipe and weighing 18.97 lb/ft.

2.06 GATE FRAMES FOR CHAIN LINK FENCING

A. Frames galvanized steel.

B. Frames round in section, 1.9-inch outside diameter, and weighing 2.72 lb/ft.

C. Frames shall have intermediate members and/or diagonal truss rods for gate leaves more than 8 feet wide.

D. Gate frames joints shall be made by welding or by means of heavy fittings making rigid and watertight connections.

2.07 TOP RAILS AND POST BRACES

A. Rails and post braces galvanized steel.

B. Rails and post braces round in section, 1.66-inch outside diameter and weighing 2.27 lb/ft.

2.08 ACCESSORIES AND ATTACHMENTS

A. Fabric ties: Galvanized steel bands of not less than 0.148-inch diameter galvanized steel wire.

B. Stretcher bars: Galvanized steel 3/16 by 3/4-inch in cross section, or equivalent cross section with length equal to full height of fabric.

C. Truss rods: Galvanized steel, 3/8-inch-diameter, or equivalent cross section, and shall have suitable adjustment.

D. Post tops: Caps of pressed galvanized steel. Provide with a hole suitable for through-passage of the top rail. Fit snugly to the post, have means for attaching securely to the post and exclude moisture from tabular posts.

E. Gates swing: Swing type, complete with latches, stops, keepers, hinge, locks and fabric. Fabric to match fence. Hinges of adequate strength to support gate and not twist or turn under action of gate. Latches of plunger bar type and full gate height located in a manner that will engage the gate stop. Forked latches used for single gates less than 10 feet wide. Latches shall provide for locking. Stops shall consist of a flush plate with anchor placed in concrete to engage the plunger bar of the latch. Other approved types of stops may be used for single gates less than 10 feet wide. Keepers shall be substantial devices for securing and supporting the free end of the gate in open position.

F. Top rail couplings: Outside sleeve type at least 6 inches long. A minimum of 20% of the couplings shall have an internal heavy spring to take up expansion and contraction.

G. Brace wire, tie wire and tension wire: Galvanized wire meeting requirements of ASTM A 121, Class 3 coating.

Unless otherwise designated, size of wire shall not be smaller than the following:

Tension wire	No. 7
Brace wire	No. 9
Tie wires or clips for fastening field fence to steel posts	No. 12
Barbed wire	3-strand, 12-1/2-gage with 14-gage, 4-point round barbs spaced approximately 5“ O.C.

Tie wires for chain-link fence of size and type recommended by manufacturer, but not smaller than No.9 for post ties or No. 12 for rail and brace ties. Equivalent galvanized steel clips or aluminum wire or clips may be used as accepted by the Engineer.

H. Galvanizing: All pipe section galvanized after fabrication in accordance with ASTM A 120. All other items incidental to erection of fence except fabric and wire fabric ties galvanized after fabrication in accordance with ASTM A 153. Wire fabric ties not less than 0.8 ounce of zinc per square foot.

I. Provide cedar slats with redwood stain.

2.09 CONCRETE FOOTINGS

A. Concrete shall be mixed and placed in strict accord with Section 03001.

PART 3 - EXECUTION

3.01 CLEARING AND GRADING

A. Contractor shall perform such clearing and grading as necessary to construct fence to required alignment and provide a reasonably smooth ground profile at the fence line.

3.02 POST ASSEMBLIES

A. End, corner, gate, and pull or intermediate anchor posts placed at designated locations. Holes 12-inch minimum diameter and 6 inches below end of post.

B. Posts securely braced and holes filled with concrete. Forms not required for post encasement.

3.03 HORIZONTAL DEFLECTION

A. At points of deflection where fence changes alignment by more than 5 degrees provide a post brace and truss rod in each fence panel adjacent to the post located at the angle point.

B. Footings for all posts located at points where the change in alignment exceeds 5 degrees shall be constructed as specified for end posts.

3.04 LINE POSTS

A. Line posts spaced at not more than 10-foot centers.

3.05 POST BRACES

A. A brace and truss assembly shall support each gate, corner, pull, or end post for chain link fencing. Brace shall extend to each adjacent line post at mid-height of fabric. Truss shall extend from line post back to gate, corner, pull, or end post.

3.06 FABRIC

A. Fabric shall not be erected until 5 days after the posts are set in concrete. Fabric shall be fastened to concrete line posts with clips or bands spaced approximately 12 inches apart and to top rail with bands or tie wires at approximately 24-inch intervals. Pull fabric taut and tie to posts, rails and tension wires. Install fabric on security side of fence and anchor to framework so that fabric remains in tension after pulling force is released.

3.07 BARBED WIRE

A. Barbed wire stretched and fastened in same manner as woven wire fabric.

3.08 TENSION WIRES

A. Tension wires installed at bottom of fabric before stretching fabric and tied to each post with wire ties or clips.

3.09 ELECTRICAL GROUNDS

A. Chain fence which crosses beneath any primary electrical power transmission line, other than a secondary feeder line for individual customer service, shall be properly grounded. Grounding shall consist of placing one ground rod at point of crossing and one 25 to 50 feet in each direction from the crossing.

1. Chain-link fence erected adjacent to and within 50 feet of a primary power line shall be grounded by placing ground rods at not more than 500-foot intervals.

2. Each applicable straight section of fence shall have at least one ground. Engineer may require installation of an additional ground at terminus of a section of fence or at other locations near areas of pedestrian traffic.

3. Ground rod shall be connected to fence.

END OF SECTION

SECTION 03200
CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Work covered by this section consists of furnishing and installing reinforcing steel, and accessories required for cast-in-place concrete.

1.02 REFERENCE STANDARDS

A. American Concrete Institute (ACI)

1. 301 - Specification for Structural Concrete for Buildings.

2. 315 - Manual of Engineering and Placing Drawings for Reinforced Concrete Structures.

3. 318 - Building Code Requirements for Reinforced Concrete.

B. American Welding Society (AWS)

1. D1.4 - Structural Welding Code - Reinforcing Steel.

C. Concrete Steel Reinforcing Institute (CRSI)

1. Manual of Standard Practice

1.03 QUALITY ASSURANCE

A. Mill tests: Furnish certified copies of mill test reports showing compliance with structural drawings and specifications.

B. Welder qualifications certificate in accordance with AWS D1.1.

1.04 SUBMITTALS

A. Shop Drawings: Prepare and submit six sets of complete Shop Drawings to the Engineer showing bending and placing diagram in accordance with ACI 315.

PART 2 - PRODUCTS

2.01 STEEL AND WIRE REINFORCEMENT

A. Reinforcing steel shall consist of deformed bars of the sizes called for on the Drawings. Steel shall conform to the requirements of ASTM A

615. Grade 60 steel shall be used for all reinforcement unless otherwise noted.

2.02 TIE WIRE

A. Use No. 16 gage double annealed iron wire.

2.03 ACCESSORIES

A. Bar supports to be detailed and placed according to minimum standards of Chapter 7, ACI 315. Include devices necessary for proper placing, spacing, supporting and fastening steel reinforcement in place. Where bottom surface of concrete is concealed, use standard steel chairs and bolsters. Where exposed, use plastic-protected chairs conforming to CRSI Manual of Standard Practice, Chapter 3 (V), "Class 1 - Plastic Protected Bar Supports."

B. In footings and ground slabs, well-cured concrete blocks may be used in lieu of above.

PART 3 - EXECUTION

3.01 FABRICATION

A. Clean, bend and splice reinforcement in accordance with Uniform Building Code and ACI 315. Hooks shall conform to Table 2-1 of ACI 315. Do not straighten or rebend Grade 60 reinforcement. All bars shall be bent cold. Welding shall be performed by welders certified by American Welding Society and in accordance with AWS D1.1.

3.02 BENDING SCHEDULES

A. Placement drawings and bending schedules shall be submitted to the Engineer for review. Reinforcement shall be formed as indicated on the Drawings. Except where specifically indicated otherwise on the Drawings, bends for bars shall be in accordance with the requirements of ACI 318, Section 7.1 and 7.2.

3.03 PLACING REINFORCING STEEL

A. Reinforcing steel, before being positioned, shall be cleaned of mill rust scale or other coatings that will destroy or reduce the bond. Reinforcement appreciably reduced in section shall be rejected. Prior to placing concrete, the reinforcement shall be reinspected by the Engineer and, when necessary, cleaned to the satisfaction of the Engineer.

1. Reinforcing steel shall not be bent or straightened without the approval of the Engineer, nor in a manner that will injure the material. Bars with kinks or bends not shown on the Drawings shall not be used. Heating or welding of bars will be permitted only when the entire operation is acceptable to the Engineer.

2. Reinforcing steel shall be positioned accurately and secured against displacement by using annealed iron wire or suitable clips at intersections and shall be supported by concrete or metal chairs or spacers, or metal hangers.

3. In slabs, beam, girders and walls subject to lateral pressure, splices of reinforcement shall not be made at points of maximum stress without the express acceptance of the Engineer. Splices where permitted, shall provide sufficient lap to transfer the stress between bars by bond and shear. Adjacent bars shall not be spliced at the same point. Where not otherwise shown, reinforcement shall be in accordance with the requirements of ACI 318.

4. The clear distance between parallel bars shall not be less than the diameter of the bars and, unless specifically authorized, shall in no case be less than 1-inch nor less than the maximum size of coarse aggregate specified. When reinforcement in beam or girders is placed in 2 or more layers, the clear distance between layers shall not be less than 1-inch, and the bars in the upper layers shall be placed directly above those in the bottom layer.

5. Concrete protection for reinforcement: Unless stated otherwise on the Drawings, reinforcement shall have a minimum cover of the following:

    a. Cast against and permanently exposed to earth: 3 inches

    b. Concrete in contact with sewage 2 inches

    c. Concrete to be in contact with ground, weather or clean water:

        No. 6 bars and larger: 2 inches

        No. 5 bars and smaller 1-1/2 inches

    d. Concrete not to be exposed to ground, weather or water:

Slabs and walls:	1-inch
Beams and Columns	1-1/2 inches
Joists	3/4-inch

3.04 TOLERANCES

A. Fabricating and placing tolerances shall be in accordance with ACI 301.

END OF SECTION

SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Work consists of walls, footings, slabs, beams, columns and other items classified as cast-in-place concrete.

1.02 REFERENCE STANDARDS

A. ACI

1. 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.

2. 301 - Specifications for Structural Concrete for Buildings. Contractor shall have at least one copy of the current edition of this standard available at the site at all times.

3. 304.2R - Placing Concrete by Pumping Methods.

4. 305R - Hot Weather Concreting.

5. 306R - Cold Weather Concreting.

1.03 QUALITY CONTROL

A. Control of materials: Materials indicated to be tested in this section shall be tested by a reputable independent testing laboratory and the results of such testing shall be submitted for review by the Engineer. Tests shall be performed in accordance with the reference standards. Materials which do not meet the requirements of the reference standards shall not be used.

1.04 SUBMITTALS

A. Shop Drawings: Submit lift drawings for concrete work. Drawings shall describe geometry of the structure, location of construction joints, pipe penetrations, anchor bolts, embedded electrical and instrumentation conduits, and other embedded items.

B. Mill certificates: Furnish certified copies of cement mill test reports showing compliance with structural Drawings and specifications.

C. Aggregate test reports

1. The Contractor shall furnish evidence to the Engineer that aggregate used in the work meet requirements specified herein. The cost of testing shall be borne by Contractor.

2. If Engineer deems that additional testing of aggregate is necessary, he may select samples from any of the aggregate to be used in the job for testing by a qualified laboratory. Such material shall not be used in the work until test reports are available. If in such tests the materials fail to meet specified requirements, aggregate will be rejected and the expense of testing shall be borne by Contractor. If such tests show the aggregate to be satisfactory, cost of additional testing will be borne by the Owner.

D. Admixture test report: Contractor shall submit copies of tests showing conformance with requirements of ASTM C 494.

1.05 TESTING AGENCY

A. Testing and inspection as described herein shall be performed by a firm in accordance with Section 01400, Testing Laboratories.

B. Cost shall be paid for in accordance with Section 01400.

PART 2 - PRODUCTS

2.01 CEMENT

A. Cement for all cast-in-place concrete shall meet all the standard physical and chemical requirements in ASTM C 150 for Type II moderate sulphate resistance cement. Only one brand of cement shall be used for exposed concrete throughout one structure or composite element. Insofar as possible, all cement used in the work shall be taken from stock bins at the place of manufacture, bins in which the cement shall have been tested and found to comply with these specifications.

B. Cement shall be suitably stored and protected from exposure to the atmosphere. In the event the cement shows signs of deterioration, it shall not be used unless additional tests show that it conforms to the requirements stated above.

2.02 POZZOLAN

A. ASTM C 618, Class F.

2.03 AGGREGATES

A. Fine and coarse aggregate for concrete shall conform to ASTM C 33.

B. Aggregate gradations shall meet the requirements of the following standards:

1. Coarse aggregate gradations shall meet the requirements of the following standards:

a. Grading No. 1, ASTM C 33, Size 467.

b. Grading No. 2, ASTM C 33, Size 67.

c. Grading No. 3, ASTM C 33, Size 8.

2. Fine aggregate shall meet the fine aggregate gradation requirements of ASTM C 33.

2.04 WATER

A. Water shall be any potable water, clean and free from injurious amounts of oil, acid, alkali, and organic materials.

2.05 ADMIXTURES

A. Water reducing agent: Water reducing (cement dispersing) admixture shall comply with ASTM C 494. Admixture shall be free of calcium chloride. In addition to ASTM requirements, use shall be in strict accordance with the manufacturer's printed recommendations. Water reducing agent shall be Pozzolith Polyheed 161 as manufactured by Master Builders; Plastiment, Plastocrete or Sikacrete as manufactured by Sika Chemical Corp.; or equal.

B. Air entraining agent

1. Materials proposed for use as air entraining admixture shall conform to ASTM C 260. Air entraining agent added shall result in an entrained air content of 4% $\pm$ 1%.

2. Air entraining admixture shall be Darex AEA as manufactured by Construction Products Division of Grace & Co., MB VR by Masterbuilders, or equal.

C. Pozzolan (fly ash) shall replace part of cement content of concrete mix provided and required 28 day strength shall be attained.

1. Fly ash Type F in accordance with ASTM C 618.

2. Maximum 3% loss on ignition.

3. Maximum 20% of total weight of fly ash plus cement.

D. Superplasticizers: ASTM C 494, Type F or G, of second or third generation type.

1. Hold slump of 6 inches or greater for time required for placement into the structure.

2. Second generation superplasticizer: Batch plant added to extend plasticity, control temperature of fresh concrete, reduce water 20 to 30%, and give higher strengths at all ages.

3. Third generation superplasticizer: Batch plant added to extent plasticity time, maintain setting characteristics similar to normal concrete throughout its recommended dosage range and at varying concrete temperatures, reduce water 30 to 40%, and give high-early and ultimate strengths.

4. Manufacturer and product:

a. Master Builders, Inc., Cleveland, OH, Rheobuild.

b. W.R. Grace & Co., Cambridge, MA, Daracem 100.

c. Euclid Chemical Co., Cleveland, OH, Eucon Super F or 537 G.

E. Other admixtures shall not be used unless approved by Engineer prior to use.

2.06 EPOXY BONDING COMPOUNDS

A. Polysulfide epoxy resin bonding compounds shall be "Concresive Liquid LPL" as manufactured by Masterbuilders, "Sikadur 32 Hi-Mod LPL" as manufactured by Sika Chemical, or equal.

2.07 EPOXY ADHESIVE

A. Epoxy adhesive shall be "Concresive Standard LVI" as manufactured by Masterbuilders, "Sikadur 35 Hi-Mod LV" as manufactured by Sika Chemical, or equal.

2.08 EPOXY MORTAR

A. Epoxy mortar shall be a mixture of epoxy adhesive as described in Paragraph 2.07 above and aggregate. The aggregate shall be as recommended by the epoxy adhesive manufacturer.

2.09 GROUT

A. Epoxy-type grout for setting reinforcing bar dowels, anchor bolts and where shown on the Contract Drawings shall be Masterbuilders "Concresive Standard LVI", Sika Chemical Company "Sikadur 35 Hi-Mod LV," or equal.

B. Nonshrink grout shall be Master Builders Masterflow 928.

C. Type 1 grout shall be composed of approximately 1 part Type II portland cement, 2 parts sand, water reducing agent and sufficient water to make a workable mix. Maximum water cement ratio shall be 0.55.

D. Type 2 grout shall be proportioned for a minimum compressive strength of 2,500 psi at 28 days with a 6- to 9-inch slump.

1. Grout materials shall be as follows:

a. Cement: ASTM C 150, normal - Type I or Type II.

b. Hydrated lime: ASTM C 207, Type S.

c. Coarse aggregate: ASTM C 404 crushed rock or gravel (pea gravel) maximum 3/8-inch nominal size.

d. Fine aggregate: ASTM C 404, Size No. 2.

e. Water: Clean and potable.

2. Grout shall be proportioned as follows in accordance with ASTM C 476.

a. "Fine" grout: Proportion by volume: 1 part portland cement, 0 to 1/10 part hydrated lime and fine aggregate (sand) equal to 2-1/4 to 3 times the sum of the volumes of cement and lime materials.

b. "Coarse" grout: Proportion by volume: 1 part portland cement, 0 to 1/10 part hydrated lime, and find aggregate (sand) equal to 2-1/4 to 3 times the sum of all volumes of cement and lime materials, and coarse aggregate equal to 1

to 2 times the sum of the volumes of cement and lime materials.

2.10 MORTAR

A. Mortar shall be composed of approximately 1 part portland cement, 1/5 part hydrated lime, 2-1/2 to 3 parts sand, water reducing agent and sufficient water to make a stiff workable mix. Materials shall be as specified for concrete except as follows:

1. Hydrated lime: ASTM C 207, Type S.

2. Fine aggregate: ASTM C 144.

2.11 CURING COMPOUND

A. Concrete curing compound shall be of a nature and composition not deleterious to concrete and shall be of a standard and uniform quality ready for use as shipped by the manufacturer. The formulation shall be such that concrete surfaces on which it is applied can be sacked or coated with finish materials such as paints. At time of use, the curing compound shall be in a stirred condition. Curing compounds shall not be diluted by addition of solvent or thinners, or be altered in any manner without specific approval of, and in a manner prescribed by, the manufacturer.

B. Curing compound shall, when tested in accordance with ASTM C 156, be effective in limiting water loss in the concrete test specimens to 3-1/2% when applied at the coverage rate recommended by manufacturer.

C. Curing compound shall conform to ASTM C 309 and shall be clear and not discoloring. Curing compound and coatings where used, shall be verified by Contractor to be compatible prior to application.

2.12 WATERSTOPS

A. Waterstops embedded in concrete shall be polyvinyl chloride (PVC) plastic meeting the following minimum requirements:

Tensile Strength	1,800 psi
Elongation	300%
Shore A Durometer	50

B. Test for materials shall be in accordance with ASTM D 412. No reclaimed PVC will be allowed.

C. Waterstops shall be 3/8-inch thick heavy-duty, ribbed center bulb type, unless indicated otherwise on the Drawings or specifications. Waterstops shall be 6 inches wide, unless otherwise shown.

2.13 JOINT FILLER, PREFORMED

A. Preformed nonextruded resilient material in accordance with ASTM D 1751 unless otherwise shown, shall be ½-inch wide, and of depth required to bring surface to within ½-inch of slab surface.

2.14 MIX DESIGN AND CONTROL

A. Concrete

1. Quality: Concrete in contact with ground or exposed to weather shall be composed of cement, pozzolan, fine aggregate, coarse aggregate, water, water reducing agent, and air entraining agent. Concrete shall be designated by class with a required 28-day strength. Cement/pozzolan ratio, coarse aggregate size, and slump shall be varied as specified below. The exact proportions of materials shall be such as to produce a workable, dense, impermeable concrete of the strength required. Maximum water-cement plus pozzolan ratio shall be 0.45 by weight.

2. Pozzolan shall be added to all concrete.

a. All concrete shall have a minimum 28-day strength of 4,000 psi.

1) Minimum combined cement plus fly ash content:

a) 517 pounds per cubic yard for concrete with 1-1/2-inch maximum size aggregate.

b) 540 pounds per cubic yard for 1-inch maximum size aggregate.

c) 564 pounds per cubic yard for 3/4-inch maximum size aggregate.

d) Increase combined cement plus fly ash content as required to meet strength requirements.

3. Consistency: Adequate water shall be used to produce the necessary workability for placement. However, in no case shall the slump determined in accordance with ASTM C 143 exceed the following values:

Vertical wall sections, columns: 4 inches

Footings, beams, slabs:	3 inches
Plain unreinforced concrete:	2 inches
Pipe bedding:	7 inches minimum 9 inches maximum

4. Coarse aggregate: Grading No. 1 shall be used in concrete where minimum cover and clear space between reinforcement is 2 inches. Grading No. 3 shall be used in concrete fill for masonry and concrete where minimum cover or clear spacing between reinforcement is less than 1-inch. Grading No. 2 shall be used in all other concrete.

B. Control tests: Characteristics of the concrete shall be controlled as follows:

1. Mix design: Before beginning concrete work, Contractor shall determine proper proportions of materials for each strength and type of concrete. Mix shall consist of the exact proportions of cementitious material, aggregates, water, and admixtures proposed for the particular concrete mix. Admixtures shall be proportions recommended by the manufacturer to achieve results herein noted. Mix design shall be prepared at the Contractor's expense, by a recognized inspection and testing laboratory acceptable to the Engineer, and shall show the expected strength, corresponding slump, air content, and all ingredient weights, and other physical properties necessary to check each design mix. Where more than one grading of coarse aggregate will be used, tests shall be made for the finest gradation to be used.

2. Laboratory tests: Each mix design shall be checked by the laboratory by the preparation of 2 trial batches, one with 2-inch slump and one with 5-inch slump, from each of which 6 standard test cylinders shall be cast and cured as specified for the job concrete. Three cylinders from each batch shall be tested at age 7 days, two at age 14 days and 1 at age 28 days. Certified copies of laboratory reports shall be sent to Engineer from the testing laboratory. No concrete placement shall commence prior to approval of the test results by Engineer. Laboratory reports shall state whether the item reported pass specifications and shall include a resume of the qualities of the mixes.

3. Field trial mix: After completion of mix design work and prior to concreting operations, Contractor shall establish, based upon the design mixes, field proportions for concrete to be used in the work. Manufacture of the field trial concrete shall be accomplished utilizing the equipment which will be used on the job. Adjustments shall be made in design mixes to provide a dense,

homogeneous, durable concrete with good workability and finishing qualities. Six standard test cylinders shall be obtained from each field trial mix and tested as in mix design. Engineer shall be notified in advance of any field trial mix work and no field trial mix shall be made without representatives of the Engineer and the accepted testing laboratory being present.

PART 3 - EXECUTION

3.01 BATCHING AND MIXING

A. Batching: Concrete batching equipment shall be provided to determine and to control accurately the relative amounts of cement, pozzolan, water, admixtures, sand, and each individual size of coarse aggregate entering the concrete. Cement, pozzolan, sand, and coarse aggregate shall be measured by direct weighing. Water and admixture shall be determined by direct weighing or by volumetric measurement.

1. Weighing equipment shall conform to requirements of the National Bureau of Standards except that accuracy of 0.4% of scale capacity will be satisfactory. Equipment shall be capable of ready adjustment to compensate for weight of any moisture contained in the aggregates and to effect changes in concrete mix proportions. Batching equipment shall be constructed and operated so that the combined inaccuracies in feeding and measuring of materials will not exceed 1-1/2% for water or weight of cement and 2% for each size of aggregate. Equipment shall be adequate to produce acceptable concrete under normal winter working conditions. Evidence of compliance with these specifications shall be furnished by Contractor if required.

B. Mixing: Concrete shall be in a batch mixer of accepted type which will ensure a uniform distribution of materials throughout the mass so that mixture is uniform in color and is homogeneous. Concrete shall be placed within 1-hour after water is first added to the batch. Mixer shall be equipped with a suitable charging hopper and a water storage and measuring device controlled from a case which can be kept locked. Mixer shall be so constructed that water can be discharged only while the mixer is being charged. The entire contents of the mixing drum shall be discharged before recharging. Volume of mixed materials per batch shall not exceed the rated capacity of mixer.

C. Transit mixed concrete: At Contractor's option, transit mixed concrete may be used. Transit concrete shall comply with applicable portions of this specification and ASTM C 94. Batch tickets shall be provided with each truckload of concrete in accordance with ASTM C 94 including type and amount of cementitious material, type and amount

of admixtures, total water content by producer, and weights of fine and coarse aggregate. No water may be added at job without authorization from Engineer. In no case shall water be added without adequate means for measuring and recording the amount added.

3.02 CONCRETE FOR PUMPING

A. Special care shall be taken when concrete is to be transported by pumping.

1. Standards: The following standards shall govern:

a. ACI 211.1.

b. ACI 304.2R.

2. Pumping: Type of pump to be used shall be approved by the Engineer.

a. No aluminum pipe will be allowed in pumping process.

b. Minimum bend radius for piping shall be 5 feet.

c. During temporary stops in pumping, the hopper shall remain nearly full to prevent segregation.

3. Mix design shall be in strict accordance with the above standards. An average loss of slump of ½- to ¾-inch per 100 feet of pipeline shall be accommodated in the mix design and batching processes.

4. Aggregates: In concrete that is to be pumped, all aggregate shall fall in the middle of ASTM C 33 gradation limits.

5. Admixtures: Any admixtures used to improve pumpability shall strictly follow Paragraph 2.05 Admixtures, and Paragraph 2.14 Mix Design and Control.

3.03 PROTECTION REQUIREMENTS

A. Cold weather concreting shall be in accordance with ACI 306 R, except as modified herein.

1. Cold weather is defined as a period when for more than 3 days the mean daily temperature drops below 40 degrees F. When temperatures above 50 degrees F occur during more than half of any 24-hour period, the concrete should no longer be regarded as cold weather concrete.

2. Concrete temperatures as mixed and as placed shall be maintained within the recommended temperature ranges for the indicated periods.

3. When heating of concrete materials is required, apparatus used shall heat the mass uniformly and not create overheated areas or hot spots. Direct heating devices will not be allowed. Any added moisture shall be taken into account in the mix design.

4. No frozen materials or materials containing ice shall be used. Surfaces with which the concrete is to come in contact shall be free of snow, ice, and frost.

5. Plans for protecting fresh concrete shall be made well in advance of expected freezing temperatures. All necessary materials and equipment shall be on site before the first frosts are likely to occur.

6. Protective coverings shall closely follow the concrete placing. If it is necessary to expose the concrete, only small areas shall be exposed at one time and then only for short periods.

7. Choice of curing method shall consider and be compatible with the cold weather protection method. If heaters are used, they shall be vented to the outside. Water curing shall not be permitted.

B. Hot weather concreting shall be in accordance with ACI 305 R, except as modified herein.

1. Hot weather is defined as any combination of high air temperature, low relative humidity, and wind velocity tending to impair the quality of fresh or hardened concrete or otherwise resulting in abnormal properties.

2. Contractor shall schedule delivery of concrete so it can be placed promptly upon arrival. Formwork shall be ready to receive concrete. Construction joints shall be properly placed and prepared. Concrete shall not be placed faster than it can be properly consolidated and finished by the personnel and equipment at hand.

3. Flatwork shall be protected from excessive drying during finishing operations, and each operation shall be performed without delay as soon as the concrete is ready for it. Curing shall be applied promptly and continued without interruption.

4. If ice is used in the mixing water, mixing shall continue until ice is melted, but not longer than specified elsewhere in this section.

5. No water shall be added to the mix at site other than that required to adjust to the specified slump, provided such an addition does not exceed the specified water-cement ratio. Any later addition of water must be approved by Engineer.

C. Protection of concrete construction: Surfaces shall be protected against injury. During the first 72 hours after placing concrete, any wheeling, working or walking on concrete shall not be permitted. Slabs subject to wear shall be covered with a layer of sand or other suitable material as soon as concrete has set. Sisalcraft paper or other similar tough, waterproof paper may also be used, provided joints between adjacent strips of paper are carefully sealed. This does not alter requirements for proper curing as specified in Paragraph 3.08, Curing Concrete.

1. No concrete shall be placed during rain unless acceptable protective shelter is provided; and during such weather, concrete placed within the preceding 12 hours shall be protected with waterproof canvas or other suitable coverings. These shall be provided and kept ready at hand.

2. Concrete construction shall be protected from excessive loading. Installation of mechanical and electrical equipment shall be accomplished by employing shores, bearing plates, frames, cranes and temporary beams.

3.04 CONSTRUCTION JOINTS

A. General: Concrete in each unit of construction shall be placed continuously, and Contractor shall not begin work on any part unless his/her facilities and forces are sufficient to complete the unit without interruption. Before new concrete is deposited on or against concrete which has set, the forms shall be retightened and the surface of the set concrete shall be cleaned of foreign matter. Wetting of concrete surfaces on which concrete is deposited shall be required and all free moisture shall be removed. Where watertight construction is required, a 1/2 sack of cement/per cubic yard shall be added to the concrete for the lowest 12-inch strip placed at the base of wall pours.

B. Construction: Construction joints shall be formed as described on the Drawings. A rough surface of exposed concrete aggregates with minimum amplitude of $\pm$ 1/8-inch shall be attained at construction joints by using a surface retardant. Where required by Engineer the limit of the treated surfaces shall be held 1-inch away from edges of the joint. Retarded surface mortar shall be removed either by high

pressure water jetting or stiff brushing or combination of both so as to expose coarse aggregates. A rough surface of exposed aggregate may also be secured by sandblasting followed by high pressure water jetting. Sandblasting, if used, shall remove 1/8-inch of cement and fine aggregate and shall expose coarse aggregate to ensure adequate bond and watertightness at construction joints. Sandblasting used for this operation shall be acceptable to Engineer.

C. Locations: Construction joint locations shall be approved by the Engineer and shall be kept to a minimum consistent with sound construction practices.

1. Unless otherwise noted on the Drawings, walls exceeding 60 feet in length shall be cast in panels not to exceed 40 feet in length. Where number of panels is three or more, panels shall be cast in an alternating pattern. Vertical construction joints shall be grooved at exposed faces. Grooves subject to wetting or weather shall be calked with joint sealer as specified or shown.

2. Construction joints in beams or girders shall be located at or near mid-point between supports. Joints in the members of a floor system shall be made at or near the center of the span. Joints in columns shall be perpendicular to the axis.

3. Unless otherwise noted or specified, slabs on grade shall be cast in panels not to exceed 40 feet in length or not to exceed 1000 square feet in area.

4. Panels shall be cast in alternate patterns. Minimum lapsed time between adjacent panels shall be 24 hours.

5. Adequate keys shall be provided and reinforcing steel shall continue through the joint in accordance with the Drawings. Floor slabs shall not be constructed over columns or walls without permitting a period of at least 2 hours to elapse to allow for shrinkage in the column or wall. No joint will be allowed between a slab and a beam or girder.

D. Watertightness: PVC waterstops shall be provided in construction joints where watertight construction is required. Waterstops shall be held firmly in proper position during concreting operation. All splices in length or at intersections shall be performed by heat sealing and in accordance with the manufacturer's recommendations. Watertight construction will be required as follows:

1. In all liquid holding structures at all joints exposed to earth or liquid on one side with areas to be occupied by nonsubmerged equipment or personnel on the other side.

2. In all liquid holding structures at all joints exposed to earth on one side and liquid on the other side.

3. If joint is not watertight after construction, the Engineer may require the following:

    a. Grouting of the joint by drilling grout holes to the center of the structural unit and forcing epoxy grout into the joint under pressure.

E. Where new concrete joins existing concrete, the existing concrete shall be cleaned to remove loose concrete, laitance or other foreign matter and shall be coated with an epoxy bonding compound prior to placing new concrete. Concrete that has been placed for more than 60 days shall be considered existing concrete.

3.05 INSERTS AND EMBEDMENTS

A. Inserts: Where pipes, castings, or conduits are to pass through walls, Contractor shall place such pipes or castings in the form before pouring concrete. In special cases, with the express consent of the Engineer or as specified, Contractor shall build accepted boxes in the form to make cored openings for subsequent insertion of such pipes, casting, or conduits as directed by Engineer. Boxes or cores shall be provided with continuous keyways all the way around, and keyways shall have a slight flare to facilitate grouting and the escape of entrained air during grouting. Grout shall be nonshrink grout material mixed in accordance with manufacturer's printed instruction. Before placing grout, coat the concrete surfaces and the surfaces of the insert with an epoxy bonding compound. Mixing and application of the bonding compound and time of placement of the grout shall be in accordance with manufacturer's printed directions.

1. Additional reinforcement shall be provided around such openings as shown or directed by Engineer. Pipes, castings, or conduits as specified shall be grouted in place by pouring in grout under a head of at least 4 inches. Grout shall be poured or rammed or joggled into place to fill completely the space between pipes, castings, or conduits, and sides of the opening so as to obtain the same watertightness as through the wall itself. Grouted castings shall be water cured as described in Paragraph 3.08, Curing Concrete. Grouting material so placed shall be

surfaced when the form are removed to give a uniform appearance to the wall if such wall will be exposed to view.

B. Embedments: Contractor shall set accurately and hold in exact position in the form all embedded items until concrete is poured and set. He/she shall furnish and set accurately all inserts and anchor bolts necessary for attaching piping, valves, and equipment.

3.06 DEPOSITING CONCRETE

A. Concrete shall not be placed until forms and reinforcement have been accepted by Engineer. Concrete shall be conveyed from mixer to place of final deposit as rapidly as possible by methods which will prevent separation or loss of ingredients. It shall be deposited in the form as nearly as practicable in its final position so as to maintain a plastic surface approximately horizontal. Concrete shall not be dropped more than 6 feet unless a suitable chute or tube is used. Form for walls or other sections of considerable height shall be provided with openings, or other devices which will permit the concrete to be placed in a manner which will avoid accumulations of hardened concrete on form or metal reinforcement. Under no circumstances shall concrete that has partially hardened be deposited in the work. Temporary joints shall not remain exposed for more than 45 minutes before adjacent concrete is placed.

B. Immediately after depositing, concrete shall be compacted by means of high-frequency mechanical internal vibrators which shall be 7,000 cycles per minute minimum. The number and type of vibrators shall be acceptable to Engineer and shall include a spare standby unit. Concrete shall be worked around reinforcement and embedded fixtures and into corners of the forms.

3.07 CURING CONCRETE

A. Immediately following placement, concrete shall be protected from premature drying, hot and cold temperatures, rain, flowing water and mechanical injury. Materials and methods of curing shall be approved by Engineer. Final curing shall continue for not less than 7 days.

1. Approved methods include ponding or continuous fog spray and liquid membrane-forming compounds as described below, except as specified elsewhere in this section.

a. Application of liquid membrane-forming compound shall conform to ASTM C 309. Material shall maintain a maximum moisture less loss of 0.11 pounds per square foot of surface in 72 hours when used at a coverage of 400 square

feet per gallon and tested in accordance with ASTM C 156. The curing compound shall be used at a maximum of 400 square feet per gallon.

2. Formed surfaces shall be kept moist prior to stripping forms. Immediately following stripping of forms, concrete shall be cured by the curing compound method.

3. Slabs shall be kept wet for 24 hours and then cured by the curing compound method if it is over 65 degrees F. If the temperature is less than 65 degrees F on completion of the pour, apply curing compound as soon as surface will not be marred by the curing compound.

3.08 REPAIR OF CONCRETE CONSTRUCTION

A. Immediately after removal of forms, concrete shall be inspected and porous concrete, rough sections or rock pockets containing loose materials shall be repaired by cutting back to solid concrete and making an opening of such size and shape as will form a 1-inch key for a cement mortar fill. Before the mortar is applied, the surface of the existing concrete shall be coated with an epoxy bonding compound. Form tie holes and imperfections greater than one-fourth cubic inch shall be filled. Fill for small imperfections and form ties shall bond to concrete and be of an equivalent quality as the surrounding concrete. Fill shall form a dense plug impervious to water. Where the area or volume of defective concrete is large, it may be repaired by reforming the surface and filling the opening with concrete. For such repairs, the concrete surface shall be coated with an epoxy bonding compound. The exposed surface shall be neatly finished to match the surface and texture of adjacent concrete. Patches shall be cured as approved by Engineer.

3.09 MORTAR BUILT-UP SURFACES

A. Where surfaces are required to be built up with mortar, such surfaces shall be cleaned by acid etching, then completely dried and coated with epoxy bonding compound prior to application of the required mortar. Immediately following application of the bonding compound apply mortar in bands or strips to form a compact, durable covering of the required thickness and free from lumps and depressions.

B. No mortar shall be applied during freezing weather unless adequate protection is provided.

C. Mortar shall be kept continuously wet for not less than 7 days by methods acceptable to the Engineer, or it shall be cured by soaking followed by application of an approved curing compound.

3.10 FINISH OF FORMED SURFACES

A. Finished or formed surfaces shall conform accurately to the shape, alignment, grades and sections as shown on the Drawings. Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing or roughness, and shall present a finished, continuous, hard surface.

B. Finishes shall conform to the following types:

1. Type A, architectural finish:

a. Location: All interior formed surfaces exposed to view except as noted otherwise on the Drawings or in this section.

b. Texture: "Grout cleaned finish" as defined in ACI 301, Paragraph 10.3.2.

(1) A portland cement, sand, and water mixture is applied to the wetted concrete surface.

(2) Surface is scrubbed vigorously to fill voids, and excess grout is removed.

(3) The dried surface is then rubbed with clean burlap.

2. Type B, blast finish:

a. Location: All exterior formed surfaces exposed to view.

b. Texture: "Sand blast finish" as defined in ACI 301, Paragraph 13.5.3.2.

(1) Use abrasive blast to remove laitance and sufficient surface mortar to provide an even color and smooth, slightly roughened texture.

c. Form tie pattern shall be submitted to the Engineer for approval.

d. Cold joints shall be allowed only as shown on the Drawings.

3. Type C, unspecified finish

a. Location: Surfaces not indicated on the Drawings or in this section to receive a Type A, or B finish.

b. Texture: "Unspecified finish" as defined in ACI 301, Paragraph 10.4.

4. Top of walls

a. Strike concrete smooth.

b. Float to texture comparable to formed surfaces.

c. Provide Type A Finish wherever adjacent formed surface is scheduled to receive Type A Finish.

3.11 SLAB FINISHES

A. Slab finishes shall be in accordance with ACI 301, Paragraph 11.7, Finishes.

1. Troweled finish shall be applied to interior slabs left exposed.

2. Broom or belt finish shall be applied to exterior walking surfaces unless noted otherwise.

3.12 SURFACE TOLERANCES

A. Finishes shall be true planes within 1/8-inch in 10 feet as determined by a 10-foot straightedge placed anywhere on the slab in any direction.

B. Slopes to drains shall be true to line, evenly graded, 1/4-inch per foot unless noted otherwise.

3.13 GROUT

A. Pre-mixed grout shall be delivered to the job in manufacturer's original sealed container with labels intact and shall be used in strict accordance with the manufacturer's recommendations. Surfaces to be grouted shall be sound, smooth, clean and free of contaminants. Grout shall be provided as follows:

Grout Type	General Application
Epoxy	Bolts and reinforcing into existing concrete
Nonshrink	Equipment bases, pipe sleeves, RCP pipe joints

Type 1	General purpose to be used unless otherwise indicated
Type 2	Door frames

3.14 FIELD TESTING

A. Concrete shall be sampled and tested in accordance with ACI 301 and supplements during the progress of concrete work. Slump and air content tests shall accompany all test cylinders for strength. Engineer shall be notified 48 hours ahead of scheduled pours. Contractor shall notify Engineer 24 hours in advance of any cancellation of pours.

1. Any additional testing required because of apparent failure of concrete to meet specification requirements shall also be paid by Contractor. When there is a question as to quality of the structure because of cylinder strength test failures, strength tests made on specimens secured from the structure and tested in accordance with ASTM C 42 will be required.

2. Samples of concrete will be obtained in accordance with ASTM C 172 and will be transported to a place on the site where air and slump tests can be made and cylinders stored without being disturbed for the first 24 hours. Cylinders for strength tests shall be made in accordance with ASTM C 31 and ASTM C 94. Contractor shall assemble cylinders in a convenient location each day, after 24 hours cure, for pick-up by the testing laboratory.

B. Cylinders shall be made as required by ACI 301 and supplements for strength tests, following applicable ASTM standards. Strength tests shall be in accordance with ASTM C 39. Two extra cylinders shall be taken from each day's pour of concrete to be post-tensioned and field cured. Concrete strengths shall be verified with field cured cylinders prior to post-tensioning. Cylinders from all other concrete shall be cured in the laboratory. If a specimen shows manifest evidence of improper sampling, molding, or testing, it will be disregarded.

C. Slump tests shall be made following the procedure in ASTM C 143. Slump tests shall be made for concrete from any batch from which strength tests are made.

1. If the measured slump falls outside limits specified, a check test shall be made immediately on another portion of the same sample. In the event of a second failure, concrete will be considered to have failed to meet requirements of the specifications and shall be unacceptable.

D. Air content tests shall be made in accordance with either ASTM C 138 or ASTM C 231.

1. If the measured air content falls outside limits specified, a check test will be made immediately on another portion of the same sample. In the event of a second failure, concrete will be considered to have failed to meet requirements of the specifications and shall be unacceptable.

E. Water Leakage Tests

1. All water-holding structures:

a. Perform leakage tests after concrete has cured and obtained its design strength, and before backfill, brick facing, or other work which will cover concrete wall surfaces is begun.

b. Make other equipment, i.e., stop gates, sluice gates, etc., or temporary bulkheads watertight prior to test.

c. As an alternative to having watertight bulkheads, gates or valves, accurately measure the leakage through gates, valves and bulkheads with methods acceptable to Construction Manager. An assumed leakage through gates and valves based on manufacturer's recommendations is not acceptable.

d. Fill with water to maximum operating liquid surface prior to leak testing, and maintain level for 48 hours for moisture absorption by concrete.

e. Close all valves and gates to the structure and measure the change in water surface for a 24-hour period.

f. During test period, examine exposed portions of structure for dampness or leaks and mark visible leaks or damp spots.

2. Test Evaluation Criteria:

a. Drop in water surface in 24-hour period with basin full to the leakage test water level elevations is less than 1/10 of 1 percent of normal volume of liquid contained in water-holding structure, after accounting for evaporation and precipitation in open basins, and damp spots or seepage are not present on walls or other areas exposed to view.

b. Determine evaporation by floating an evaporation pan in structure during test period.

3. Excessive Leakage and Leakage Test Failure: If drop in water surface exceeds test evaluation criteria or if damp spots or seepage is visible in exposed surfaces.

4. Repairs:

a. If leakage is excessive, and if damp spots and observed seepage is present on exposed surfaces, drain water-holding structure, epoxy grout inject all cracks, patch all surface areas and damp spots previously marked, and make necessary repairs as outlined hereinbefore and retest basin.

5. Retest:

a. Refill water-holding structure and test for leakage until structure meets test criteria.

b. Successful Test: If liquid level criteria is met and damp spots and seepage problems are corrected.

F. Failure of Contractor to perform required tests shall be cause for rejection of the subject work.

END OF SECTION

SECTION 05500
METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Miscellaneous steel and aluminum framing and supports and bearing plates.

1.3 SUBMITTALS

A. Shop Drawings: Include plans, elevations, sections, details of installation, and attachments to other Work.

B. Templates: For anchor bolts.

PART 2 - PRODUCTS

2.1 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces without blemishes.

B. Ferrous Metals:

1. Steel Wide Flange: ASTM A 572, Grade 50 or ASTM A 992, Grade 50.

2. Other Shapes, Steel Plates, and Bars: ASTM A 36/A 36M.

3. Stainless-Steel Bars and Shapes: ASTM A 276, Type 316L.

4. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500.

5. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

C. Aluminum:

1. Extrusions: ASTM B 221, alloy 6063-T6.

2. Alloy Rolled Tread Plate (Checkered Plate): ASTM B 632/B 632M, alloy 6061-T6.

3. Shapes, Bars and Plates: ASTM B 221, alloy 6061-T6.

2.2 PAINT

A. Shop Primer for Ferrous Metal: See Division 9 “Painting.”

B. Galvanizing Repair Paint: SSPC-Paint 20, high-zinc-dust-content paint for regalvanizing welds in steel.

2.3 MISCELLANEOUS MATERIALS

A. Fasteners: Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, where built into exterior walls, of type, grade, and class required by application indicated.

B. Nonshrink, Nonmetallic Grout: ASTM C 1107, factory-packaged, nonstaining, noncorrosive, nongaseous grout.

2.4 FABRICATION

A. Connections, General: Use connections that maintain structural value of joined pieces.

1. Shear and punch metals cleanly and accurately. Remove burrs.

2. Weld corners and seams continuously. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals. Obtain fusion without undercut or overlap. Remove welding flux immediately. Finish exposed welds smooth and blended.

3. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes.

4. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.

B. Miscellaneous Framing and Supports: Fabricate steel and aluminum framing and supports as necessary to complete the Work as shown on Drawings. Cut, drill, and tap units to receive hardware, hangers, and similar items.

C. Miscellaneous Steel Trim: Fabricate units with continuously welded joints and smooth exposed edges. Miter corners and use concealed splices where possible. Fabricate cutouts, fittings, and anchorages; coordinate assembly and installation with other work.

2.5 FINISHES

A. Finish metal fabrications after assembly. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Shop prime ferrous-metal items not indicated to be galvanized.

1. Hot-dip galvanize items indicated to be galvanized to comply with ASTM A 123 or ASTM A 153/A 153M as applicable.

2. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."

3. Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Provide anchorage devices and fasteners for securing metal fabrications to in-place construction. Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, with edges and surfaces level, plumb, and true.

1. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

2. Fit exposed connections accurately together. Weld connections, unless otherwise indicated. Do not weld, cut, or abrade galvanized surfaces.

3. Deliver steel bearing plates and other items to be built into other work so as not to delay the other work.

B. Touch up surfaces and finishes after erection.

1. Painted Surfaces: Clean field welds, bolted connections, and abraded areas and touch up paint with the same material as used for shop painting.

2. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

C. Aluminum fabrications shall be bolted with stainless steel bolts where bolts are required.

END OF SECTION 05500

SECTION 05501
ANCHORAGE TO CONCRETE

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This section covers all anchorage to concrete, complete with washers and nuts.

1.02 GENERAL

A. Like items of materials provided hereunder shall be the end products of one manufacturer in order to achieve standardization for appearance, maintenance, and replacement.

1.03 ANCHOR BOLTS AND CONCRETE ANCHORS

A. The diameter shall be as required by the equipment or machinery manufacturer. The Contractor shall verify the capacities and configurations conform to the Drawings.

B. The Contractor shall provide design calculations, stamped by a State of Oregon licensed structural engineer, for all anchor bolts and concrete anchors exceeding the capacities, or not conforming to the configurations, specifically shown on the Drawings.

1.04 SUBMITTALS

A. Submittals shall be made in accordance with Division 1 of the City of Gresham Public Works Standards. In addition, the following specific information shall be provided:

1. ICBO (International Conference of Building Officials) reports verifying the products meet or exceed the capacities shown on the Drawings. Manufacturers' information showing the recommended installation equipment and procedures for the following:

   a. Drilled in concrete anchors.

   b. Epoxy anchor adhesive.

2. Design calculations, stamped by a State of Oregon licensed structural engineer, for all anchor bolts and concrete anchors exceeding the capacities, or not conforming to the configurations, specifically shown on the Drawings.

1.05 EXPOSURE CONDITIONS

A. Exposure conditions shall be defined as follows:

1. Dry: Indoor areas not subject to moisture, washdown, or chemicals.

2. Wet: Indoor areas subject to moisture, washdown, or chemicals, or outdoor areas.

3. Submerged: At or below a point 1 foot 6 inches above maximum fluid surface.

B. All nonsubmerged surfaces shall be considered wet, unless noted otherwise.

PART 2 - PRODUCTS

2.01 GENERAL

A. The use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired only.

B. Unless otherwise indicated, all materials shall conform to the latest issue of the following ASTM Specifications:

1. Anchor Bolts and Nuts:

a. Carbon Steel: ASTM A 307, Grade A 36.

b. Stainless: ASTM A 193, Type 316.

2. Galvanized Steel Bolts and Nuts: ASTM A 153, zinc coating for ASTM A 307 or A 36.

3. Flat Washers (Unhardened): ASTM F 844, use ASTM A 153 for zinc coating.

4. Threaded Bars: ASTM A 36.

5. Drilled-In Concrete Anchors:

a. Carbon Steel Anchors: ASTM A 108.

b. Stainless Steel: ASTM A 193, Type 316.

6. Epoxy Anchors:

a. Stainless-Steel Anchors: ASTM A 193, Type 316.

b. Epoxy Adhesive: ASTM C 881, Type 1, Grade 3, Class A, B, or C.

7. Grouted Concrete Anchors:

a. Stainless-Steel Anchors: ASTM A 193, Type 316.

b. Grout: As specified in Section 03300, Cast-in-Place Concrete.

8. Nuts:

a. Carbon Steel: ASTM A 307.

b. Stainless Steel: ASTM A 194, Type 316.

9. Galvanizing:

a. Carbon Steel: ASTM A 153, Zinc Coating for ASTM A 307.

C. The concrete anchorage system indicated on the Drawings, or required to secure the various parts together and provide a complete installation, shall be included under this section. The tabulation of items herein is not intended to be all-inclusive, and it shall be the Contractor's responsibility to provide all metalwork and castings shown, specified, or which can reasonably be inferred as necessary to complete the project.

2.02 ANCHOR BOLTS

A. Unless shown otherwise on the Drawings, use 3/4-inch minimum diameter by 12-inch long and other geometry shown on the Drawings. Furnish a minimum of two nuts and a washer of the same material for each bolt. Provide sleeves as shown on the Drawings for location adjustment.

B. Coated anchor bolts shall be coated as specified in Section 09900, Painting, using the Fusion Bonded Coating, System No. 29. Coating of anchor bolt threads is not required. Where threads are covered with a fusion bonded coating, provide the nut of proper size to fit and provide a connection of equal strength to the embedded bolt.

C. Provide anchor bolt material for the exposure conditions as noted below:

1. Equipment and Machinery:

    a. Dry exposure, use stainless steel.

    b. Wet exposure, use stainless steel.

    c. Submerged exposure, use coated stainless steel.

2. Fabricated Metalwork or Structural Building or Frame Components:

    a. Dry Exposure:

        1) Steel anchoring, use galvanized steel.

        2) Other metal anchoring, use stainless steel.

    b. Wet exposure, use stainless steel.

    c. Submerged exposure, use coated stainless steel.

D. Anchor Bolt Sleeve: High-density polyethylene plastic.

1. Single unit construction with deformed sidewalls such that the concrete and grout lock in place.

2. The top of the sleeve shall be self threading to provide adjustment of the threaded anchor bolt projection.

3. Material requirements shall conform to the following:

    a. Plastic: High-density polyethylene.

    b. Density: ASTM D 1505.

    c. Vicat Softening Point: ASTM D 1525.

    d. Brittleness Temperature: ASTM D 746.

4. Manufacturer: Sinco West, 655 East Cochran Street, Simi Valley, CA 93085, telephone 805/522-3901.

2.03 CONCRETE ANCHORS

A. Drilled-in concrete anchors shall be Red head Wedge anchors or Red Head Sleeve anchors, manufactured by ITT Phillips, Michigan City, IN; Kwik-Bolt stud type or HDI Drop-In anchors, manufactured by Hilti, Inc., Stamford, CT; Wej-It, manufactured by Wej-It Corporation, Broomfield, CO; or Parabolt PB anchors, manufactured by Molly

Division of Emhart Corp., Temple, PA. Anchors shall have allowable working loads not less than those tabulated in the Structural General Notes. Provide diameter shown or required except minimum diameter of 3/8 inch.

B. Epoxy Threaded Rod Anchors:

1. Anchor Rod: 316 stainless steel threaded rod free of grease, oil, or other deleterious material with a 45-degree chisel point.

2. Epoxy Adhesive:

a. Meet ASTM C 881, Type 1, Grade 3, Class A, B, or C.

b. Two-component, 100 percent solids, nonsag, paste, insensitive to moisture, designed to be used in adverse freeze/thaw environments, and gray in color.

c. Cure Temperature, Pot Life, and Workability: Compatible for intended use and environmental conditions.

3. Mixed Epoxy Adhesive: Nonsag paste consistency with ability to remain in a 1-inch diameter overhead drilled hole without runout, holding the following properties:

a. Slant Shear Strength, ASTM C 881/882, no failure in bond line, dry/moist conditions: 5,000 psi.

b. Compressive Strength, ASTM D 695: 14,000 psi minimum.

c. Tensile Strength, ASTM D 695: 4,500 psi.

d. Heat Deflection Temperature, ASTM D 648: 135 degrees F, minimum.

4. Epoxy Adhesive Packaging:

a. Disposable, self-contained cartridge system capable of dispensing both epoxy components in the proper mixing ratio and fit into a manually or pneumatically operated caulking gun.

b. Dispense components through a mixing nozzle that thoroughly mixes components and places epoxy at base of predrilled hole.

c. Mixing Nozzles: Disposable, manufactured in several sizes to accommodate sizes of anchor rods.

d. Cartridge Markings: Include manufacturer's name, batch number, mix ratio by volume, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.

5. Storage of Epoxy Adhesive:

a. Store expoxy cartridges on pallets or shelving in a covered storage area.

b. Control temperature above 60 degrees F and dispose of cartridges if shelf life has expired.

c. If stored at temperatures below 60 degrees F, test adhesive prior to use to determine if adhesive meets specified requirements.

6. Manufacturers: Adhesive Technology Corp., 21850 88th Place South, Kent, WA 98031; or Anchor-It Fastening Systems, HS 200 Epoxy Resin.

7. Anchors shall have allowable working loads not less than those tabulated in the Structural General Notes. Provide minimum diameter of 3/8 inch.

C. Coated concrete anchors shall be coated as specified in Section 09900, Painting, using the fusion bonded coating, System No. 29. Coating of threads is not required. Where threads are covered with a fusion bonded coating, provide the nut of proper size to fit and provide a connection of equal strength to the embedded anchor.

D. Provide concrete anchors for the exposure conditions as noted below:

1. Drilled-In Concrete Anchors:

a. Dry exposure, use galvanized steel.

b. Wet exposure, use stainless steel.

c. Submerged exposure, do not use.

2. Epoxy Anchors:

a. Dry exposure, use stainless steel.

b. Wet exposure, use stainless steel.

c. Submerged exposure, use coated stainless steel.

d. Epoxy anchors shall not be used in any overhead applications.

3. Grouted Concrete Anchor:

a. Dry exposure, use stainless steel.

b. Wet exposure, use stainless steel.

c. Submerged exposure, use coated stainless steel.

E. Drilled-in concrete anchors shall not be used for anchoring of any machinery or equipment with moving parts.

2.04 STAINLESS-STEEL FASTENERS LUBRICANT (ANTI-SEIZING)

A. Where stainless steel nuts and machined bolts, anchor bolts, concrete anchors, and all other threaded fasteners are used, Contractor shall apply an anti-seizing lubricant to the threads prior to making up the connections. The lubricant shall contain substantial amounts of molybdenum disulfide, graphite, mica, talc, or copper.

PART 3 - EXECUTION

3.01 GENERAL

A. Install per manufacturer's recommendations. Cutting and welding shall not be permitted. Protect dissimilar metals in conformance to Section 05500, Fabricated Metalwork and Castings. Items to be embedded in concrete shall be placed accurately and held securely during placement. Anchors shall be protected after installation by coating the exposed threads with lubricant (anti-seizing) and installing the nut.

3.02 ANCHOR BOLTS

A. All anchor bolts shall be accurately located and held in place with templates at the time the concrete is poured.

3.03 CONCRETE ANCHORS

A. Installation shall not begin until the concrete or masonry receiving the anchors has attained its design strength. Install in strict conformance

with manufacturer's written instructions. Use manufacturer's recommended drills and equipment.

B. Epoxy Anchors: Do not install when temperature of concrete is below 35 degrees F or above 110 degrees F.

C. Furnish manufacturer's representative, for each type of concrete anchor used, to the jobsite to conduct jobsite training for proper installation, handling, and storage of each anchor system for personnel as required. Notify Construction Manager of training session schedule.

D. Flush mounted concrete anchors shall not be used unless specifically shown on the Drawings or approved by the Construction Manager.

3.04 GALVANIZING AND REPAIR

A. The minimum pitch diameter of the threaded portion of all bolts, anchor bars, or studs shall conform to ANSI B1.1, having a Class 2A tolerance before galvanizing. After galvanizing, the pitch diameter of the nuts or other internally threaded parts may be tapped over ANSI B1.1, Class 2B tolerance by the following maximum amounts:

3/8-inch through 9/16-inch	0.016-inch	oversize
5/8-inch through 1-inch	0.023-inch	oversize
1-1/8-inch and larger	0.033-inch oversize	

B. Galvanized surfaces that are abraded or damaged at any time after the application of the zinc coating shall be repaired by solvent cleaning the damaged area (Steel Structures Painting Council SP 2 or SP 3) the damaged areas, removing all loose and cracked coating, after which the cleaned areas shall be painted as specified in Section 09900, Painting.

END OF SECTION

SECTION 08305
ACCESS HATCHES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Work consists of furnishing all labor, material, and equipment required for the installation of all access hatches as shown on drawings and specified herein.

1.02 RELATED SECTION

A. Section 03300 – Cast-In-Place Concrete

B. Section 09900 - Painting

1.03 GENERAL REQUIREMENTS

A. Guarantee: Completed installation shall be guaranteed against defects of materials and workmanship for a period of 2 years after date of Certificate of Substantial Completion. Guarantee is also to cover repairs required to maintain product installed and to ensure against leakage due to ordinary wear from the elements at no expense to Owner.

B. Labels and packaging: Deliver materials to jobsite in undamaged packaging with material name and manufacturer identified.

C. Delivery, storage, and handling: Delivery of shop-fabricated items shall be scheduled for immediate incorporation into the work. Otherwise protected storage must be provided until items can be used.

D. Installation: Install all materials in strict accordance with manufacturer's requirements and as shown on drawings.

E. Submittals: Submit product data and manufacturer's installation instructions for access hatches in accordance with Division 1 of the City of Gresham Public Works Standards .

PART 2 - PRODUCTS

2.01 ACCESS HATCHES

A. Access hatches shall be JAH Series manufactured by The Bilco Company, or approved equal.

B. Description

1. Single door leaf 1/4 inch aluminum diamond pattern plate to withstand H-20 live load with maximum defection of 1/150th of the span.

2. Provide channel frame 1/4 inch aluminum with anchor flange around the perimeter.

3. Equip door with heavy forged brass hinges, stainless steel pins, spring operators enclosed in telescopic tube and automatic hold-open arm with release handle. Hinges shall be through-bolted to the caver with tamperproof stainless steel lock bolts and through-bolted to the frame with stainless steel bolts and fiber lock nuts.

4. Provide 1-1/2 inch drainage coupling located in right front corner of channel frame.

5. Hardware shall be stainless steel.

6. Aluminum shall be mill finish with bituminous coating applied to exterior of the frame. See Section 09900 paint system C- 3-U.

7. Accessories

   a. Provide padlock hasps located on exterior faces of all door leafs.

   b. Provide pipe support sockets for guardrail at all access hatches as shown in the drawings. Install at factory.

PART 3 - EXECUTION

3.01 PREPARATION

A. Surfaces to receive access hatches shall be free of all debris and prepared in accordance with Manufacturer's requirements.

3.02 ACCESS HATCH INSTALLATION

A. Install access hatches according to manufacturer' s recommendations and as shown on drawings. Anchor securely to surrounding construction.

B. Prime surfaces of aluminum materials in contact with concrete, masonry materials or dissimilar metals with bituminous paint system C- 3-U (see Section 09900) or provide a gasket where paint is not acceptable or surfaces are exposed to view.

3.03 CLEANUP

A. Clean accessories in accordance with manufacturer's instructions.

END OF SECTION

SECTION 09900
PAINTING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Work of this section includes all materials, labor, and equipment necessary for and incidental to painting work as indicated on the drawing and specified herein.

1.02 QUALITY ASSURANCE

A. Specifications for non-latex paint are based on products of the Tnemec Co., Inc. Equivalent products by the following manufacturers are acceptable:

Porter	Degraco	Glidden
Mobil	Carboline	PPG Industries
Koppers	Engard	Sherwin-Williams

B. Field quality control: Coating thickness will be measured in the following ways:

1. Visual Inspection: Show-through of substrate or previous coating will be grounds for rejection.

2. Dry film thickness on steel and galvanized substrates will be measured with a calibrated magnetic nondestructive testing apparatus.

3. Coverage rates for concrete and masonry surfaces will be determined by a count of empty containers remove or permanently deface labels of empty containers after counting by Engineer. Remove empty, counted containers from jobsite.

C. Specifications for varnish and latex paint are based on products of the Glidden Coatings Division of SCM Corp. Equivalent products by the following manufacturers are acceptable:

Pratt and Lambert	Preservative Paint Co.
Cowman-Campbell	Sherwin-Williams
PPG Industries	Dutch Boy
Fuller O'Brien Co.	

D. Shop Painting: Except where shop finishing is specified as final material finish, all items required to be painted shall be painted as specified herein including surface preparation, primer and subsequent coats.

Exceptions:

1. Equipment or assembly shop-painted with primer system approved by Engineer and Painting Installer as equivalent to the specified primer system and compatible with subsequent coats.

2. Equipment or assembly shop-painted with the specified paint system or equivalent approved by the Engineer.

3. Where a specific primer system is specified as a shop coating the shop primer shall be considered the equivalent of the surface preparation and primer specified in this section.

1.03 Submittals

A. Product Data: Submit manufacturer’s material specifications and application instructions, including recommendations for application equipment to be utilized.

B. Colors: Submit color cards for Engineer's color selection for finish coat paints.

C. Samples: Submit 6-inch-square samples of each finish coat with base coat applied in each color selected for use. Engineer will review for color and texture only.

D. Maintenance Instructions: Submit manufacturer recommendations for procedures and products used for recoating of each specified finish coat.

1.04 DELIVERY AND STORAGE

A. Deliver all materials to the jobsite in original, new, and unopened packages and containers bearing manufacturer's name and label.

1. Provide labels on each container with the following information:

a. Name or title of material.

b. Federal Specification number, if applicable.

c. Manufacturer's stock number.

d. Manufacturer's name.

e. Contents by volume, for major pigment and vehicle constituents.

f. Thinning instructions.

g. Application instructions.

B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing, and application of paint in a clean condition, free of foreign materials and residue.

1.05 JOB CONDITIONS

A. Do not apply painting when conditions are such that dust, dirt, or other deleterious substances which nay impair the quality of coats or the finish are present or will be present before the coating is fully dry.

B. Comply with manufacturer’s recommended limitations for ambient and surface temperature and humidity.

C. Comply with manufacturer' s recommendations for minimum and maximum times between applications.

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide the best quality grade of the various types of paint as regularly manufactured by approved materials manufacturers. Materials not displaying the manufacturer' s identification as a standard, best-grade product will not be acceptable.

B. Provide undercoat paint produced by the same manufacturer as the finish coats. Use only thinners approved by the special coatings manufacturer, and use only within recommended limits.

C. Paint Coordination: Provide finish coats, which are compatible with primer paints, used. Upon request from other trades, furnish information or characteristics of specified finish materials, to ensure compatible primer coats are used.

2.02 PAINT SYSTEMS

A. Paint system C-2-A

1. Surface preparation: See Paragraph 3.02H of this section.

2. Primer: Vinyl acrylic latex sealer, Tnemec 51-792 PVA Sealer; OFT 1.0 to 2.0 mils.

3. Intermediate coat: Alkyd semi -gloss enamel; Tnemec Series 23 Enduratone; OFT 2.0 to 3.0 mils.

4. Finish coat: Alkyd semi-gloss enamel; Tnemec Series 23 Enduratone; OFT 2.0 to 3.0 mils.

B. Paint system C- 3-T

1. Surface preparation: SSPC SP-7 or acid etch.

2. Finish coat: Modified epoxy masonry texture coating; Tnemec Series 52 Tneme-Crete; application rate 800 square feet/gallon. Apply with roller only. Do not spray or brush apply?

C. Paint system C- 3-U

1. Surface preparation: SSPC-SP1.

2. Finish coat: Coal tar pitch; Tnemec 46-465 Hi -Build Tank Coating; OFT 8.0 to 12.0 mils.

D. Paint system G- 3-A

1. Surface preparation: Solvent clean, detergent wash, water rinse.

2. Primer: Vinyl wash primer; Tnemec 32-1210 Tneme-Grip; OFT 0.3 to 0.5 mils.

3. Intermediate coat: Alkyd enamel semi -gloss; Tnemec Series 23 Enduratone; OFT 1.5 to 3.0 mils.

4. Finish coat: Alkyd enamel semi -gloss; Tnemec Series 23 Enduratone; OFT 1.5 to 3.0 mils.

E. Paint system G- 3-Z

1. Surface preparation: SSPC-SP1 followed by SSPC-SP2, SP3 or SP7.

2. Primer: Organic zinc; Koppers organic zinc; OFT 2.0 to 3.0 mils.

F. Paint system S- 3-A

1. Surface preparation: SSPC-SP6.

2. Primer: Modified alkyd rust-inhibitive primer; Tnemec 10-99; OFT 2.0 to 3.5 mils.

3. Intermediate coat: Alkyd gloss enamel; Tnemec Series 2 Tneme-gloss; OFT 1. 5 to 2. 5 mils.

4. Finish coat: Alkyd gloss enamel; Tnemec Series 2 Tneme-gloss; OFT 1.5 to 2.5 mils.

G. Paint system S-4-B

1. Surface preparation: SSPC-SP10.

2. Primer: Coal tar epoxy; Tnemec 46-413 Tneme Tar; OFT 8.0 to 10.0 mils.

3. Finish coat: Coal tar epoxy; Tnemec 46-413 Tneme Tar; OFT 8.0 to 10.0 mils.

H. Paint system S-7-B

1. Surface preparation: SSPC-SP3 or SP8.

2. Primer: Vinyl wash primer; Tnemec 32-1210 Tneme-Grip; Tneme-Zinc OFT .0025 mils.

3. Intermediate coat: Coal tar epoxy; Tnemec 46H-413 Hi Build Tneme-Tar; OFT 8.0 to 10.0 mils.

4. Finish coat: High solids catalyzed; Tnemec Series 61 Tneme-Liner; OFT 5.0 to 6.0 mils (tin hole free coat).

PART 3 - EXECUTION

3.01 INSPECTION

A. Installer must examine the areas and conditions under which painting work is to be applied. Notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

1. Test previously painted or primed surfaces for compatibility with painting systems.

B. Leak tests and other functional tests shall be completed prior to painting unless permitted otherwise by the Engineer.

C. Starting of painting work will be construed as the installer's acceptance of the surfaces and conditions within any particular area.

3.02 PREPARATION

A. General: Perform preparation and cleaning procedures in strict accordance with the paint manufacturer's instructions and as herein specified, for each particular substrate condition.

B. Masking: Protect surfaces that have received finish coat or are specified below not to be painted (or receive special coating) by any method which will prevent overspray, spatters, or drips from affecting finished surfaces.

C. Prefinished items:

1. Unless otherwise indicated, do not include painting when factory finishing or installer finishing is specified for such items as (but not limited to) toilet accessories, partitions, lab equipment, cabinetwork, acoustical materials, and acoustical ceilings.

2. For factory finished items that require additional field painting see paint schedule in paragraph 3.05 of this section.

D. Finished metal surfaces: Metal surfaces of aluminum louvers and similar finished materials will not require painting except as otherwise indicated.

E. Operating parts and labels:

1. Do not paint any moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sensing devices, motor and fan shafts, unless otherwise indicated.

2. Do not paint over any code-required labels, such as Underwriters Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.

F. Remove all hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted, or provide surface-applied protection prior to surface preparation and coating operations. Remove, if necessary, for the complete painting of the items and adjacent surfaces. Following completion of painting of each space or area, reinstall the removed items using workmen skilled in the trades involved.

G. Clean surfaces to be painted before applying coatings or surface treatments. Remove oil and grease prior to mechanical cleaning. Program the cleaning and painting so that contaminants from the cleaning process will not fall onto wet, newly coated surfaces.

H. Preparation of surfaces:

1. Concrete and Masonry:

a. Prepare surfaces of concrete and Masonry to be painted by removing all efflorescence, chalk, dust, dirt, grease, oils, through etching, wire brushing, fiber brushing, stoning or scraping to remove glaze.

1) Brush-off blast cleaned concrete surfaces to remove form release agent and loose concrete. If blasting is impractical surface may be acid etched with muriatic acid solution.

b. Determine the alkalinity and moisture content of the surfaces to be painted by performing appropriate tests. Do not paint over surfaces where the alkalinity or moisture content exceeds that permitted in the manufacturer' s printed directions.

2. Steel and cast iron: Specified surface preparation techniques are those published by the Steel Structures Painting Council (SSPC) in "Steel Structures Painting Manual. "

3. Galvanized steel and nonferrous natal: Solvent clean in accordance with SSPC-SP 1. Wash with detergent and rinse.

4. Plastic and previously primed or painted surfaces. Sand lightly to remove gloss. Wash with detergent and rinse.

I. Repair of galvanized surfaces: For galvanized surfaces not to be painted use Paint System G-3-Z to make required repair.

3.03 APPLICATION

A. General:

1. Apply painting in accordance with the manufacturer’s directions. Use applicators and techniques best suited for the type of material being applied. Do not exceed manufacturer’s recommended coverage per gallon.

2. Apply additional coats when undercoats, stains, or other conditions show through the finish coating, until the paint film is of uniform finish color and appearance.

3. Apply painting to surfaces behind movable equipment and furniture the same as similar exposed surfaces. Coat surfaces behind permanently fixed equipment or furniture with prime coat and base coat only.

B. Back priming: Conduit, conduit fittings, structural steel, miscellaneous steel and ironwork shall be primed and painted to match adjacent surfaces unless otherwise specified. All natal brackets, angles and devices mounted against concrete or masonry surfaces shall be back-primed before installing. Paint surface exposed after installation.

C. Factory-finished items (including factory primer):

1. The Contractor shall repair or have repaired all surface damage to factory-finished items. The Engineer shall determine if damage can be

repaired at job site or if item is to be returned to the factory. Any coating done shall be equal to the original coating in every way, and compatible with the shop coats.

2. Where additional coats of paint are required, the factory-applied primer shall be from the paint system selected, or be compatible with it. This finish coat will be field applied. Coordinate this work with equipment manufacturers. Colors will be selected by the Engineer.

D. Coating inspection: Each coat of material shall be inspected and approved by the Engineer before applying succeeding coats; otherwise no credit for coat applied will be given, and Contractor assumes recoat responsibilities.

3.04 CLEANUP

A. Cleanup: During the progress of the work, remove from the project daily all discarded coating materials, rubbish, cans, and rags.

B. Upon completion of painting work, clean all window glass and other spattered surfaces. Clean by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

C. Correct any damage by cleaning, repairing, or replacing, and painting as directed by the Engineer. Provide "Wet Paint" signs as required to protect newly coated finishes. Remove temporary protection wrappings provided by others for protection of their work, after completion of painting operations.

3.05 PAINTING SCHEDULE

A. Schedule

	Item	Location	Exposure	Spec. Section	Paint System
1.	Cast-in-place concrete				
	a. Walls, ceiling		Interior	03300	C-2-A
	b. Walls, roof slab		Exterior	03300	C-3-T
2.	Metal fabrications				
	a. Buried steel	Metal in contact with concrete or dissimilar metals	Buried	05500	S-4-B
	b. Aluminum		Interior	05500	C-3-U
			Exterior	05500	C-3-U
3.	Aluminum Access Hatches	Metal in contact with concrete	Exterior	08305	C-3-U
4.	Exposed Piping				
	a. Galvanized			15060	G-3-A
	b. Ductile Iron			15060	S-3-A
	c. Steel			15060	S-3-A
	d. Cast Iron			15060	S-3-A
5.	Buried Piping		Buried	15060	S-4-B
6.	Submerged Piping		Submerged	15060	S-4-B
7.	Valves		Exterior	15100	S-3-A
			Interior	15100	S-3-A

B. Definitions (exposure)

1. Interior (Int.): Within enclosed space, not exposed to elements; not buried, exterior, or submerged.

2. Exterior (Ext.): Not within enclosed space, exposed to elements; not buried or submerged. (Note: exterior paint systems are, in some places, scheduled for interior use.)

3. Buried (Bur.): In contact with earth.

4. Submerged (Sub.) : In contact with water or sewage. Paint system shall extend to 1 foot above high water line unless indicated otherwise. In wet wells, walls shall be painted to the underside of top slab unless noted otherwise.

5. Above water level (AWL): Water level shall be high water line as indicated on hydraulic profile.

END OF SECTION

SECTION 11930
FLOW METERS

PART 1 - GENERAL

1.01 DESCRIPITON OF WORK

A. The Contractor shall provide all flow indicating elements shown on the drawings or as required within a system to make that system operational.

1.02 SUBMITTALS

A. The Contractor shall submit manufacturer's data on flow indicators to Engineer prior to ordering. Provide information showing that the flow rate recommended by the equipment supplier falls within the range herein specified. Submittals shall be in accordance with Division 1 of the City of Gresham Public Works Standards.

PART 2 - PRODUCTS

2.01 EFFLUENT FLOW METER

A. The flow meter shall be an obstructionless electromagnetic flow meter with an accuracy of $\pm$ 1% of the flow rate. The operating range shall be 0.0 to 20 feet per second.

B. The flow meter shall have 150 lb flanged ends. It shall be microprocessor based, and shall indicate, totalize and transmit flow. The output shall be a 4 to 20 mA signal. The accuracy shall be plus or minus 1% of the rate. The liner material shall be hard rubber. The electrode material shall be 316 stainless steel.

C. The transmitter shall be remote mounted and housed in a NEMA 4X enclosure. It shall have a 6 digit totalizer (Gal x 100) and flow rate (Gal x 100) readout. It shall produce a 4-20 mA signal.

D. The flow meter shall be a Sparling, McCrometer or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All equipment shall be installed as per manufacturer's recommendations at locations that are shown on the drawings or as directed by the Engineer. Alignment and adjustments shall be verified after installation.

END OF SECTION

SECTION 15000
MECHANICAL, GENERAL

PART 1 - GENERAL

1.01 DESCRIPITON OF WORK

A. This section pertains to all mechanical equipment supplied in this contract.

1.02 SUBMITTALS

A. Complete layout drawings of all mechanical equipment shall be provided. Layout drawings shall consist of plan and section views of all areas containing mechanical equipment clearly showing pipe, fittings, valves, pipe hangers and supports, duct, and all mechanical equipment and related appurtenances actually submitted and approved. The mechanical drawings do not show complete details of building construction. The Contractor shall check actual conditions and shall refer to mechanical and electrical drawings. Rerouting of pipe and duct from that shown on construction drawings due to interference will be permitted only as reviewed by the Engineer on submitted shop drawings. Layout drawings shall be completely dimensioned. Drawings shall be reviewed by Engineer before the applicable portion of mechanical work is performed. Submit shop drawings in accordance with Division 1 of the City of Gresham Public Works Standards.

PART 2 - PRODUCTS

2.01 FLANGES AND PIPE THREADS

A. Unless otherwise noted, all flanges on equipment and appurtenances provided under this section shall conform in dimensions and drilling to ANSI B16.1, Class 125. All pipe threads shall conform in dimension and limits of size to ANSI B2.1, Taper Pipe Thread.

2.02 BEARINGS

A. Unless otherwise specified, all equipment bearings shall be oil or grease lubricated, ball or roller antifriction type of standard manufacture. Bearings shall be conservatively designed to withstand all stresses of the service specified. Each bearing, except when otherwise noted, shall be rated in accordance with the latest revisions of AFBMA Methods of Evaluating Load Ratings of Ball and Roller Bearings for one of the following classes of B-10 rating life: Class M1, 8,000 hours of operation; Class M2, 20,000 hours of operation; Class M3, 50,000 hours of operation; Class M4, 100,000 hours of operation. Bearings shall be not less than Class M3 unless otherwise noted.

1. All grease-lubricated bearings, except those specified to be factory lubricated for life, shall be fitted with easily accessible grease supply, flush, drain and relief fittings. Extension tubes shall be used when necessary. Grease supply fittings shall be the standard hydraulic type.

2. Oil lubricated bearings shall be equipped with either a pressure lubricating system or a separate oil reservoir type system. Each oil lubrication system shall be of sufficient size to safely absorb the heat energy normally generated in the bearing under a maximum ambient temperature of 40 degrees C and shall be equipped with a filler pipe and an external level gage.

3. During transportation bearings shall be suitably blocked or otherwise suitably protected to avoid work hardening or "Brinelling" damage from vibration. Bearings shall be separately packed if necessary to comply with this requirement.

2.03 ELECTRICAL DEVICES

A. All electrical motors, starters, controls and other devices furnished with mechanical systems shall be UL labeled or furnished with other certification satisfactory to the local administrative authority. In addition, electrical components shall comply with Division 16 of these specifications. See diagrams on electrical plans.

PART 3 - EXECUTION

3.01 SPARE PARTS STORAGE AND MARKING

A. All spare parts shall be wrapped in weatherproof material and packed in a painted wooden box with a hinged cover and hasp lock. The box shall be clearly labeled on the front and top as to its contents. No box shall weigh more than 150 pounds when full.

3.02 LUBRICANTS

A. The Contractor shall furnish all mechanical equipment with supply and relief lubricant fittings and with its proper supply of correct lubricant for starting, testing and adjustment. The Contractor shall provide the Engineer with 5 copies of a list showing the proper lubricants for each item of mechanical equipment.

1. Unless otherwise noted, all grease lubrication fittings shall be the standard hydraulic type.

2. For consistency throughout the facility all oil products shall be manufactured by the Standard Oil Company of California.

3.03 STORAGE

A. All equipment before and after delivery to the jobsite prior to its incorporation into the work shall be stored in a warm, dry, ventilated enclosure that shall afford complete protection against the elements and ensure that cleaned surfaces remain cleaned. All bearing capsules and housing shall be filled with fresh lubricant. All piping connections shall be plugged, blind flanged or capped to prevent the entrance of foreign objects and all space heaters in control panels shall be connected to a suitable power source.

END OF SECTION

SECTION 15030
MOTORS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work covered by this section shall include electrical motors.

1.02 REFERENCE STANDARDS

A. All motors shall be in accordance with National Electrical manufacturer's Association (NEMA) Standard MG latest revision insofar as they are applicable. Motors shall also comply with the applicable portions of the National Electric Code (NEC), latest revision, and should comply, insofar as possible, with all OSHA regulations, including Underwriters Laboratory, Inc. (UL) standards.

1.03 SUBMITTAL DATA

A. Submittals shall be in accordance with requirements of Division 1 of the City of Gresham Public Works Satndards and shall include complete nameplate data in accordance with NEMA standards MG1-10.37 or MG1-10.38, as applicable.

The following additional data shall be submitted for motors 1 hp or larger.

1. Motor outline, dimensions and weight.

2. Descriptive bulletins, including description of insulation system.

3. Motor performance data including:

   a. Full load current.

   b. Power factor at 100 percent, 75 percent, 50 percent load.

   c. Efficiency at 100 percent, 75 percent, 50 percent load.

   d. No load amperes.

1.04 WARRANTY

A. Motor components shall have a full three year performance warranty on inverter or sine wave power."

PART 2 - PRODUCTS

2.01 SERVICE CONDITIONS

A. All equipment shall be designed and built for industrial service and be capable of operating successfully under the following applicable conditions.

1. 40 degrees C maximum ambient temperature.

2. Voltage variations to ±10% of nameplate rating.

3. Frequency variations to ±5% of nameplate rating.

4. Combined voltage and frequency variations to ±10% total, as long as frequency does not exceed ±5%.

2.02 TYPE OF MOTORS

A. Provide squirrel-cage induction motors unless otherwise noted.

1. Provide motors especially suitable both electrically and mechanically to drive the loads specified. The speed, horsepower, torque, base, bearing, shaft, insulation, and enclosure shall be closely coordinated with equipment requirements specified herein and in other portions of this specification to provide a satisfactory, efficient drive without overloading, overheating, abnormal noise or vibration. The BHP required of the driven equipment under the most severe operating conditions for the equipment served shall not exceed the rated nameplate horsepower of the motor when operating at a service factor not to exceed 1.0. The "most severe operating conditions" shall include the full possible range of normal operating conditions but shall not include unusual conditions such as equipment failure.

2. Unless otherwise specified, all motors larger than 1/2-horsepower shall be 3-phase, squirrel-cage induction type, NEMA Design B, connected and rated for operation on a 480-volt, 60-Hz, alternating current system. Conductors shall be copper.

3. Unless otherwise specified, all motors 1/2 horsepower and smaller, shall be standard single-phase, capacitor-start, induction type, designed for operation on 115-volt, 60-Hz alternating current system. Conductors shall be copper.

2.03 APPLICATION TYPES

A. Motors will be identified as follows:

1. Type I: Process Motors

2. Type II: Nonprocess Motors

B. Each motor shall be of the type specified in the individual equipment specifications. The requirements for Type I and Type II motors shall be as specified elsewhere in this motor specification.

1. Unless otherwise noted, Type I or process motors are defined as motors driving sewage pumps, water pumps, air handling units, motors driving equipment located in below ground rooms, and motors exposed to the weather. A motor may also be a process motor designated in the equipment drive specification.

2. Unless otherwise noted, Type II or nonprocess motors are defined as motors driving fans located in above ground, small integral pump-motor or compressor-motor combinations specified for unit construction and fractional horsepower single-phase motors.

2.04 ELECTRICAL REQUIREMENTS FOR MOTORS

A. Energy efficiency: Type I motors shall be high efficiency motors equal to or better than General Electric's saver line of motors. All Type I 3-phase motors from 1.5 to 200 hp shall be energy efficient type. Energy efficient motors shall meet or exceed the published guaranteed minimum efficiency value and the tested efficiency shall be in accordance with IEEE Standard 112, test method B.

1. Type II motors shall be standard efficiency as defined by IEEE.

B. Service factor for 3-phase motors shall be 1.15. Service factor for single-phase motors shall be as specified in NEMA MG1-12.47. Motors not having service factors shall be sized such that they do not exceed 85% of full load amperage at any point on the operating curve of the driven device.

C. Time rating: Unless otherwise specified, all motors shall have continuous time ratings.

D. Torques: Motors shall meet, or exceed, the locked rotor (starting) and breakdown (maximum) torques specified in NEMA Standards for the NEMA design and rating specified.

E. Locked rotor starting kVA shall not exceed NEMA Code F for motors rated 20 hp and larger.

F. Protection: Current density and heating characteristics shall be such that the motors will not burn out if subjected to a maxima of a 20-second stall at 6 times full-load current.

G. Temperature rise: The allowable temperature rise as measured by resistance when operating at rated service factor load shall conform to the limiting observable temperatures in NEMA-MG1, latest revision for Class B insulation.

2.05 NAMEPLATES

A. Motor nameplates for Type I motors shall be stainless steel. Nameplates for Type II motors shall be of a noncorrosive metal that is not discolored by hydrogen sulfide. Nameplates shall be engraved or stamped and shall be fastened to the motor frame with screws or drive pins of the same material. Nameplates shall indicate clearly all the item of information enumerated in NEMA Standard MG1.

1. The Contractor shall coordinate the motor nameplate location so it is readily visible for inspection in the completed machine.

2. Mount nameplate for submersible motors inside starter door.

2.06 ELECTRICAL REQUIREMENTS FOR 3-PHASE MOTORS

A. Rating: Motors shall not be required to operate at greater than their nameplate horsepower. Use of the service factor will not be allowed.

B. Insulation: Unless otherwise specified, motors shall have Class B or F insulation, whichever is the manufacturer's standard, however limit temperature risk to Class B limits as specified above.

1. Class A insulating materials shall not be utilized except in single-phase fractional horsepower Type II motors for use in dry locations, with a standard reduction in rated temperature rise.

a. Nonhygroscopic: Where nonhygroscopic is specified, provide an insulation system which is nonhygroscopic.

b. Additional moisture protection: Where specified, provide additional moisture protection insulation to provide a minimum resistance of 1.0 megohm after 168 hours of exposure at 100% humidity.

c. Encapsulation: Where specified, provide insulation resin encapsulation by a molded or equivalent process in which the resin completely surrounds the conductors in the slots and end turns, leaving no voids between the conductors or adjacent stator steel.

C. Locked rotor limitations: All drive motors 20 horsepower and larger shall have a starting current in rush limited to 6 times the running full load current.

In the event this restriction is exceeded, the motor shall be replaced at no expense to the City.

D. Efficiency: Provide energy efficiency type motors for all horizontal motors and where possible, for vertical motors. Minimum efficiency shall be as follows for all efficient type motors.

Horsepower	Minimum Efficiency	Horsepower	Minimum Efficiency
1	80.0	30	91.0
1.5	81.0	40	91.5
2	81.0	50	91.5
3	83.5	60	91.0
5	85.0	75	92.0
7.5	86.0	100	93.0
10	87.5	125	93.0
15	89.5	150	93.0
20	90.0	200	94.0
25	91.0		

E. Motors used with Variable Frequency Drives (VFDs): In addition to the latest revisions of NEMA Standards MG, all motors used with VFDs shall include the following:

1. Motors shall be rated for inverter duty, compliant to NEMA MG1 Part 31.

2. Service Factor and Ambient - Standard motors shall be rated for a 1.15 service factor on sine wave power and 1.0 service factor on VFD power in a 40C ambient.

3. Temperature Rise - The temperature rise, by resistance, shall be 105 degrees C or less when measured at rated load on inverter power .

4. Insulation: Motors shall utilize inverter grade insulation system which shall consist of at a minimum Class F or better insulation materials with additional phase insulating material, extra end-turn bracing and Class H spike resistant wire. The resultant system shall withstand 2000 volt

transients without premature motor failure and have no cable limitations in motor application.

5. Conduit Box - shall be gasketed between the conduit box halves. A grounding provision shall be provided in the conduit box. The conduit box shall be oversize as compared to NEMA requirements and diagonally split and rotatable in 90 degree increments. The conduit box shall be field convertible to cast iron.

6. Nameplate - shall be of stainless steel and stamped per NEMA Standard MG1 Part 10 and Part 31. Nameplate information shall include as a minimum, the nominal efficiency value per NEMA Standard MG1 Part 12, the bearing identification numbers, power factor, Torque values with speed range and amps for that torque value. Nameplate also shall include Full Load Slip RPM, Magnetizing amps. The nameplate shall indicate that the motor is inverter duty rated. The nameplate shall include full load current for PWM inverter feed.

2.07 MECHANICAL REQUIREMENTS FOR 3-PHASE MOTORS

A. Frame sizes: frames shall conform to latest NEMA Standard MG1 for "T" frames, and all dimensions shall meet NEMA Standards insofar as they apply.

B. Enclosures for Type I motors, unless otherwise specified may be drip-proof or totally enclosed fan cooled. Enclosures for Type II motors shall be drip-proof unless otherwise specified.

1. Enclosures shall include, but not be limited to, the following environmentally protected types as defined in NEMA MG1.

a. Drip-proof.

b. Totally enclosed fan-cooled (TEFC).

c. Totally enclosed non-ventilated (TENV).

d. Drip-proof weather-protected

e. Submersible.

f. Explosion-proof.

2. Totally enclosed motors shall be provided with drilled and tapped holes to drain all cavities within the motor. motors with frames 286T or smaller shall have corrosion-resistant plugs in the drain holes. Motors with frame 324T or larger shall be provided with automatic breather-drain devices. TENV motors may be substituted for TEFC where recommended by the equipment manufacturer.

3. Explosion-proof motors shall be UL listed for Class I, Division I, Group D hazardous locations, and shall be provided with breather-drains listed for the hazardous location.

4. Submersible motors shall conform to the equipment specifications.

C. Shafts shall be in accordance with NEMA "T" or "TS" dimensions. Long shafts shall be suitable for belt, chain, or gear drive, within limits established by good industrial practice and documented by NEMA Standards MG-1-1-14.42 and MG1-14.07. Short shafts shall be used for direct connection.

D. Bearing and Lubrication: All bearings shall be antifriction-type AFBMA standard sizes. All motors up to and including 40 horsepower shall provide a minimum (B-10) bearing life of approximately 50,000 hours. All motors shall have thrust ratings not less than the combined static and dynamic loads to be imposed. The bearing housing shall be large enough to hold sufficient lubricant to minimize the need for frequent relubrication; but, facilities shall be provided for adding new grease and draining out old grease without major motor disassembly. The bearing housing shall have long, tight, running fits or rotating shields to protect against the entrance of foreign matter into the bearings, or leakage of grease out of bearing cavity.

1. Submit upon the Engineer's request, certification of bearing life on motors where application conditions suggest significant belt drive or thrust loads.

E. Balance and vibration

1. The vibration in any direction, as measured at the bearing housings, when tested in accordance with NEMA standard MG1, shall be within the limits established as follows:

Speed	Maximum Amplitude (inches)
3000 to 4000	0.001
1500 to 2999	0.0015
1000 to 1499	0.002
999 to below	0.0025

2. If balance weights are added to the rotor, they shall be permanently secured by welding, peening, or other approved methods.

F. Materials: Stator frames may be cast iron, or cast or extruded aluminum. End shields may be cast iron or cast aluminum. Conduit boxes on Type I motors shall be cast iron or cast aluminum. (See also Conduit Boxes, Paragraph G.)

G. Conduit boxes for Type I motors shall be split from top to bottom and shall be arranged for rotation so conduit can be brought in from top, bottom or either Side. Conduit boxes for Type I motors shall be tapped for threaded conduit connection. Conduit hole size shall conform to minimum "AA" dimension, NEMA standard MG1 depending on motor rating.

H. Lifting lugs: All motors, 213 frame and larger, shall have lifting eyebolts or lifting lugs.

I. Motor leads into conduit box shall have the same insulation class as the winding. Leads shall be marked throughout the entire length to provide identification after terminals are taped or clipped. Leads insulated with glass braid shall be furnished with a metal marker on the lead.

J. Shaft seals: All Type I motors shall have a rotating seal or slinger located on the shaft at the drive-end shield opening to protect the bearing cavity from moisture and other foreign material.

K. Connection diagram shall be permanently attached to the motor, either inside the conduit box or on the motor frame in a location readable from the conduit box side.

L. External finish: All motors shall be painted with a durable machine enamel, manufacturer's standard.

M. Hardware: All bolts, screws and other external hardware shall be treated for resistance to corrosion.

N. Sound levels shall be in accordance with NEMA Standard MG1.

O. Shop primer:

1. For interior motors: Modified alkyd; Tnemec 10-99, or equal.

2. For exterior motors: Inorganic zinc; Tnemec N9OE92, or equal.

2.08 ACCEPTABLE MOTORS

A. The following three-phase motors listed by type and enclosure are acceptable, provided they otherwise meet the requirements of this motor specification.

1. Type I - Process motors

a. Drip-proof: General Electric Type K Custom Polyseal; Westinghouse Life-Guard Life-Line "T" ; or equal.

b. TEFC - General Electric, Custom Severe Duty, Type K, Class F Insulation; Westinghouse MAC Standard Life-Line "T"; or equal.

c. Weather-Protected NEMA Type I - TEFC or Drip-Proof as specified above, with screens over ventilating openings on drip-proof motors.

d. Explosion-proof: General Electric, Type K-Custom, Westinghouse MAC Specific Purpose; or equal.

B. Type II - Non-process motors

1. Drip-proof - General Electric Custom Type K; Westinghouse Standard Life-Line "T"; or equal.

2. TEFC - General Electric custom Type K; Westinghouse Standard Life-Line "T"; or equal.

3. Explosion-proof: General Electric Type K Custom, Westinghouse Standard Life-Line "T"; or equal.

2.09 ELECTRICAL AND MECHANICAL REQUIREMENTS FOR SINGLE-PHASE MOTORS

A. Rating: Unless otherwise specified, single-phase motors shall not be required to deliver more than their rated nameplate horsepower under any condition of required loading.

B. Enclosures: Unless otherwise specified, single-phase motors shall be totally enclosed or TEFC. Small single-phase fan motors may have open-type enclosures if they are suitably protected from moisture, dripping water and lint build-up.

C. Insulation: Unless otherwise specified, single-phase motor insulation system shall be as recommended by the motor manufacturer.

D. Construction: Unless otherwise specified, single-phase motor construction shall be as recommended by the motor manufacturer.

E. Bearings: Unless otherwise specified, single-phase motors shall be provided with sealed ball bearings lubricated for minimum 10 years normal use.

F. Overload protection: All single-phase motors shall be self-protected unless specified "for separate protection," and the self-protection characteristics shall be indicated on the motor nameplate. Protection shall be manual or automatic

reset type as specified or required by safety considerations of the equipment served.

PART 3 - EXECUTION

3.01 TESTS

A. Insulation check: The City may test the insulation resistance of the motor at any time after delivery of the motor to the job site or at any time during the warranty period. Tests for acceptability will be made using a 1,000-volt megohm meter (megger). interpretations of test results for minimum acceptable values of insulation resistance will be made in accordance with IEEE No. 43. All deficiencies shall be corrected by the Contractor at no cost to the City.

B. Load testing: The City may test a motor at any time after delivery of the motor to the job site or at any time during the warranty period to determine its ability to operate at nameplate current or less, under all normal operating conditions. In the event that a motor does not meet the load test requirements, the Contractor shall replace the motor at no cost to the City.

C. Shop prime: All ferrous non-machined surfaces of motors shall be shop primed as follows:

1. Interior motors:

a. Surface preparation: SSPC-6 commercial sandblast.

b. Shop prime: DFT 2.0 to 3.5 mils.

2. Exterior motors:

a. Surface preparation: SSPC-5 white metal sandblast.

b. Shop prime: DFT 2.0 to 3.0 mils.

3.02 PREPARATION FOR SHIPMENT

A. Protective coating: Before shipment, the shaft extension and any other external bare exposed metal parts of each motor shall be coated with an easily removable rust preventive.

B. Packaging: All motors shall be packed in styrofoam or securely fastened to a skid or pallet for fork-truck handling and shall be covered for protection against dirt and moisture during transit and for outdoor storage.

END OF SECTION

SECTION 15060
PIPE AND PIPE FITTINGS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Work covered by this section shall include all labor, materials and equipment necessary to supply, install, and test pipe, fittings and related items in the wet well and valve chamber, and in the pump station, complete as specified herein and as indicated on the drawings. Special pipe, fittings, or installation require rents may be specified with the particular equipment involved.

B. Construction of gravity and pressure sewer pipes shall be performed in accordance with Section 02221.

1.02 RELATED SECTIONS

A. Section 02221 - Trenching, Backfilling and Compacting
B. Section 03300 – Cast-In-Place Concrete
C. Section 09900 - Painting
D. Section 15000 - Mechanical, General
E. Section 15075 - Hose and Nozzles
F. Section 15100 - Valves

1.03 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO).
B. American National Standards Institute (ANSI).
C. American Petroleum Institute (API).
D. American Public works Association (APWA).
E. American Society of Mechanical Engineers (ASME).
F. American Society for Testing and Materials (ASTM).
G. American Water works Association (AWWA).
H. American welding Society (AWS).
I. Federal Specification (FS).
J. Manufacturer's Standardizations Society of the Valve and Fittings Industry (MSS).

1.04 GENERAL

A. Contract drawings: The contract drawings indicate the general arrangement and location of equipment, pipe, fixtures, outlets, and the like. It is desired that the indicated positions be followed as closely as possible. The exact location of the various items is subject to structure construction, and the actual equipment furnished by the Contractor. The Contractor shall verify the location of all items furnished, installed, or connected to by him.

1. The drawings are not to be scaled. All implied locations shall be determined at the building site after field measurements have been taken.

2. Should interferences or discrepancies prevent the installation of any part of the work, the Engineer shall be notified and he will determine the steps necessary to complete the true development of the intent of the drawings and specifications.

B. Materials

1. General

a. Unless otherwise specified or shown, pipe, fittings and general purpose valves for each piping system shall be as specified in Paragraph 2.04, Piping Specification Sheets. The Piping Specification Sheets are a summary of the materials and appurtenances to be used for each system; whereas the detailed requirements for each type of pipe are given in Paragraph 2.02.

b. Pipe thickness classes are given in Paragraph 2.02, Pipe and Fittings, and Paragraph 2.04, Piping Specification Sheets. If there are any conflicts in the specifications, use the stronger pipe class. Contractor shall submit calculations with shop drawings where specified.

2. Piping Systems

a. Piping designation: Piping is designated by a 2-part code consisting of:

1) Pipe diameter in inches.

2) An abbreviation indicating the service.

For example, the designation 8"PL shall mean an 8-inch-diameter pressure line. Refer to the Piping System table herein for the services, operating pressures, temperatures, and testing informationtion as specified. Piping and fitting materials are listed in the piping specification sheets.

Piping service abbreviations:

CSP	Concrete Sewer Pipe
FM	Force Main
SPD	Pressure Line

b. Piping below process water surfaces: See Section 09900 for Paint System S-4-B.

1.05 SUBMITTALS

A. Shop drawings and product data shall be submitted in accordance with the requirements of Division 1 of the City of Gresham Public Works Standards. For all piping systems, including valves, flanges, rigid and flexible couplings, unions, expansion joints, fittings, tanks, equipment, and other items showing insulation and jacketing, materials, dimensions, and method of construction.

PART 2 - PRODUCTS

2.01 COUPLINGS

A. Flanges, gaskets and bolts: Cast-iron flanges shall conform to ANSI B16.1, Class D. Steel flanges may be bolted to cast-iron valves, fittings, or other parts having either integral Class 125 companion flanges or screwed Class 125 companion flanges. When such construction is used, the raised face on mating flanges shall be removed. Flanges shall be flat faced unless otherwise noted. Flange gaskets shall be full-face type, asbestos composition, synthetic rubber or other material, suitable for the intended service. Substitution of other gasket materials shall be only with the express written consent of the Engineer or as noted herein. Gasket thickness shall be 1/16 inch for pipe 10 inches and less and 1/8 inch for larger pipe. Flange assembly bolts shall be heavy pattern hexagon head carbon steel machine bolts with heavy pattern, hot pressed, hexagon nuts, all ANSI B18. 2. Threads shall comply with ANSI B1.1, coarse threads series, Class 2 fit. Bolt length shall be such that after joints are made up, the bolt shall protrude through the nut at least 2 threads, but not more than 1/2 inch. Bolts and nuts for use in submerged service shall be stainless steel. All screwed flanges on cast-iron pipe shall be refaced after fabrication to ensure that pipe ends are flush with face of flange.

   1. Forged steel flanges, where required, shall be raised face, welding neck, conforming to ASTM A 181 Grade I and ANSI B16. 5. Forged steel flange gaskets shall match raised faces and shall be asbestos composition. On 3 ½-inch forged steel flanges and smaller, gaskets shall be 1/16 inch thick. On 4-inch flanges and larger, gaskets shall be 1/8 inch thick. Forged steel flange assembly bolts shall be alloy steel studs, ASTM A 193 with 2 F.S. hexagon nuts ASTM A 194 per stud.

   2. For low-pressure service, 20 psig and under, Class B lightweight flanges conforming to AWWA C 207 may be used.

B. Pipe threads: Unless otherwise noted, all pipe threads shall conform in dimension and limits of size to ANSI B2.1 Class 2 NPT, taper pipe thread.

C. Mechanical pipe couplings

1. Flexible pipe couplings: Where flexible pipe couplings are shown or specified for use with plain end steel or ductile-iron pipe, Dresser Style 38, Rockwell Type 411 or 431, or equal, shall be used. Couplings used for pipe under pressure where not otherwise secured or anchored against expansion shall be equipped to take tension by means of joint harnesses with shackle rods meeting the requirements of AWWA Manual M1l, Section 19.8. Use of locking pins in drilled holes is not acceptable. Restraint components shall be hot-dip galvanized.

2. Couplings for connecting steel pipe to ductile-iron pipe, or ductile iron to PVC shall be Rockwell Type 413, Dresser Style 62, or equal. Insulating couplings shall be Rockwell Type 416, Dresser Style 39, or equal.

3. Flanged coupling adapters shall be used where valves and piping are secured against expansion with shackle rods or other means, they shall be Dresser Style 128, Rockwell Type 913, or equal, for plain end pipe.

4. All coupling gaskets shall be a synthetic rubber suitable for exposure to water containing grease or petroleum products and shall be as recommended by the coupling manufacturer for the service intended. Mechanical pipe couplings and flexible pipe couplings shall be provided where required by good piping practice and as necessary for disassembly.

D. Modular mechanical expanding rubber seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide an absolutely watertight seal between the pipe and wall opening. The seal shall be constructed so as to provide electrical insulation between the pipe and wall opening. The seal shall be constructed so as to provide electrical insulation between the pipe and wall, thus reducing chances of cathodic reaction between these 2 members.

1. Contractor shall determine the required inside diameter of each individual wall opening or sleeve before ordering, fabricating, or installing. The inside diameter of each wall opening shall be sized as recommended by the manufacturer to fit the pipe.

E. Unions 1 ½-inch and smaller: Ground joint, malleable type; 2 inches and larger, flange type 250-pound pattern. Grinnel, Crane, Walworth, or equal.

F. Dielectric unions shall meet the dimensional requirements and tensile strength of pipe unions in accordance with Fed. Spec. WW-U-531. The unions or flanges shall be suitable for the required operating pressures and

temperature conditions. The unions shall have metal connections on both ends of union. The ends of the unions shall be threaded or soldered to match adjacent piping. The metal parts of the union or flange shall be separated to prevent current flow between the dissimilar metals.

2.02 PIPE AND FITTINGS

A. Steel pipe shall meet the requirements of ASTM A 53, A 120, or API 5L shall be standard weight except as otherwise specified on the Piping Specification Sheets or herein. Steel pipe specified to meet the requirements of AWWA C 200 shall be designed to the maximum internal pressure given on the Piping System Table or 50 psig, whichever is greater.

B. Ductile-iron pipe and fittings: All ductile-iron pipe shall conform to the current provisions of ANSI A21.51. Ductile-iron pipe shall be standard thickness Class No. 53 minimum.

C. Cast-iron soil pipe and fittings shall be service weight and conform to ASTM A 74. Joints for hub and spigot pipe shall be ASTM C 564 rubber gasket.

D. Copper piping and tubing shall be drawn and shall meet the requirements of ASTM B 88. Type L soft temper shall be used for exposed areas and Type K hard temper for buried services. Brass compression type fittings shall conform to ANSI E16. 26 and ASTM E 62, Swagelok, Gyrolok, Parker CPL, or equal. Wrought copper or bronze pressure type solder joints fittings shall meet the requirements of ANSI B16.22 and ASTM E 75.

2.03 PIPING SYSTEM TABLE

A. The following table lists the piping specification applicable to the various piping systems, the working pressure and temperature, and the pressure-testing data. Refer to Paragraphs 2.01,2.02, 3.01, and 3.02 for detailed specifications. In case of conflict, the more stringent specifications shall apply.

PIPING SYSTEM TABLE

Designation	Pipe Spec	Working Pressure (psig)	Working Temp. (Deq. F)	Test Medium	Pressure Test Pressure (psig)	Duration (Minutes)
OVERFLOW	CSP	G	70	H2O	See 1.	60
FORCE MAIN	FM	--	70	H2O	3 x working[2]	120
WATER[3]	SPD	90	70	H2O	150	60

1. Gravity lines should be tested at maximum water level plus 6 feet.
2. Working Pressure is Defined as the Average Pressure Immediately Upstream of the Isolation Valves in the Valve Vault.
3. Insulate Exposed Piping System

B. All buried nonmetallic piping is to have detectable Tracer tape located above the pipe.

2.04 PIPING SPECIFICATION SHEETS

A. The following piping specification sheets set forth the requirements for pipe, fittings, and general-purpose valves for piping systems. Refer to Paragraph 2.02 for detailed specifications and to Paragraph 3.01 for construction. Where the Piping Specification Sheets callout trade nameS or specification, with or without the number, or additional features, they shall be additional to the detailed specifications in Paragraph 2.02. In case of conflict, the more stringent specifications shall govern.

SYSTEM CSP

PIPE

Exposed,	None.
Buried, Embedded, Encased:	Reinforced concrete sewer pipe; ASTM C76, class as designated or ASTM C 655, minimum O-load as designated. Gaskets and joints per ASTM C 443.

FITTINGS

Exposed:	None.
Buried, Embedded, Encased:	Same as pipe.

VALVES

None.

SYSTEM FM

PIPE

Exposed, Buried: 14 inches and smaller ductile-iron ANSI A21.51, flanged, cement mortar lined.

FITTINGS

Exposed, Buried: 14 inches and smaller ductile- or cast-iron ANSI A21.10; ductile-iron, push-on, flexible restrained; cement mortar lined.

VALVES

Exposed: All sizes; isolating and control - non-lubricated eccentric plug, semi-steel; throttling. Same as isolating; check - clear way swing, cast iron.

Buried: All sizes, same as exposed, except with extension stem and valve box.

SYSTEM SPD-1

PIPE

Exposed:	3-inch and smaller; steel, ASTM A 120, Schedule 40, galvanized .
Buried, Embedded, Encased:	3-inch and smaller polyethylene SDR 7.

FITTINGS

Exposed:	3-inch and smaller; ISO-pound galvanized malleable iron, ANSI B16.3, screwed and banded.
Buried, Embedded, Encased:	3-inch and smaller; compatible with polyethylene pipe using stainless-steel straps and stainless-steel flared liners.

VALVES

Exposed:	3-inch and smaller; Isolating - Eccentric plug or ball or gate as shown on the drawings; Throttling - same as Isolating; Check - Swing.
Buried:	3-inch and smaller; Isolating - Ball, PVC or gate, as shown on the drawings, with extension stem and valve box.

REMARKS

For valve specification, see Section 15100.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: The types and sizes of pipes to be used shall be as specified and shown. Where size or location of small pipe are omitted from the drawings and not mentioned in the specifications, the sizes to be used shall correspond to the latest edition of the Uniform Plumbing Code requirements. In any event, undesignated pipe shall be proper for the functions to be performed and as accepted by the Engineer. Installation shall be in accordance with the manufacturer's written manual.

1. All pipe shall be carefully placed and supported at the proper lines and grades, and where possible shall be sloped to permit complete drainage. Piping runs shown on the drawings shall be followed as closely as possible, except for minor adjustments to avoid equipment, architectural, and structural features. If major relocations are required, they shall be acceptable to the Engineer.

2. In erecting the pipe a sufficient number of screw unions, flanged or grooved end type joints shall be used to allow any section or run of pipe to be disconnected without taking down adjacent runs. Flanged and mechanical pipe coupling joints shall be employed on pipelines 3 inches in diameter and larger. The provision of an adequate number of appropriate take-down fittings must be rigidly adhered to whether or not such fittings are indicated on the drawings. Take-down fittings shall also be provided for removal of valves and other appurtenances. Where piping passes through concrete or masonry walls, take-down fittings shall be employed as near the wall as possible. Dielectric unions shall be used at all locations to join pipe or equipment of dissimilar metals. Eccentric reducers shall be used to keep the top of piping at pump suctions level.

3. Unless otherwise specified, all pipes passing from concrete or steel to earth shall be provided with a bell-and- spigot or flexible couplings as specified herein. Wherever a polyvinyl chloride pipe passes from concrete to earth, a horizontal "U" bend shall be installed as a flexible coupling. For PVC pipes 3 inches in diameter and smaller, the leg perpendicular to the run shall be at least 4 feet long, and the leg parallel to the run shall be at least 1 foot long. For PVC pipes 4 inches in diameter and larger, the leg perpendicular to the run shall be at least 6 feet long, and the leg parallel to the run shall be at least 2 feet long. Wherever a metallic pipe 1 inch in diameter or larger passes from concrete to earth horizontally, 2 flexible pipe couplings spaced from 2 feet to 4 feet apart depending on pipe size shall be installed, whether shown or not. Only one flexible pipe coupling is required on vertical runs from the structure. One coupling shall be within 1 foot of the

structure. Particular care shall be taken to ensure a full support of the pipe in the earth between and beyond the joints.

4. All eccentric plug valves installed with seat upstream (unseating head).

5. All pressure taps on the suction and discharge sides of all the pumps, shall be provided with ball valves unless otherwise shown.

6. Unless otherwise specified, the suction and discharge of all pumps, blowers, and fans shall be provided with flexible couplings suitable for the intended service.

7. All drain holes from equipment platforms, and the like, that require drains, shall be piped to the nearest sump, floor drain or floor trench.

B. Pipe supports

1. Supports for exposed piping shall conform to the latest requirements of the ANSI Code for Pressure Piping B31.10 and MSS Standard Practice SP-58, except as supplemented or modified by the requirements of this specification.

   a. Designs generally accepted as exemplifying good engineering practice, using stock or production parts, shall be utilized wherever possible.

2. Spacing of clamps for support of vertical piping shall be close enough to keep the pipe in alignment as well as to support the weight of the piping and contents, but in no case shall be more than 10 feet.

3. Clevis or band-type hangers. Grinnel 260 or 269, Elcen, or equal, shall be provided. Strap hangers not permitted.

4. Provide floor stands, wall bracing, concrete piers, etc., for all lines running near the floors or near walls and which can be properly supported or suspended by the walls or floors. Hanging of any pipe from another is prohibited.

5. Equipment shall be so positioned and aligned that no strain shall be induced within the equivalent during or subsequent to the installation of pipe work.

6. When temporary supports are used, they shall be sufficiently rigid to prevent any shifting or distortion of the piping or related work.

7. Flexible couplings shall be installed where shown on the drawings and at such other points as nay be required for ease of installation or removal of the pipe, subject to approval of the Engineer. Flexible

couplings shall be of the restrained type where necessary to prevent separation of pipe due to internal pressure.

8. All pipe supports, hangers, racks, and anchors shall be hot-dip galvanized and shall be painted to fletch the pipe.

C. Installation at concrete walls and footings

1. Whenever a pipe line of any material terminates at, or extends through, a structural wall or sump' the Contractor shall install in advance of pouring of concrete the fittings or special casting required for the particular installation.

2. Unless otherwise shown on the drawings, pipe other than ductile iron, steel, PVC, and concrete shall not be cast in concrete or masonry walls.

3. Pipe other than concrete to be cast in water-bearing walls or more than 4 feet below grade shall have water-stop rings. Water stop rings shall be cast integrally with pipe or fabricated. If fabricated, they shall be at least 6 inches larger diameter than pipe, 1/4-inch thick, and continuous welded all around on both sides.

D. Piping through walls and slabs: Unless otherwise indicated, pipes passing through walls and slabs shall be installed in accordance with the standard details shown on the drawings. Care shall be taken to ensure no contact between embedded sleeves or pipes and reinforcing steel. Pipe must be isolated from reinforcing steel.

E. Pipe cutting: The Contractor shall perform all work of cutting pipe and fittings or special castings necessary to the proper and accurate assembly, erection, and completion of the work. All pipe shall be cut to fit accurately with smooth edges and faces.

F. Pipe threads: Pipe ends shall be reamed to the full bore of the pipe. Threads shall conform in dimension and limits of size to ANSI B2.1, tapered pipe thread. In making up threaded joints, an accepted thread lubricant shall be applied to the male threads only.

G. Flanged joints shall be made up square with even pressure upon the gaskets and shall be watertight.

H. Solder joints: Solder to be used in copper piping shall be 50% lead and 50% tin, and shall conform to alloy SOB of ASTM B 32. All pipe and fittings to be joined with solder shall be free from all burrs and wire brushed or steel wool cleaned. After cleaning, a paste flux shall be evenly and sparingly applied to the surfaces to be joined. Solder shall then be applied and flame passed toward the center of the fitting until the solder disappears. All excess solder shall be removed while it is still plastic. Absolutely no acid flux or acid wipe shall be use in making solder joints.

3.02 PIPELINE TESTING

A. General: All piping shall be subject to acceptance tests. The Contractor shall provide all necessary utilities, labor, and facilities for testing and shall dispose of all waste, including water.

1. All piping including valves, fittings, and the like, shall be pressure tested prior to backfill or connection to equipment such as pumps. Test all pipe penetrations with clean water in wet wells.

2. All exposed pipe shall be pressure tested and flushed in accordance with these specifications before they are painted. Furthermore, no concrete or concrete slabs shall be poured over or around any piping (except wall penetrations) until the pipe has been tested for acceptance. If a piping system (or portion thereof) fails to meet an acceptance test, repairs shall be made at the Contractor's expense. The repair method used shall be subject to the Engineer's approval and the unacceptable portion shall be retested until it meets these testing specifications.

B. Pressure pipelines

1. General: Test pressures, testing media, and test duration shall be as specified in Piping System Table. Care should be exercised to isolate equipment that is not rated for the specified test pressure to avoid damage to the equipment. Systems operating at less than 15 psi will be subject to 24 hours of leak proof operation as an additional requirement to pressure tests. All joints which will later be encased in concrete or insulated, whether buried or not, shall be tested prior to encasement. Pipe with leakage greater than allowed herein shall be repaired at the Contractor's expense.

Allowable leakage:
Leakage shall be no greater than determined by the following formula:

$$L = \frac{ND\ SQRT(P)}{7400}$$

in which L is the allowable leakage in gallons per hour; N is the number of joints in the length of pipeline being tested; D is the nominal diameter of the pipe in inches; and P is the average test pressure during the leakage test, in pounds per square inch gage.

3.03 PAINTNG

A. All pipe, fittings, and appurtenances specified herein shall be painted in accordance with Section 09900. All pipes to be painted will be sandblasted and primed with the specified primer, or approved equal, prior to installation.

END OF SECTION

SECTION 15075
HOSE AND NOZZLES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Work covered by this section shall include all labor, materials and equipment required to furnish and install all hoses, nozzles, spray nozzles, specialties and other appurtenances as shown on the drawings and as specified.

1.02 RELATED SECTIONS

A. Section 15060 - Pipe and Pipe Fittings.
B. Section 15100 - Valves.

1.03 MANUFACTURER

A. The materials specified shall be furnished by experienced manufacturers, qualified and reputable in the manufacture of such equipment. All equipment specified shall be designed, constructed and tested in accordance with the best practices and methods.

1.04 SUBMITTALS

A. The Contractor shall submit to the Engineer shop drawings to indicate the general arrangement and location of the equipment and fixtures in accordance with Division 1 of the City of Gresham Public Works Standards..

PART 2 - PRODUCTS

2.01 HOSES

A. One 25-foot hose shall be furnished for each pump station. Hose racks shall be as detailed on drawings.

1. Water hose, one and one-half (1-1/2) inch, U.S. Rainbow Water Hose P-340, B. F. Goodrich General Service Black 150 W. P., or equal. Couplings shall match the hose nozzle and hose bibs.

2.02 NOZZLES

A. Hose nozzles for the above specified water hoses shall be Allenco No. 97, plain tip with American National Threads, handle operated ball valve, Jarresbury, Worcester, Dixon quick- couplings and brass adaptors, all of which shall form one single unit.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The equipment specified herein shall be installed in strict compliance with the manufacturer's recommendations.

END OF SECTION

SECTION 15100
VALVES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Work covered by this section consists of furnishing all labor, material and equipment required to install and test all valves as shown on the drawings and as specified.

1.02 RELATED SECTIONS

A. Section 02221 - Trenching, Backfilling and Compacting
B. Section 03300 – Cast-In-Place Concrete
C. Section 09900 - Painting
D. Section 15030 - Motors
E. Section 15060 - Pipe and Pipe Fittings
F. Section 15140 – Pumps
G. Section 16900 - Motors and Controls

1.03 REFERENCE STANDARDS

A. American National Standards Institute (ANSI:)

1. ANSI B16.5 - Steel pipe flanges, flanged valves and fittings.

B. American Society for Testing and Materials (ASTM)

1. ASTM A 126 - Standard Specification for Gray Iron Castings for valves, Flanges, and Pipe Fittings. 15100-1

2. ASTM B 62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

3. ASTM B 139 - Standard Specification for Phosphor Bronze Rod, Bar, and Shapes.

4. ASTM B 584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

5. ASTM D 2000 - Classification System for Rubber Products in Automotive Applications.

D. Military Specification (MIL)

E. Structural Steel Painting Council (SSPC)

1.04 GENERAL

A. Valves shall be as specified in Section 15060, Paragraph 2.04, Piping Specification Sheets, and/or as specified herein. Valves noted on the drawings or in other parts of the specifications as different than specified in Piping Specification Sheets shall meet the requirements herein. All valves shall be designed for the intended service.

1. Unless otherwise specified as shown on the drawings, all 2 ½-inch or larger buried valves shall have nonflanged ends, all 2 ½-inch or larger exposed valves shall have flanged ends, and all 2-inch or smaller valves shall have threaded ends. Flanges shall conform to ANSI B16.5. Wafer style valves, where allowed, shall be designed for installation between ANSI ISO-pound flanges.

2. A union or flanged connection shall be provided within 2 feet of each threaded end valve unless the valve can be otherwise easily removed from the piping.

1.05 SUBMITTALS

A. Submit product data in accordance with Division 1 of the City of Gresham Public Works Standards. Where additional, more detailed submittals are necessary, those requirements are included in this section.

B. Shop drawings shall be provided for each type of valve used on the project.

PART 2 - PRODUCTS

2.01 VALVE OPERATORS

A. General: All valves noted in Section 15060, Piping Specification Sheets, shall be provided with manual operators unless otherwise noted. Unless otherwise indicated, the direction of rotation of the wheel, wrench nut, or lever to open the valve shall be to the right (clockwise). Each valve body or operator shall have cast thereon the word "OPEN" and an arrow indicating the direction to open. Remote controlled valves and hand-operated valves requiring remote position indicators shall have built-in limit switches.

B. Manual operators: All manual operators shall, unless otherwise specified, be equipped with a geared operating wheel. Valves less than 2 inches may use lever operators.

2.02 VALVES

A. Gate valves 2-1/2 inches and smaller shall be 200-pound WOG, bronze body conforming to ASTM B 62, solid wedge disc non-rising stem and capable of being repacked under pressure when the valve is fully open.

Other gate valves shall be in accordance with AWWA C 500 and as follows. Valves 6 inches and smaller installed in vertical lines shall be solid wedge. Except where solid wedge gates are specified, all gate valves 3 inches and larger shall be double disc. All exposed gate valves shall be rising stem, OS&Y. Buried gate valves shall be nonrising stem type.

B. Eccentric plug valves shall be 150 psi rated, have ductile-iron or semi-steel bodies, synthetic rubber-coated semi-steel eccentric plugs with circular port which shall be completely out of the flow stream when fully open, and shall be drip tight shutoff with pressure in either direction. Valves 6 inches and smaller shall be lever operated. Larger valves shall have totally enclosed worm gear operators with handwheel, operating nut, or chainwheel as required. Operating' nut shall be 2-inch square, AWWA nut. Handwheels shall be not smaller than 6 inches nor larger than 18 inches. Ball-centric or eccentric plug valves shall be as manufactured by DeZurik, Homestead, or equal.

C. Ball valves for water service 2 inches and smaller shall be Walworth 580, Salisbury 350, W-K-M 310, or equal, and 2-1/2 inches and larger shall be Jarresbury D150F-21, Walworth C4100F, W-K-M 310, or equal.

D. Globe and angle valves shall be iron body, brass-trimmed valves with corrosion resisting metal discs and screwed-in renewable seat rings. Valves shall permit repacking under pressure when wide open.

E. Check valves 2 inches and larger, unless otherwise noted, shall be iron body, brass trimmed, 150-psi working pressure, swing type, balanced, external spring loaded, with a clear opening equal to or greater than the connecting piping and shall be Eddy-Iowa List 114 or 115, Dresser 60SL, or equal. The spring and lever shall be extra heavy with stainless-steel shaft and keys.

1. Furnish with external adjustable spring. The valve shall be suitable for installation in the force main piping shown.

2. Supply check valves in force main piping with mounted position switch of type specified in Section 16900.

F. Hose valves, flushing cocks, and quick disconnects: Flushing cocks shall consist of a DeZurik 101S, Homestead, or equal. Viton-faced eccentric plug valve fitted with a male, bronze, quick coupling Dixon, Air King, Lehi, or equal.

1. Quick disconnect couplings for utility station water service and other services where shown shall be male, bronze, quick coupling, Dixon, Air King, Lehi, or equal, and shall be 1-inch or ½ -inch in diameter unless noted otherwise.

2. Unless specified otherwise, all hose valves, flushing cocks, and quick disconnects shall be compatible with the hoses supplied under this contract.

G. Sewage air and vacuum valves shall have cast. iron body, caver and baffle; stainless steel float, float stem; bronze float guide and Buna-N seat. Air and vacuum valves shall be APCO 400 series with short body, with back flushing attachment, or experienced on most installations.

2.03 BACK FLOW PREVENTER

A. Back flow preventer: Reduced pressure principle, bronze body and working parts, stainless-steel springs, minimum 125-psi working pressure. Furnish with gate valves fitted with test cock and fittings. Beeco Model FRP-II.

2.04 FLOOR DRAINS

A. Floor drains shall be J.R. Smith, Figure 2220, Josam 34220 Series, or equal, with cast-iron body and grate, flashing collar, removable sediment bucket, cast-iron P-trap, and outlet same size as the connecting line.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All valves shall be installed in accordance with the manufacturer's recommendations, drawings, and/or specifications. Alignment and adjustments shall be verified after installation.

1. Valves: Prior to valve installation, Contractor shall clean and touch up all surfaces previously primed: make visual check of operating parts for proper and satisfactory operation, and clean and remove all foreign matter from the valve.

   All valves shall be installed in strict accordance with the manufacturer's instructions and as shown on the drawings. Buried valves shall have all operators or valve boxes installed so that tee wrenches or operators perform freely and without binding or other interference. Buried valves shall be bedded and backfilled according to the requirements of the pipe to which they are attached. Concrete supports for operators, where required, shall be as shown on the drawings.

2. Operators: Manual valve operators shall be installed so that they do not extend into passageways in either position.

3. Plug valves: For sewage service the valve shall be installed so that the flat portion faces upstream thus preventing buildup of sludge or other particles inside the valve.

4. Gage shutoff: A shutoff cock shall be provided at each pressure gage.

B. Backflow preventer to be installed in accordance with City of Gresham requirements.

3.02 PAINTING

A. All equipment shall be painted in accordance with Section 09900. All ferrous metal parts in contact with concrete shall be coated with one coat of bituminous paint.

3.03 TESTING

A. The Contractor shall furnish all equipment, material and labor to perform the tests, as specified in Paragraph 3.02, Section 15060, for each piece of equipment. Any defects that become evident during the tests shall be corrected by the Contractor at his own expense and the test rerun. The Contractor shall notify the Engineer at least 5 days prior to performing any tests.

1. Valves shall be tested and proven satisfactory with the pipeline they are attached to and at the pipeline pressure specified in the respective pipe sections herein. In addition to the pressure test, all valves shall be given an operational test by completely opening and closing the valve satisfactorily a minimum of 4 cycles against the maximum differential of pipeline test pressure required on one side and 0 pressure on the other side of the disc.

2. Operators shall be adjusted and tested by operating through complete cycles of opening, closing, and opening. , Valves shall be adjusted so that they operate freely and leakage around the periphery shall be held to a minimum amount consistent with the intended use.

END OF SECTION

SECTION 15140
PUMPS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Work covered by this section consists of providing, installing and testing of pumps, controls, and appurtenances.

1.02 GENERAL

A. The manufacturers shall be of established good reputation regularly engaged in the fabrication of such equipment. Unless otherwise noted, equipment offered shall be current modifications which have been in successful regular operation under comparable conditions.

B. Each type and style of pump shall be by one manufacturer only. Manufacturer shall have a parts warehousing facility and persons qualified in problem troubleshooting and repair of pumps permanently located within Oregon for the past five years and be located within a 150 mile radius of Gresham Oregon.

1.03 SUBMITTALS

A. For for submittal of shop drawings, See Division 1 of the City of Gresham Public Works Standards, Submittals; and for the furnishing of operation and maintenance manuals, see Section 01730, Operating and Maintenance Data. Where additional, more-detailed submittals are necessary; those requirements are included in this Section.

B. Shop drawings: Submit shop drawings of pumps for approval. Shop drawings shall include the following features:

1. Manufacturer's specification data and descriptive literature.

2. Performance curves showing capacity of gpm, NPSH, head, and pump horsepower.

3. Motor efficiencies and power factors at design operating points.

4. Provide the submittal data on motors as required in Section 15030.

5. Drawings showing general dimension, confirming the size of the pump, openings, connections, construction details of the equipment, wiring diagrams, piping drawings, and weights of major components.

6. Procedures for proper installation.

7. Manufacturer's guarantee.

8. Information about the nature and location of parts, service crews, and repair facilities.

C. Shop drawing submittals shall be complete in one submittal. Individual manufacturer's submittals for portions of the pump unit will not be approved.

1.04 GUARANTEE

A. The Contractor warrants that all equipment supplied by him and delivered hereunder will be free of defects in material and workmanship for a period of 12 months from the date of final acceptance of the equipment in operation, or 24 months from the date of receipt at the job site, whichever shall first occur. During this warranty period, the Contractor is responsible for all parts and labor required for all repairs--mechanical, electrical and structural.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver pumping equipment to the jobsite at the appropriate time for installation. Equipment items shall be crated or affixed to pallets with protective wrappings. Exercise care to prevent damage from handling.

B. Store mechanical and electrical components off the ground in weathertight enclosures. Keep equipment dry.

PART 2 - PRODUCTS

2.01 PUMPING SYSTEM COMPONENTS

A. General requirements for each type of pump and other components are provided hereafter. Specific requirements for each pump or pumping system are detailed separately under the specific pump types.

B. Motor shall comply with requirements of Section 15030 and shall be Type I unless otherwise specified. Couplings shall be recommended by the pump manufacturer, unless otherwise specified, and as approved by the motor manufacturer and the Engineer.

C. The pump, motor and accessories specified herein and in Section 16900 shall be furnished through the pump supplier to obtain mechanical integration with the pump.

D. Pump control: When any motor starter is energized, all auxiliaries of the pumping unit shall also be energized.

E. Cutout and alarm circuits shall be fail-safe and the cutout circuit shall be maintained until manually reset. The cutout and alarm circuits shall be automatically reset upon resumption of power after a control power outage.

2.03 PUMP GENERAL CONSTRUCTION

A. Pumps shall be constructed in accordance with the following specification.

B. Casing connections: Suction and discharge connections shall be ANSI 125-pound flat-face flanges. All flange bolt holes shall be slotted for ease of assembly and disassembly. Each suction and discharge flange shall be drilled and tapped for gate connections. A 1/2-inch IPS tap shall be supplied in the suction nozzle, and a 1/2-inch IPS tap in the discharge nozzle.

C. Data plates: All data plates shall be of stainless steel suitably attached to the pump. Data plates shall contain the manufacturer's make, pump size and type, serial number, speed, impeller diameter, capacity and head rating, and other pertinent data.

a. A special data plate shall be attached to the pump frame which shall contain identification of frame and bearing numbers.

b. Location of all data plates shall be easily visible in the completed installation. Contractor shall coordinate location of data plates with equipment suppliers.

D. Hardware: All machine bolts, nuts, and capscrews shall be of the hex head type. Hardware or parts requiring special tools or wrenchs shall not be used.

2.04 SUBMERSIBLE PUMPS

A. Furnish and install a total of two (2) totally submersible electrically operated sewage pumps. Pumps shall be Flygt, or equal. Motors shall be 460 V, 3 Phase, 60 Hz.

B. Operating Conditions

1. The pumps and motors shall be sized to meet the following condition..:

Flow (gpm) Head (ft) BHP RPM Minimum Efficiency (%)	

C. Pump Design: The pump(s) shall be automatically and firmly connected to the discharge connection, guided by no less than two guide bars extending from the top of the wet well to the discharge connection. There shall be no need for personnel to enter the wet well where the pumps are located. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be acceptable. No portion of the pumps shall bear directly on the sump floor.

D. Pump Construction:

1. Major pump components shall be of gray cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts or bolts shall be AISI type 304 stainless steel or brass construction. All metal surfaces coming into contact with the pumpage, other than stainless steel or brass, shall be protected by a factory applied spray coating of alkyd primer with a chlorinated rubber paint finish on the exterior of the pump.

2. Sealing design shall incorporate metal to metal contact between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Fitting will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.

3. Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing components, elliptical O-rings, grease or other devices shall be used.

E. Cooling System: Motors are sufficiently cooled by the surrounding environment or pumped media. A water jacket is not required.

F. Cable Entry Seal: The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of a single cylindrical elastomer grommet,

flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be separated by a stator lead sealing gland or terminal board, which shall isolate the interior from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

G. Motor:

1. The pump motor shall be induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber, NEMA B type. The stator windings and stator leads shall be insulated with moisture resistant Class H insulation rated for 356^{o} F (180^{o} C). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The stator shall be heated shrink fitting to the cast iron stator housing. The use of multi step dip and bake-type stator insulation process is not acceptable. The use of use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty handling pumped media of 104^{o} F (40^{o} C) and capable of up to 15 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum. Thermal switches set up at 260^{o} F (125^{o} C) shall be embedded in the stator lead coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. The junction chamber containing the terminal board, shall be hermetically sealed from the motor by an elastomer compression seal. Connection between the cable conductors and stator leads shall be made with threaded compression type binding posts permanently affixed to a terminal board. Wire nuts or crimping type connection devices are not acceptable. The motor and pump shall be designed and assembled by the same manufacturer.

2. The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15. The motor shall be designed for operation up to 104^{o} F (40^{o} C) ambient and with a temperature rise not to exceed 176^{o} F (80^{o} C). A

performance chart shall be provided showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no-load characteristics.

3. The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.

4. The motor horsepower shall be adequate so that the pump in non-overloading throughout the entire pump performance curve from shut-off through run-out.

5. The pump system and appurtenances, including the pump, motor and wiring shall be approved by a national approved testing agency for installation in the State of Oregon for explosion proof service. The system shall be rated for Class I, Division I, Group C and D service as determined by the national electrical code and approved by a nationally recognized testing agency (U.L. or F.M.) at the time of bidding of this project.

H. Bearings: The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated, external bearing lubrication ports, will not be allowed. The calculated B10 bearing life rating shall be 50,000 hours minimum. The upper bearing shall be a single deep groove ball bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Single row lower bearings are not acceptable.

I. Mechanical Seal:

1. Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The seals shall operate in an oil reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the oil chamber, shall contain one stationary and one positively driven rotating tungsten-carbide ring. The upper, secondary seal unit located between the oil chamber and the motor housing, shall contain one stationary tungsten-carbide seal ring and one positively rotating carbon seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. The position of both mechanical seals shall depend on the shaft. Mounting of the lower mecha-

nism seal on the impeller hub will not be acceptable. For special applications, other seal face materials shall be available.

2. The following seal types shall not be considered acceptable nor equal to the dual independent seal specified: Shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces. Cartridge type systems will not be acceptable. No system requiring a pressure differential to offset pressure and to effect sealing shall be used.

3. Each pump shall be provided with an oil chamber for the shaft sealing system. The oil chamber shall be designed to prevent overfilling and to provide oil expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate dry without damage while pumping under load.

J. Pump Shaft

1. Pump and motor shaft shall be the same unit. The pump shaft is an extension of the motor shaft. Couplings shall not be acceptable. The shaft shall be AISI type 420 stainless steel.

2. If a shaft material of lower quality than 420 stainless steel is used, a shaft sleeve of 420 stainless steel is used to protect the shaft material. However, shaft sleeves only protect the shaft around the lower mechanical seal. No protection is provided in the oil housing and above. Therefore, the use of stainless steel sleeves will not be considered equal to stainless steel shafts.

K. Impeller: The impeller(s) shall be of gray cast iron ASTM A-48, Class 30, dynamically balanced, double shrouded non-clogging design having a long through outlet without acute turns. The impeller(s) shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in wastewater. A full vaned, not vortex, impeller shall be used for maximum hydraulic efficiency. Mass moment of inertia calculations shall be provided by the pump manufacturer upon request. Impeller(s) shall be keyed to the shaft, retained with an allen head bolt and shall be capable of passing a minimum 3 inch diameter solid. All impellers shall be coated with alkyd resin primer.

L. Wear Rings: A wear ring system shall be used to provide efficient sealing between the volute and suction inlet of the impeller. Each

pump shall be equipped with a brass, or nitrile rubber coated steel ring insert that is drive fitted to the volute inlet.

M. Volute: Pump volute(s) shall be single-piece gray cast iron ASTM A-48, Class 30, non-concentric design with smooth passages large enough to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified.

N. Protection:

1. All stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. At 260^{o} F (125^{o} C) the thermal switches shall open, stop the motor and activate an alarm.

2. A leakage sensor shall be included to detect water in the stator chamber. The Float Leakage Sensor (FLS) is a small float switch used to detect the presence of water in the stator chamber. When activated, the FLS will stop the motor and send an alarm both local and/or remote. Use of voltage sensitive solid state sensors and trip temperature above 260^{o} F (125^{o} C) shall not be allowed.

3. The thermal switches and FLS shall be connected to the pump control panel as shown on the drawings.

O. Pump Accessories:

1. Guide bars: Two 2-inch diameter stainless steel guide bars shall be provided for guiding each pump unit in raising and lowering. The guide bars shall not support any portion of the weight of the pump. The lower guide bar holders shall be integral with the discharge elbow. The pump unit shall be guided on the bars by a guide bracket which shall be an integral part of the pump.

2. Guide: Provide upper guide holders for the pump guide bars. Provide a sufficient number of intermediate guide holders to adequately support the guide bars during removal and replacement of the pumps.

3. Chain: Each pump shall be provided with 20 feet of high tensile strength stainless steel chain,

4. Package Pump Control Panel: Work includes the fabrication and testing of a duplex pump control panel for the control and protection of all motors and controlled equipment in

conformance with manufacturer's requirements and applicable codes. The specified controls shall be provided in a single NEMA 12 wall mounted control panel. The Drawings indicate maximum dimensions for the control panel, including clearances between the control panel and adjacent surfaces and other equipment. The control panel construction shall comply with indicated maximum dimensions shown. The control panel equipment and materials shall meet all of the requirements shown on the Drawings and as specified in Divisions 16 and 17. The pump equipment supplier shall submit all control panel documentation as specified in Section 17100.

2.05 SUMP PUMPS

A. Operating conditions for the pumps shall be as follows:

	Operating Conditions
Design head, feet	26 '
Design flow, gpm	20 gpm
Maximum pump speed	1750 rpm
Motor Type	Submersible, 460 volt, 3 phase
Horsepower, minimum	1/2 hp

1. Construction: Pumps shall have integral bronze pump and motor housing with lifting handle. Two vane sewage type impeller shall be nonclog sewage handling type, dynamically balanced and capable of passing 1 l/2-inch diameter spheres. Precision mechanical shaft seal of carbon and ceramic faces shall prevent leakage of pumped medium into motor. Pump discharge shall be a vertical 2-inch NPT threaded pipe connection. Pump shall have automatic level control maintained by externally mounted float switches. Floats shall be set to turn pump on at l3-inch water depth and off at 3-inch water depth. Pumps shall be completely wired and supplied with the necessary cord. The pumps shall be designed to plug into a duplex receptacle for electrical connection.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All above equipment shall be installed in accordance with the manufacturer's recommendations, drawings, and/or specifications. Alignment and adjustments shall be verified after installation.

B. Before connecting pumps to piping, all piping shall be thoroughly flushed and cleaned. All piping connected to pumps shall be supported from the adjacent structure without placing any load on the pumps.

C. All work performed under this section shall be carefully inspected by the Contractor and Engineer for rejections or flaws to be corrected and for proper compliance with plans and specifications. Adjustments and corrections shall be made to assure that all items operate and function satisfactorily. Remove all debris, all unused or rejected materials.

D. Pump bases shall be bolted to the concrete base slab with hot-dip galvanized anchor bolts and nuts unless otherwise indicating on drawings. Grout leveling pads shall be used on top of concrete pad with a minimum thickness of 1-1/2 inches. Nonshrink grout shall meet the requirements of Section 03300 of these specifications. Grout shall be neatly mitered from base and troweled smooth. All grout spatter shall be completely cleaned from all surfaces.

3.02 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Complete operating and maintenance instructions for each piece of equipment shall be furnished as specified in Section 01730.

3.03 TESTING

A. In addition to testing that may be required by codes, the Contractor shall perform all test specified in this section and shall furnish and pay for all material and labor required for tests. Prior to the plant start-up, each pump shall be tested in place with its own motor and drive unit. The tests shall duplicate all normal operating modes and all failure modes such as over-pressure, vibration, etc. The Contractor shall notify the Engineer or Owner a minimum of 5 days in advance of running any tests unless otherwise specified and no tests shall be accepted unless the Engineer or representative of the Owner is present. Should a test indicate unsatisfactory operation or leaks occurring, conditions shall be corrected and test repeated at Contractor's expense.

B. During the test of each piece of motor-driven equipment, the service factor of each motor will be checked.

C. The pump manufacturer shall factory-test all pumps and furnish to the Engineer 5 copies of certified pump curves showing compliance with specification requirements. The Engineer reserves the right to have a representative present during the factory tests, and the pump manufacturer shall notify the Engineer at least one week in advance of

performance of such tests. The pump manufacturer shall assume full responsibility for the electrical motor matched to his pump, the combined efficiency for the unit and its performance.

D. All pump tests shall be included in the contract lump sum price.

3.04 START-UP AND FOLLOW-UP SERVICE

A. Qualified manufacturer representative pump manufacturer shall supervise start-up of the equipment by the Contractor's personnel. The Contractor shall provide the services of the required journeymen craftsmen for start-up labor.

END OF SECTION

SECTION 15170
GAGES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Work covered by this section consists of furnishing all labor, material, and equipment required for all gages as shown on the drawings and as specified.

1.02 RELATED SECTIONS

A. Section 15000 - Mechanical, General
B. Section 15060 - Pipe and Pipe Fittings
C. Section 15100 - Valves and Gates
D. Section 15140 - Pumps
E. Section 16100 - Basic Materials and Methods
F. Section 16900 - Motors and Controls

1.03 MANUFACTURERS

A. Manufacturers shall be of good established reputation, regularly engaged in the production of such equipment. Unless otherwise noted, any equipment offered shall be current modifications that have been in successful regular operation under comparable conditions.

1.04 SUBMITTALS

A. Submit product data and shop drawings in accordance with the requirements of Division 1 of the City of Gresham Public Works Standards. Submit operation and maintenance manuals in accordance with Section 01730, Operating and Maintenance.

PART 2 - PRODUCTS

2.01 PRESSURE GAGES

A. General: Provide a pressure gage on the discharge side of each pump except sump pumps. The range of all gages shall be approximately 2 times the normal system pressure so that when the system is operating, the pressure gage will read near center scale or as indicated on drawings. Gages for pumps shall be remotely mounted in a vibration-free area adjacent to the force main. Gages and appurtenances specified herein by Ashcroft, Marsh, or equal.

B. Gages for sewage service shall be 4 ½-inch dial; wall mounted black phenolic case; high impact, noncracking plastic lens; bourdon tube assembly; liquid filled gage mechanism and case suitable for temperature range of 0 to 150 degrees F; white dial background with black numerals and

gradations; accuracy of +/-1% of full scale; ½-inch NPT connection; and pulsation dampener.

1. Tubing between pipe and wall mounted gage shall be flexible, spiral armor, stainless-steel capillary tube. Diaphragm seals shall be provided on all gages and provided with flushing connections and isolation cocks.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Pressure gages shall be installed per manufacturer's recommendations, mounted on the wall with diaphragm seals and flexible tubing, easily accessible to view and maintenance wherever possible.

3.02 PAINTING

A. Gage piping and valving shall be painted along with the piping system in accordance with Section 09900, Painting.

3.03 TESTING

A. Gages inserted in pipelines shall be pressure tested with the system in which they are installed.

END OF SECTION

SECTION 15800
VENTILATION

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Work covered by this section consists of furnishing all labor, materials and equipment for a complete and satisfactory installation and operation of the ventilation system as shown on the drawings and as specified.

1.02 RELATED SECTIONS

A. Section 05500 - Metal Fabrications
B. Section 15030 - Motors
C. Section 15060 - Pipe and Pipe Fittings
D. Section 15100 - Valves
E. Section 15140 - Pumps
F. Division 16 - Electrical

1.03 REFERENCE STANDARDS

A. All equipment, apparatus, and systems shall be fabricated and installed in complete accordance with the latest edition or revision of the following applicable codes and standards:

1. Air Conditioning and Refrigeration Institute (ARI).
2. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).
3. American Society of Mechanical Engineers (ASME).
4. American Society for Testing and Materials (ASTM).
5. National Fire Protection Association (NFPA).
6. National Electric Code (NEC).
7. National Electric Manufacturers Association (NEMA).
8. Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
9. Underwriters Laboratory, Inc (UL).
10. Air Moving and Conditioning Association (AMCA).

B. Where conflicts arise between the plans and code requirements, the latter shall prevail, unless the plans are more stringent.

1.04 SUBMITTALS

A. Submit shop drawings, material specifications, control schematics product data and equipment mounting details in accordance with Division 1 of the City of Gresham Public Works Standards. No materials shall be purchased or installed until reviewed and accepted by the Engineer.

B. Submit operation and maintenance manuals and parts lists for each specific model of equipment furnished in accordance with Section 01730.

1.05 WARRANTY

A. Equipment specified under this Division shall be covered by the manufacturer's standard warranty on the new equipment for 1 year from date of issuance of the Certificate of Substantial Completion and as further protected by the manufacturer's standard warranty. If within 12 months from the Date of Substantial Completion any of the equipment herein described is proved to be defective in workmanship or materials, it will be replaced or repaired free of charge.

PART 2 - PRODUCTS

2.01 DUCTWORK SYSTEM

A. Ductwork: All low velocity ductwork shall provide for velocities not to exceed 2,000 fpm, and static pressures not to exceed 2 inches W.C.

1. Construction: All ductwork shall be constructed of aluminum or Schedule 40 PVC as shown on the drawings. Aluminum ductwork shall be in accordance with the tables and figures shown in the SMACNA Low Velocity Duct Construction Standards, Sixth Edition. PVC ductwork shall be used in the wet well and directly buried.

2. Hangers and supporting systems shall be in accordance with Section V of the SMACNA Low Velocity Duct Construction Standards. Aluminum hangers shall be use in dry areas and stainless steel in wet areas.

2.02 WALL EXHAUST FAN

A. Centrifugal fan, rated and tested in accordance with AMCA Standards, double-width, double-inlet, 16-gage steel casing with 1/2-inch neoprene-coated sound attenuation on all interior surfaces, inlet and discharge duct collar connections, steel surfaces, inlet and discharge duct collar connections, steel support frame for fan and motor assembly isolated from basic casing with spring isolators, 1050 rpm direct-drive motor, integral self-resetting overhead protection on single- phase motors, standard factory baked enamel finish. Provide slot type aluminum grille with blank-off on the inlet duct connection.

B. Provide exhaust fan with capacity to turn over air in two minutes, at 0.25-inch static pressure, 120-volt, single-phase explosion proof motor.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. All equipment shall be installed in strict accordance with the manufacturer's instructions. All equipment permanently mounted on concrete shall be installed on a base or equipment pad and shall be leveled and aligned.

B. Cutting and patching: Locate and verify all openings required in structure construction for ventilating work.

C. Work shall be subdivided in the following manner:

1. Power wiring shall be by Division 16, Electrical.

2. Control wiring shall be per this section.

D. All equipment and ductwork shall be installed in strict accordance with SMACNA specifications.

E. Paint: Non-aluminum exposed ductwork and accessories per Section 09900.

3.02 DUCTWORK INSTALLATION

A. Ducts shall conform accurately to dimensions indicated which are net inside dimensions. Ducts shall be anchored securely to structure and shall be installed so as to be completely free from vibration under all conditions of operation. Duct installation shall be in strict accordance with manufacturer's specifications and shall comply with SMACNA Low Velocity Duct Construction Standards. All connections between duct and rotating equipment shall have flexible canvas vibration isolators.

B. Drawings do not attempt to show all offsets in ductwork. Contractor shall make such offsets in ducts as necessary, for installation of work without additional cost to Owner. Where offsets are required, angle of offset shall be not larger than 15 degrees.

C. Duct penetrations through walls, ceilings and roof shall be furnished with flanged sheet metal closure.

3.03 TESTING

A. All control equipment shall be tested to demonstrate that all equipment is operating satisfactorily.

3.04 INSTRUCTION

A. On completion of the job, the Contractor shall arrange to instruct the Owner's representative on the operation of the ventilating system and supply him/her with the control operating and instruction manual as specified in Section 01730. Contractor shall obtain from the Owner's representative, a signed receipt that he has received the instruction manuals and complete instructions on the operation of the system.

END OF SECTION

SECTION 16010
GENERAL PROVISIONS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work consists of furnishing all labor, materials, services, tools and other equipment necessary for the construction, installation, connection and testing of all electrical work for this project as shown on the drawings or specified herein.

B. Costs/charges for installation of all permanent and temporary facilities shall be included in the lump sum bid for each of the pumping stations. This includes any up-front money required by the utility to provide permanent service.

1.02 RELATED WORK

A. Section 16100 - Basic Materials and Methods
B. Section 16400 - Service and Distribution
C. Section 16500 - Lighting
D. Section 16900 - Motors and Controls

1.03 INTENT OF DRAWINGS AND SPECIFICATIONS

A. Riser and other diagrams are schematic only and shall not be used for obtaining quantities.

B. The electrical drawings do not show complete details of the site conditions. The Contractor shall check actual conditions.

1.04 COORDINATION OF WORK

A. The Contractor shall plan his work in coordination with the power and telephone utility authorities.

B. The Contractor shall field verify all dimensions of equipment to be installed or provided by others so that correct clearances and connections may be made between the work installed by the Contractor and equipment installed or provided by others.

C. The Contractor shall arrange all conduit runs so that they do not interfere with duct work, structural members, etc.

D. All working measurements shall be taken from the sites, checked with those shown on the drawings, and if they conflict, reported to the Engineer at once, and before proceeding with the work. Should the Contractor fail to

comply with this procedure, he shall alter his work at his own expense as directed by the Engineer.

E. No extra payments will be allowed where obstructions in the work of other trades, or work under this contract requires offsets to conduit runs.

1.05 SUPERVISION

A. The Contractor shall maintain adequate supervision of the work and shall have a responsible person in charge during all times that work under this contract is in progress, or when necessary for coordination with other work.

1.06 CODES

A. Work shall conform to the National Electrical Code (NEC), and State codes and other applicable codes, even though not specifically mentioned for each item. These shall be regarded as the minimum standard of quality for materials and workmanship.

1.07 WORKMANSHIP

A. All work shall be performed by personnel skilled in the particular trade. Workmanship shall conform to National Electrical Contractors Association Standard of Installation.

B. The Engineer shall be the sole judge as to whether or not the finished work is satisfactory; and if in his judgment any material or equipment has not been properly installed or finished, this Contractor shall replace the material or equipment whenever required, and reinstall in a manner entirely satisfactory to the Engineer without any increase in cost to the Owner.

C. All work shall meet all requirements of the NEC for wet locations. All wiring methods shall conform to NEC Requirements for Wet Locations.

1.08 PERMITS, FEES AND SERVICE CHARGES

A. Contractor shall obtain all electrical permits and pay all related fees.

1.09 CONTRACTOR' S RECORD DRAWINGS

A. The Contractor shall maintain a neatly marked set of record drawings. In addition, the locations of panels, field mounted instruments and panels, terminal boxes, junction boxes and any other materials included in this contract shall be shown. Drawings shall be kept current with the work as it progresses and shall be subject to inspection by the Engineer at any tine.

PART 2 - PRODUCTS

2.01 MATERIALS

A. See subsequent electrical sections and the drawings for specified materials.

2.02 PORTABLE OR DETACHABLE PARTS

A. The Contractor shall retain in his possession and shall be responsible for all portable and detachable parts or portions of installations such as fuses, key locks, adaptors, blocking chips, and inserts until completion of his work.

B. These parts shall be delivered to the Engineer and an itemized receipt obtained. This receipt, together with 2 copies of the final inspection certificate, shall be attached to the Contractor's request for final payment.

C. All equipment shall be demonstrated to operate in accordance with the requirements of this specification and the manufacturer's recommendation.

PART 3 - EXECUTION

3.01 SUPPORT BACKING

A. Provide any necessary backing required to properly support all fixtures and equipment installed under this contract.

3.02 CUTTING, PATCHING AND FRAMING

A. The Contractor shall determine in advance the locations and sizes of all sleeves, chases, and openings necessary for the proper installation of his work.

B. Whenever practical, inserts or sleeves shall be installed prior to covering work. Cutting and patching shall be held to a minimum. All required holes in concrete construction shall be made with a core drill and patched with non-shrink grout.

C. Cutting, fitting, repairing and finishing of carpentry work, metal work, or concrete work, and the like, which may be required for this work shall be done by craftsmen skilled in their respective trades. When cutting is required, it shall be done in such a manner as not to weaken walls, partitions, or floors; and holes required to be cut in floors Im1st be drilled without breaking out around the holes.

3.03 FINISHES AND IDENTIFICATION

A. Electrical and instrumentation equipment to be finished as specified in Section 09900.

3.04 TESTS

A. The Contractor shall furnish all labor, material, instruments and tools to make all connections for testing of the electrical and instrumentation installation. All equipment shall be demonstrated as operating properly prior to the acceptance of the work. All protective devices shall be operative during testing of equipment. The tests shall be made under the supervision of the Engineer. All deficiencies or unsatisfactory conditions as determined by the Engineer or inspecting authorities shall be corrected by the Contractor in a satisfactory manner at his own expense.

B. After visual inspection of joints and connections and the application of tape and other insulating materials, all sections of the entire wiring system shall be thoroughly tested for shorts and grounds. A log of results for each circuit shall be kept by the Contractor and presented to the Engineer.

C. A phase rotation check shall be made to demonstrate that all power receptacles, service feeders, main power feeders, and emergency generator have the same A-B-C phase rotation and ground relationships.

D. Equipment shall be tested by operating all electric motors, relays, controls, switches, heaters, etc. sufficiently to demonstrate proper installation and electrical connections. Control and emergency conditions shall be artificially simulated where necessary for complete system or subsystem.

E. Insulation resistance measurements of each circuit shall be made with loads connected and contactors, if any, blocked closed to give complete circuits. Insulation resistance of complete circuit shall be measured from the circuit breaker load terminals with the breaker open. A log of complete results shall be prepared by the Contractor and presented to the Engineer. Values of resistance shall be 10 megohms or greater.

END OF SECTION

SECTION 16100
BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work consists of furnishing all labor, material and equipment required for electrical work shown on the drawings and as further described in these specifications.

1.02 RELATED WORK

A. Section 02221 - Trenching, Backfilling and Compacting
B. Section 09900 - Painting
C. Section 15140 - Pumps
D. Section 15800 - Ventilation
E. Section 16010 - General provisions
F. Section 16500 - Lighting
G. Section 16900 - Motors and Controls

1.03 SUBMITTALS

A. Submit shop drawings of the following items for approval of the Engineer in accordance with Division 1 of the City of Gresham Public Works Standards.

1. Raceways
2. MC cable
3. Cable terminators
4. Outlet boxes
5. Pull boxes
6. Conductors
7. Wiring devices

1.04 REFERENCE STANDARDS

A. American National Standards Institute (ANSI).
B. American Society for Testing and Materials (ASTM:).
C. Federal Specification (FS).
D. National Electric Code (NEC).
E. National Electrical Manufacturers Association (NEMA).
F. Insulated Cable Engineer's Association (ICEA).
G. Institute of Electrical and Electronic Engineers (IEEE).
H. Underwriters Laboratory Inc. (UL).
I. State of Oregon Department of Environmental Quality – Oregon Standards for Design and Construction of Wastewater Pumping Stations.
J. City of Gresham, Public Works Standards, current edition.

1.05 INTENT OF DRAWINGS AND SPECIFICATIONS

A. The drawings are partly diagrammatic and do not necessarily show the physical arrangements of the conduit and equipment unless specifically dimensioned. Diagrams are schematic only and shall not be used for obtaining quantities or lineal runs of conduit.

1.06 REGULATIONS AND PERMITS

A. The Contractor shall comply with all applicable codes, ordinances and regulations, including the National Electrical Code, National Electrical Safety Codes, and the State of Oregon.

B. The Contractor shall obtain and pay for all permits, inspections, utility connection fees and other costs incidental to providing or modifying the electrical installations.

C. The Contractor shall obtain a Certificate of Electrical Inspection from the local inspecting authority and submit to the Owner upon completion of the project.

1.07 COORDINATION OF WORK

A. The Contractor shall plan his work so that it proceeds with a minimum of interference with other trades.

B. Check all dimensions of the equipment to be installed or provided by others so that correct clearance and connections may be made between the work installed by this Contractor and the equipment installed or provided by others.

C. The Contractor shall coordinate painting of all electrical equipment with Section 09900.

1.08 EXCAVATION AND BACKFILL

A. Perform all necessary excavation for buried conduits and conductors as specified in Section 02221.

B. No backfilling shall be done until all direct burial cables, conduits and penetrations to be covered have been inspected and approved.

1.09 POWER SERVICE

A. Responsibility of the contractor. Responsibility of the primary line extension and new power service to the pump station shall be divided between the power company and the Contractor as outlined below or shown on the drawings. The point of termination and division of responsibility utility and the Contactor shall be the line side lugs of the meter base. It

shall be the responsibility of the Contractor to coordinate an on-site meeting with the power company field construction coordinator prior to excavation. Contact the power company a minimum of 30 days before the required service connection. The Contractor shall pay all power company fees for the new service. Contractors shall include in their offer price an allowance of $_____ for this work based on a preliminary estimate from the power company. The Contractor shall provide and install the following:

1. Trenching, conduit and backfill for the service as shown on the drawings. The Contractor shall coordinate utility inspection of the trench installation prior to backfill.

2. The transformer pad.

3. Provide and install one metered service panel with a seven (7) terminal meter socket in a utility approved NEMA 3R enclosure.

4. The Contractor shall have the electrical service inspected and approved for connection by the authority having jurisdiction.

B. Responsibility of the electrical utility company. The power company will provide, install and make final terminations of:

1. The primary conductors

2. The transformer

3. The secondary conductors

4. The meter.

PART 2 - PRODUCTS

2.01 QUALITY OF MATERIALS

A. All contract nateria1s shall be new, of proven quality, without imperfections and blemishes. All nateria1 not specifically detailed in this specification required to accomplish the completion of this contract shall be of compatible quality to the items specified and be approved by the Engineer. All materials shall be products of manufacturers regularly engaged in production of such equipment and shall be of the m9nufacturer's latest design. Where 2 or more units of the same class of equipment are required, these units shall be of the same manufacture. All material and equipment shall be per NEMA, ANSI, IEEE or ICEA Standards as applicable, except as modified by these specifications. All material shall be U/L labeled as applicable.

2.02 RACEWAYS

A. All raceways shall be UL approved for the application.

B. Rigid steel conduit: Provide zinc-coated rigid steel conduit conforming to Federal Specification WW-C-581.

C. Flexible metallic conduit: Provide liquid tight flexible conduit, zinc-coated steel core, extruded gray PVC cover, UL approved, Sealtite type "UA" or Liquatite type "LA", or equal. Where permitted by local inspection authority, sizes larger than 3-inch shall be Sealtite type "EF", or Liquatite type "LT", or equal.

D. Flexible couplings: Provide liquid light flexible explosion proof couplings with integral electrical conductivity, suitable for Class 1 Division 1 environments.

E. Rigid PVC conduit: Provide rigid polyvinyl chloride (PVC) conduit, schedule 40, UL listed for concrete encased, direct burial underground, and exposed use. Rigid PVC conduit, including couplings, elbows and nipples shall conform to the requirements of the latest edition of FS-WW-C-1094, and NEC.

F. Rigid steel conduit, PVC coated (PVC-RGS): PVC coated conduit and fittings shall be rigid steel, galvanized, with an overall PVC coating. Coating shall be self-extinguishing and shall overlap to provide moisture-proof joints. Conduit shall be "Korkap" as manufactured by Plastic Applicators, P.O. Box 7631, Houston, Texas; or Ocal PVC coated conduit as manufactured by Occidental Coating Company, 14533 Kesbech Street, Van Nuys, California; or Robroy Industries, Pittsburgh Standard Division, River Road, Verona, Pennsylvania; or equal.

2.03 CONDUIT FITTINGS

A. Provide conduit fittings as follows unless otherwise noted or detailed. Catalog numbers shown are RACO/ /Appleton Electric Company unless otherwise noted. Similar products of other manufacturers are equally acceptable.

Rigid Conduit Insulating Bushings	- Series 1400/ /Series BBU
Rigid Conduit Set Screw Fittings	- 3010-3022, 3102-3116// Series SRNTC and SNTCC
Flexible Metallic Conduit Fittings	- Pylets (Pyle-National)// Unilets
Expansion Joints	- Adalet Type STR//OZ Type AX or TX

Conduit Wall Entrance Sealing Fitting	- OZ Type FSX-GALV//or FSC-G-GALV
Conduit Sealing Fittings	- OZ Type EYA or equal
Rigid Conduit Seals (Explosion Proof)	- Series EYSM, ESUM,EYM SFM, EYDM

2.04 OUTLET BOXES

A. Provide outlet boxes as follows unless otherwise noted, detailed, or existing.

Lighting Outlet Boxes	Appleton Elec. Co. JB series
Switch, Receptacles, Telephone and Junction Boxes	FS Series with cast cover and gasket
Junction Boxes Explosion Proof	Appleton Elec. Co. series DER, GUB1, GUB2, GUB3, EJB, EXB

2.05 PULL BOXES

A. Provide galvanized cast iron pull boxes as shown on the drawings. Provide removable screw cover on the largest access side of the box unless otherwise detailed. Provide conduit entrances with threaded hubs. Provide stainless steel screws at all exterior and damp locations. Where pull boxes are required but not shown, provide pull boxes as specified above sized per NEC requirements. Pull boxes shall be OZ/Gedney Type "YF" or equal.

2.06 WIRING DEVICES

A. Provide wiring devices indicated. Catalog numbers shown are Bryant/Pass and Seymour, or equal, unless otherwise noted. Equal devices by other manufacturers may be substituted. All devices shall be submitted for approval. Provide all similar devices of same manufacturer unless indicated otherwise.

B. Switches: Provide flush switches, ac-type, rated 15 amp or higher suitable for the type load to be controlled.

Single-pole	801-GRY/15ACIGRY

C. Receptacles: Provide grounding-type receptacles as follows:

Duplex	5262-GRY/6200 GRY

Sump Pump Receptacles: Provide two-gang receptacle assembly, UL Listed for Class I, Division 2, Group D location. Provide matching plug for these

devices to maintain hazardous are listing. Crouse-Hinds ENR series or equal.

Receptacles for use in Class I, Division 2, Group D locations, provide receptacle assembly and matching plug, Crouse-Hinds ENR series or equal.

Where indicated, provide receptacles with ground fault interrupter. Unit shall be furnished with internal, solid state, ground fault current sensing and tripping. The receptacles shall include built-in "TEST" and "RESET" switches and "TRIPPED" indicator and shall be rated 20-amp, 120-volt. The receptacles shall be UL approved. They shall be as manufactured by Pass and Seymour, 3M, Square D, or equal.

The "GFI" receptacle shall be the" feed-thru" type and shall protect all receptacles on the same circuit.

2.07 PLATES

A. Provide plates for all wiring devices. Use Appleton, Pyle-National, Crouse-Hinds, or equal, "FSK" covers. Use cast malleable covers with gasket and stainless steel screws.

2.08 CONDUCTORS

A. This specification covers all conductors not specified in other sections. All conductors and cable shall conform to UL, Federal Specification J-C-30, or ICEA as applicable. Provide new cable manufactured within one year of installation.

B. 600 volt power, lighting and control cable: Provide copper conductors unless otherwise specified, conforming to Federal Specification J-C-30. For types THHN, THWN, or THW provide insulation conforming to UL-83. For type RHW and RHH, provide insulation conforming to ICEA S-19081. For type XHHW, provide insulation conforming to ICEA S-66-524. Provide neoprene jacket on RHW-RR type cables in accordance with ICEA S-19-81 specifications.

C. Minimum conductor size: Provide No. 12 AWG minimum branch circuit wire size. Provide No. 14 AWG control circuits unless otherwise specified or required by over-current protection. Provide smaller conductor sizes for specific application where shown on the drawings.

D. Class 2 remote control and signage conductors: Provide cables UL approved for such use. Voltage rating shall be not less than 600 volts. Utilize multi - conductor cables with like or related functions generally grouped together. Unless otherwise specified or shown on the drawings, utilize No. 14 AWG conductors.

E. Instrumentation cables: Multi-conductor cables shall have the quantity and size of conductors shown on the plans. Individual conductors shall be bare soft annealed copper Class B, 7-strand concentric per ASTM B-8. Individual conductor insulation shall be flame-retardant per UL 13, 15 mils nominal thickness, with a 105 degree C temperature rating. Conductor pairs shall be uniquely identified according to manufacturer's standard method. Overall cable assembly shall have 2.35 mil (minimum) aluminum-polyester tape shield overlapped for 100% coverage and provided with a 7-strand tinned copper drain wire the same size as an individual conductor. The jacket shall be flame-retardant per UL 13, with a 105 degree C temperature rating and a ripcord laid longitudinally under the jacket to facilitate removal. Conductors shall be twisted pairs and the cable shall be rated for operation to 600 volts.

2.09 HEAT TAPE

A. Provide Chromalox Type RTSR-4L-16-1CR heat tape. Provide Chromalox Thermostat set to maintain a 40^{o}F temperature.

PART 3 - EXECUTION

3.01 CONDUIT INSTALLATION

A. Conduit buried in earth: Install raceways to provide not less than 36 inches cover to finished grade. Pitch to drain away from station; there shall be no trapped runs. Grade trenches and place pipe bedding material to provide uniform trench bottom for raceway support. Buried raceway shall be rigid steel. Conduit in the wet well shall be PVC-RGS.

B. Provide rigid steel conduit at all exposed locations and buried in concrete.

C. Exposed conduit shall be run in straight lines parallel to column lines, walls or beams. Where conduit is grouped, the bends and fittings shall be installed to present an orderly appearance. Unnecessary bending or crossing shall be avoided.

D. Raceways in reinforced concrete: Do not displace reinforcing steel to accommodate the installation of raceways and outlet boxes. In general, locate all embedded conduits in the physical center of the particular section of concrete. Wooden plugs inserted in concrete or masonry are not acceptable as a base for raceway fastenings. Provide raceways embedded in reinforced concrete in conformance with the following usual types of conditions unless otherwise instructed by the Engineer. Particular attention is called to the fact that there are many extenuating conditions where the Contractor may be instructed during the course of the project not to place embedded conduits in certain areas, generally due to the possibility of unsightly cracking or for structural reasons. This instruction does not entitle

the Contractor to extra compensation. Special approval will be required for any condition not covered by the following usual conditions.

Location	Maximum Allowance
Floors and Walls	Displacement of 1/3 of thicknesses of concrete, spaced not less than three diameters o.c.
Beams and Joists	Displacement of 1/3 of last dimension, spaced not less than three diameters o.c.
Sleeves through Floors and Walls	Two-inch maximum pipe size, not less than three diameters o.c.

E. Raceways entering the facility below grade: Provide raceways with galvanized cast iron wall entrance seals having water-tight sealing gland assembly.

F. Supports for exposed conduit runs shall be furnished and installed within 3 feet of each box. Supports shall be secured by means of expansion inserts in concrete.

G. Conduit and fittings shall be properly protected during the construction period against mechanical injury from any cause. Conduit which extends out of floors, walls or slabs shall be boxed or otherwise protected and ends shall be capped with metal pipe plugs.

H. Rigid conduit joints and connections shall be made thoroughly watertight and rustproof by means of thread compound that will not insulate the joint. Each threaded joint shall be thoroughly cleaned to remove all the cutting oil before the compound is applied. Running threads will not be allowed. Erickson couplings may be used in dry and exposed locations provided that in wet or exposed locations, they are installed with fixed threaded connection at the top of vertical runs. Joints in PVC coated conduit shall be field coated in accordance with the manufacturer' s recommendations.

I. Rigid conduit exiting Class 1 Division 1 areas and not more than 18 inches from terminal boxes in Class 1 Division 1 shall be sealed according to the NEC using rigid conduit sealing fittings and sealing cement.

J. Instrumentation cables and conductors shall be installed in conduit and conform to the same standard as power wiring.

3.02 WIRE AND CABLE INSTALLATION

A. Conduit shall be thoroughly cleaned of all foreign material just prior to pulling the wire or cable. Lubricants shall be compounds specifically

prepared for cable pulling and shall not contain petroleum or other products that will affect cable insulation. Lubrications shall be UL approved.

B. Splicing of conductors No.8 AWG OR SMALLER shall be by pre-insulated spring-pressure connectors, such as "Scotchlok" Types Y, R and B, Ideal "Wingnut" or equal. All uninsulated splices, joints and free ends of conductors shall be covered with rubber and friction tape or high-dielectric strength, plastic tape.

C. Terminal strips in panels shall be identified throughout the equipment utilizing unique numbering systems at the switchboard and the control panel.

D. Wires terminating on terminal strips shall be tagged with the designation of the terminal strip and the number of the terminal to which they are connected. Wires shall be numbered with Brady nylon wire markers at all accessible locations.

E. Wiring diagrams shall show the terminal strips, terminals, and their identifying designations.

3.03 EQUIPMENT INSTALLATION

A. Boxes and cabinets shall be installed on the surface level and plumb and affixed to the surface with expansion inserts in concrete and machine screws to tapped holes in metal surfaces.

B. Interconnections between equipment shall be made per manufacturer’s wiring diagrams. All wiring shall be clearly labeled and external connections in control panel and remote cabinet brought out to terminal blocks. All equipment connected to telephone lines shall be protected against voltage transients.

C. In wet wells, all anchors, attachments, supports and hardware shall be stainless steel. All fabricated steel equipment shall be hot-dip galvanized after fabrication. All enclosures and fittings shall be corrosion resistant stainless steel and rated for the explosion hazard.

END OF SECTION

SECTION 16400
SERVICE AND DISTRIBUTION

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Work consists of providing the complete service and distribution system shown on the drawings and specified herein. The requirements of all other sections of the specification are equally applicable to the work to be performed under this section.

1.02 SHOP DRAWINGS

A. Submit shop drawings of the following for approval of the Engineer:

1. Panelboards
2. Switches and disconnecting means

1.03 REFERENCE STANDARDS

A. American National Standards Institute (ANSI).
B. Federal Specification (FS).
C. Institute of Electrical and Electronic Engineers (IEEE).
D. National Electrical Manufacturers Association (NEMA).
E. Underwriters Laboratory Inc. (UL).

PART 2 - PRODUCTS

2.01 SITE SERVICE

A. Electrical Service

1. The utility companies rendering electrical service to this project is Portland General Electric (P.G.E). Furnish and install all labor and material not furnished by the utility company, including metered service panels or poles as shown on the plans, and as required by utility company to render service to the project from utility service point. Verify service point metering requirements, panel construction details, and the like, and include all costs in bid proposal. Refer to Power Service specification, Section 16100, 1.09.

2. Provide and ground services as required and satisfy utility company and code requirements.

3. Provide trenching and backfill at locations shown on the plans and as required by the utility company for service cable to the project site.

4. For utility service conduit, provide sweeps per utility company standards.

5. Verify all pull boxes, transformer pad, meter and panel details and cable details with the utility company and observe utility company standards throughout.

2.02 SYSTEM CHARACTERISTICS AND LOADS

A. System Characteristics.

Provide electrical system nominal utilization voltage characteristics as follows:

Typical Voltage Description Herein	Nominal Utilization Voltage
480/277	460/265
120/208	116/200
120/240	115/230

2.03 SAFETY SWITCHES AND DISCONNECTING MEANS

A. Furnish safety switches as shown on the drawings. All equipment shall conform to NEMA standards latest revision as applicable.

B. Switches shall be heavy-duty class, quick-make, quick-break, safety-type, externally operable, with by-passable interlock to prevent opening of cover in "ON" position. Switch shall have positive indication of "OFF" and "ON" position. Devices shall have visible blades unless molded-case breaker mechanism is used. Switches shall be so constructed as to preclude single phasing of switch blades due to mechanical failure. Switches shall be padlock able in the "OFF" position.

C. Switches shall be of the proper horsepower, ampere and voltage rating with number of poles required to open all undergrounded conductors and with S/N bar where required.

D. Unless otherwise indicated, individually mounted switches shall be in NEMA type 1 enclosure except in wet locations or where indicated as weatherproof, in which case a NEMA type 4 stainless steel enclosure shall be provided.

2.04 MANUAL TRANSFER SWITCH (MTS)

A. The manual transfer switch shall meet UL standards and shall have the continuous current rating shown on the plans. It shall be double-throw with

positive make, quick break operating mechanism. Handle shall be capable of being padlocked in the "top", "neutral", or "bottom" positions. Switch shall meet Federal Specification WS-865c for normal duty.

2.05 PANELBOARDS

A. General: Provide panelboards in conformance with the following specification for installation as shown on the drawings.

B. Panelboards: Panelboards shall be dead-front, flush mounted or surface mounted with subbreakers, main lugs, double lugs, or main breakers as shown on the drawings. Lugs shall be sized for feeders and shall confonl1 to the specification for splicing and terminations. Buses shall be copper, full panel height. Buses shall be identified. Minimum bus rating shall not be smaller than the setting of the feeder protective device.

1. Circuit breakers: Provide molded case bolt-on circuit breakers with thermal magnetic trip units, and a common trip bar for two or three-pole breakers, connected internally to each pole so that the tripping on one pole will automatically trip all poles of each breaker. Handle bales or clips will not be acceptable. Provide breakers of the trip-free and trip-indicating plug-in type, with quick-make, quick-break contacts. Provide single two or three-pole breaker interchangeability.

2. Special features: Provide split-bus, subfeed lugs, subfeed protective device and contactors as indicated on the drawings or specified in this or other sections of these specifications.

3. Tandem, duplex, or half-sized circuit breakers: Do not use this type of equipment unless specifically noted.

4. Low Voltage Power Center

   a. Provide a unitized low voltage power center consisting of four C41 main components: primary breaker/disconnect, dry-type distribution transformer, secondary breaker/disconnect and a secondary power panel.

   b. The transformer assembly shall be the totally encapsulated type for indoor/outdoor operation using a 180-degree C., UL recognized insulation system. It shall be provided with 2-5 percent below normal taps. Primary voltage shall be 480 volts, single or 3-phase and secondary voltages shall be 120/240-volt single- phase or 120/208-volt 3-phase as shown on the drawings. The transformer KVA ratings shall be as shown on the drawings.

   c. The panel assembly shall be similar to and meet all applicable requirements of panelboards. It shall accept 1, 2 or 3-pole, 1- inch breakers and ground fault breakers. Provide quantities and sizes as

shown on the drawings. The assembly shall provide the transformer primary and secondary nein breakers sized per NEC Article 450.

d. The entire assembly shall be UL listed for indoor/outdoor use. Units shall be Acme electric panel Tran, Westinghouse Mini-Power Center, similar by Square D, or equal.

2.05 GROUNDING SYSTEM

A. This grounding specification is applicable to this and all other sections of the work. Provide all grounding systems and make connections mechanically secure and electrically continuous. Ground all line voltage electrical systems completely and effectively as required by code and as specified herein.

B. Ground all raceway systems and equipment enclosures. Where not otherwise indicated, grounding conductor size shall conform to the most stringent of the governing codes.

1. Ground the service and transformers in an approved manner.

2. Provide station grounding where indicated on the drawings. All station ground mat conductors shall be bare soft drawn copper sized as noted. Bury all conductors approximately 12-inches below grade.

3. Grounding conductor connections shall be bolted except at inaccessible ground rods, buried station ground conductors and reinforcing steel grounding conductor connections, where connections shall be brazed. Consideration will be given to bolted connections in lieu of brazed connections, subject to the Engineer's approval. Exothermic welded connections may be substituted for brazed connections subject to the Engineer's approval and demonstration on the project with actual test connections that the connections will be successfully made.

4. Ground conductors, unless otherwise noted, shall be insulated and shall be run in conduit.

5. Continuity of equipment ground shall be maintained throughout the entire raceway, cabinet and equipment enclosure system. Ground bushings and jumpers shall be used wherever normal conduit termination does not insure continuity. Where nonmetallic conduit is used for distribution or where direct burial cables are employed, install a green insulated equipment ground conductor with each circuit.

6. Metal parts of lighting fixtures not otherwise grounded by bolted fastenings shall be bonded to conduit system with green ground wire. Receptacles shall be grounded to outlet boxes with green ground wire and machine screw.

7. Motors and equipment shall be bonded to the equipment grounding system by a continuous green insulated equipment ground conductor run with each circuit through approved flexible conduit connections as permitted by code. Where flexible conduit size exceeds the code approved limits, provide a separate green grounding conductor inside each flexible conduit, bonded to the inside of the connection box and to the nearest accessible supply end conduit junction box.

8. Where concrete pad is provided for utility-furnished transformers, suitable grounding systems shall be provided under this section, including driven ground rods. Details on the drawings are to establish the general scope of work, but installation shall conform to the serving utility company requirements.

PART 3 - EXECUTION

3.01 EQUIPMENT BASES

A. Provide equipment bases for all floor-mounted electrical equipment. Unless otherwise indicated, bases shall be poured- in-place concrete, nominally four inches high, and be one inch larger on all exposed edges than the equipment to be mounted. On all equipment bases in interior locations, unless otherwise noted, provide two or more parallel, cast-in-place continuous-slot channel erection system concrete inserts for equipment mounting. Bolt equipment to channels. Provide additional surface-mounted channels where required to match and lineup with existing equipment. Provide concrete pads and mounting provisions for all exterior equipment as indicated on the drawings or specified in other portions of the specifications.

3.02 SUPPORTS

A. Provide hangers or other devices such as pads, channels, struts, joists, anchors, etc., necessary for the support of electrical equipment. Provide the design, fabrication and erection of supplementary structural framing electrical equipment. Show on shop drawing supplementary framing including design loads, member size and location. When supplementary framing is indicated, verify that dimensions are suitable for the equipment furnished. Provide additional strength when equipment furnished is heavier than that specified.

3.03 DAMP AND WET LOCATION

A. Provide 1/4-inch air space behind all electrical equipment mounted in damp and wet locations and on concrete walls below grade. Use corrosion-resistant washers, bolts and anchors.

END OF SECTION

SECTION 16500
LIGHTING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work consists of providing a complete lighting system as specified herein and shown on the drawings.

1.02 SUBMITTALS

A. Fixture construction details, photometric data, and ballast type shall be supplied as part of the submittal procedure specified in Division 1 of the City of Gresham Public Works Standards.

1.03 REFERENCE STANDARDS

A. National Electric Code (NEC).

B. Underwriters Laboratory Inc. (UL).

1.04 QUALITY ASSURANCE

A. The Contractor shall test all lighting installations and demonstrate satisfactory operation of switching controls upon completion of the installation. The Contractor shall replace all defective lamps and/or ballasts prior to occupancy by the Owner. All fixtures shall be cleaned and visible labels removed.

PART 2 - PRODUCTS

2.01 FIXTURES

A. Refer to the fixture schedule for type designations, description, and required lamps. The Contractor shall be responsible for the complete equipment of all fixture types. All standard fixtures shall be approved by UL and shall have UL inspecting labels attached thereto. Fixtures shall be grounded in accordance with the NEC.

2.02 LAMPS

A. The Contractor shall furnish and install all lamps required in all fixtures of the size shown on the drawings. Fluorescent tubes shall be "super-saver" or equal. Incandescent lamps shall be super-saver "hard service" type. Furnish five (5) spare lamps of each type.

2.03 BALLASTS

A. Ballasts shall totally isolate line voltage from lamploaad, to conform with NEC requirements.

1. Fluorescent
   a. Ballasts shall be energy saving high power factor type and shall bear CBM and UL labels. Ballast thermal protection: Equip all ballasts with automatic resetting protective device in accordance with UL requirements.

   b. Ballast mounting: Mount ballasts to eliminate vibration noise and to Provide approved, adequate heat transfer. This mounting shall incorporate captive bolts and nuts or similar means to permit easy replacement of ballast.

   c. Ballast sound rating: Provide ballasts with a sound rating not less than "B" for 430 MA rapid start circuits.

2. Induction

   a. Provide single-lamp, high-power factor, constant-wattage type ballast unless otherwise specified. Ballasts shall be suitable for – 20 degrees C.

2.04 ACCESSORIES

A. Fixtures shall be furnished complete with all lenses, trims, hangers, nipples, and extensions necessary for a complete installation.

2.05 POLES

A. Poles shall be round tapered aluminum lighting poles with anchor base. Wind load requirements shall be for gust to 130 mph velocity with luminaire mounted.

B. A hand hole shall be located 18-inches above base. Anchor bolts shall be 1/2-inch x 30-inches x 3-inches, galvanized with nuts and flat washers. Bolt circle to be per manufacturer

2.06 POLE BASE

A. Pole base shall be as shown.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Supports

1. Install luminaires at the height and in the manner indicated. Provide accessories, such as straps, mounting plates, nipples, or brackets, for proper installation.

B. Grounding

1. Lighting systems shall be securely grounded. For rigid conduit, a threaded hub or double locknut and bushing connection shall be considered adequate.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

Work consists of all motors and controls shown on the drawings and specified herein and in other divisions of the specifications. In general, all motors shall be furnished with the driven equipment. The requirements of all other sections of the specifications are equally applicable to the work to be performed under this section. Motors and controls are specified in this and other divisions of the specifications. In the event of conflicts, the more restrictive specifications shall apply.

1.02 RELATED WORK

A. Section 15030 - Motors

B. Section 15140 - Pumps

C. Section 15800 - Ventilation

1.03 REFERENCE STANDARDS

A. National Electrical Manufacturers Association (NEMA).

1.04 SHOP DRAWINGS

A. Submit shop drawings of the following for approval of the Engineer.

1. Motor controllers

2. Pilot control devices

3. Prewired systems

a. General descriptive literature of the manufacturer's standard equipment.

b. Complete panel layout including construction details.

c. Complete bill for materials.

d. Schematic and ladder diagrams of internal control wiring of each unit and connections and functioning of outside control devices required in the particular installation.

e. Complete composite diagram showing wiring of power and control, interconnections between sections, terminal markings and wire size.

4. Complete schedule of nameplate legends.

PART 2 - PRODUCTS

2.01 SERVICE CONDITIONS

A. All equipment shall be designed and built for industrial service and be capable of operating successfully under the following applicable conditions.

1. 40 degrees C maximum ambient temperature.

2. Voltage variations to +/- 10% of nameplate rating.

3. Frequency variations to +/- 5% of nameplate rating.

4. Combined voltage and frequency variations to +/- 10% total, as long as frequency does not exceed +/- 5%.

5. 3,300 foot maximum altitude.

2.02 MOTOR CONTROL

A. General:

1. Furnish and install a complete motor control system as specified, shown on the drawings or required for the control and protection of all motors and motor-operated equipment in conformance with manufacturer's recommendations and applicable codes.

2. This section of the specification applies to all motor controls specified herein and in other sections of the specification.

3. All controls shall conform to the requirements of NEMA standards latest revision.

4. Motor control shall be manufactured General Electric, Westinghouse, Square D, Cutler-Hammer or equal.

B. Control requirements: Provide for each motor a suitable controller and devices that will perform the functions specified or shown on the drawings for the respective motor. Each motor shall be provided with thermal overload protection.

1. Single-phase motors shall be self-protected and control shall be through manual switches or automatic contacts as specified or indicated on the drawing.

2. Polyphase motors shall have thermal overload heater elements provided integral in the motor controller for each ungrounded conductor.

C. Overload relays:

1. Self-protected single-phase motor operation devices shall be as specified under Section 15030.

2. Single-phase motor protection provided integral with the motor controller shall utilize fixed-type melting alloy or bimetallic thermal overload units sized to trip at the motor-rated service factor current but not more than 125 percent of normal full load current.

3. Polyphase motor protection shall utilize interchangeable, adjustable units. Bimetallic thermal overload adjustment range shall be 85 percent to 115 percent of the unit's basic current rating. Utilize standard trip characteristic units unless otherwise recommended by the manufacturer. Make the initial setting of overload units to provide a maximum of 115 percent protection or equal to the motor-rated service factor current whichever is less.

4. Adjust and/or replace thermal overload units initially provided under this contract as required to provide the closest possible, trouble-free, thermal overload protection consistent with the motor, control and driven equipment manufacturer's recommendations and sound application practice including but not limited to consideration of motor service factor, special motor characteristics and ambient temperature conditions at the motor and controller locations.

5. Manual reset shall be utilized for all overload relays installed integral with motor controllers and shall have external reset pushbuttons.

D. Controller:

1. Manual controllers shall be utilized where specifically indicated on the drawings or specified. Provide switches that are horsepower rated for the load served.

2. Automatic controllers such as thermostats, float or pressure switches shall control motors directly where indicated. Provide devices that are designed for the purpose, properly rated for the load served and provide the control functions indicated.

3. Magnetic motor starters shall be utilized at all locations unless otherwise noted. Controllers shall be AC full-voltage non-reversing type unless otherwise noted or required, NEMA Size 1 or larger.

E. Pilot:

1. Operate 120-volts unless otherwise noted.

2. Pushbutton, selector switches and pilot lights shall be as follows unless otherwise indicated.

   a. Push-buttons: Oil tight, heavy-duty type.

   b. Pilot Lights: Provide oil tight heavy-duty, 125-volt transformer push-to-test type with 6-volt incandescent lamp and lens colors as shown.

3. Running time meter (H): Provide a semi-recessed running time meter for all pump motors and where indicated. Utilize a nonresettable unit with four registers to indicate up to 9,999 hours.

4. Automatic control devices: Float switches and similar devices shall conform to the above requirements for push-buttons as applicable, shall be heavy-duty type and shall be applied within their electrical, mechanical and environmental rating.

5. Control relays and contacts: Provide control relays as specified and as required to accomplish the control functions indicated. Relays shall be industrial control relays conforming to NEMA Standard ICS, Part ICS 2-12. Contacts shall have current and voltage rating as required by the application but not less than required in NEMA Standard ICS for Class B1. Contact arrangement shall be Subclass B.

6. Intrinsically Safe Relay: Provide intrinsic relays that shall limit switching current to less than O. 1 ampere and shall provide an output contact rated 5 amps at 120 volts. Unit shall be Transamerica Delaval Safe-Pak, or equal.

F. Combination starters: Combine the above specified or indicated control functions in a common enclosure with a "magnetic only " molded-case circuit breaker.

G. Enclosure: Provide NEMA 12 enclosure except in wet locations, where exposed to weather or where weatherproof is indicated, in which case, provide NEMA 4 enclosure. In hazardous locations, provide enclosure rated for the environment indicated. All enclosures shall be provided with engraved phenolic nameplates indicating equipment controlled and indicating warnings where required.

2.03 POWER MONITOR RELAY

A. Provide as specified with the control panel.

2.04 PREWIRED SYSTEMS

A. Prewired systems shall be complete in all respects and shall provide all required functions. All components of the system shall conform in all

respects to all portions of the specification. It is desired to take the fullest possible advantage of the manufacturer's standard methods and therefore, the drawings indicated general functions without details and the specifications generally call for the system, to be the "manufacturer's standard". Such specifications and drawings do not relieve the manufacturer from the requirement to alter his "standard" components and methods and usual scope of work in order to provide the completeness, quality, quantity, function and interchangeability with the function specified herein and shown on the drawings. Prewiring of systems shall be complete including all required interconnections, integral wiring and interunit conduit and wiring, ready for the indicated external connections. It is the Contractor's responsibility to review the extent of electrical work and connections shown on the electrical drawings and to provide compatible prewired systems for a complete, coordinated and proper functioning system.

2.05 TELEMETRY

A. General.

Installation of the telemetry panel shall provide a link to the City's existing system. Station alarm status and pumping rate data shall be telemetered to the City of Gresham Wastewater Treatment Plant. At the time of this printing, telemeter utilizes Nextel wireless technology and is monitored via an internet based system. The telemetry system shall conform to specifications and requirements provided by the Wastewater Services Division to ensure compatibility with systems in use at the time the pump station is constructed. The Contractor shall be responsible for furnishing and installing all telemetry system's equipment, installation of the telemetry panel, and making all wire terminations. At least one month before the final acceptance tests, the Contractor shall notify the Engineer that the telemetry system is functional. This will allow the City to make a final system's check.

B. Telemetry Panel Construction Methods

Construction practices should result in a neatly wired assembly. All terminations (including Contractor's field terminations) shall be made with spade type terminals to facilitate easy removal from screw terminals. Where special equipment mating connectors are required, they shall be provided using insulated type connectors. Equipment ground wires shall be terminated on terminal blocks that are referenced to the back panel. Incoming drain lines of shielded conductors shall be terminated on ground blocks provided.

C. Documentation

The telemetry panel shall be provided with a complete set of documentation, including:

1) Scale drawing of back panel parts layout.

2) Scale drawing of basic enclosure with telemetry rack mounting.

3) Complete parts list with O&M manuals.

4) Complete wiring and connection diagram.

5) Recommended equipment.

2.06 CONTROL PANEL WIRING

A. All electric wiring 115 volts or greater on the panels shall be in accordance with the standards of the NEC. Wires shall be Type THWN stranded, 600-volt insulation and shall be in sizes not less than No. 16 gage, suitable for the currents to be carried. All wiring shall be enclosed in either sheet metal raceway or plastic wiring duct. Connections to the terminal strips shall be made using pressure type lugs. Locate all fuses on a common fuse block with circuit designations. Terminate all connections to external equipment at numbered terminal blocks. One 15-amp circuit shall be extended to the panel.

B. All electrical wiring shall be identified at each end with imprinted Mylar adhesive back wire markers. Show terminal numbers on as-built wiring diagram.

PART 3 - EXECUTION

3.01 GENERAL

A. Install equipment and materials in a neat and workmanlike manner and align, level and adjust for satisfactory operation. Install equipment so that all parts are easily accessible for inspection, operation, maintenance, and repair.

B. Provide trip settings of all main and feeder circuit breakers as directed by the Engineer.

C. After the equipment is installed, touch up any scratches, narks, and the like, incurred during shipment or installation of equipment. If required by the Engineer because of undue amount of scratches, repaint the entire assembly at no additional cost to the Owner.

3.02 FIELD TESTS

A. Functional test: Prior to plant startup, all equipment shall be inspected for proper alignment, proper connection, and satisfactory performance by operation of each starter and feeder.

3.03 WIRING

A. Arrange wiring in cabinets, panels and motor control centers neatly cut to proper length, and remove surplus wire. Apply stak-on or similar terminals to control wiring for connection to terminals, and bridle and secure in an approved manner. List all circuits emanating from power, distribution, and lighting panelboards by function on the directory card. Identify all circuits entering motor control centers or other control cabinets by directory card listing terminal block number and function or by means of tags securely fastened to the conductors.

3.04 EQUIPMENT BASES

A. Provide equipment bases for all floor-mounted electrical equipment. Unless otherwise indicated, bases shall be poured-in-place concrete, nominally four inches high, and be one inch larger on all exposed edges than the equipment to be mounted. On all equipment bases in interior locations, unless otherwise noted, provide two or more parallel, cast-in-place continuous-slot channel erection system concrete inserts for equipment mounting. Bolt equipment to channels. Provide additional surface-mounted channels where required to match and line up with existing equipment. Provide concrete pads and mounting provisions for all exterior equipment as indicated on the drawings or specified in other portions of the specifications.

3.05 SUPPORTS

A. Provide hangers or other devices such as pads, channels, struts, joists, anchors, etc., necessary for the support of electrical equipment. Provide the design, fabrication and erection of supplementary structural framing required for attachment of hangers or other devices supporting electrical equipment.

END OF SECTION