SECTION 43 05 20 - COMMON WORK RESULTS FOR LIQUID HANDLING EQUIPMENT

This Section includes basic materials and other requirements for pumps and is segregated from other such equipment Sections to permit rapid editing and to eliminate necessity of repeating text within other liquid handling equipment Sections.

Manufacturers found in SpecAgent for this Section were identified as representative and not as an endorsement for meeting requirements of this Specification.

This Section includes performance, proprietary, and descriptive type specifications. Edit to avoid conflicting requirements.

This Section includes the term "Architect/Engineer." "Architect" is used in AIA contract documents; "Engineer" is used in EJCDC contract documents. Retain appropriate term.

See Drawing Coordination Considerations for information needed to coordinate this Specification Section with Drawings.

Some of the paragraphs may be deleted. When deleting, do not renumber all the paragraphs. Simply leave the section number and title as is, delete the text, and add the words "Not Used".

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Lubrication.
2. Pump piping, fittings, and valves.
3. Piping connections.
4. Shaft coupling guards.
5. Accessories.

B. Related Sections:

List other Sections directly related to or affecting Work of this Section. Include Sections specifying information expected to be found in this Section as well as Sections required to describe complete system or assembly requirements.

For Division 26, input required from electrical/control subconsultant.

1. Section 03 30 00 - Cast-in-Place Concrete: Equipment support (housekeeping) pads.
2. Section 05 50 00 - Metal Fabrications: Fasteners, brackets, and other miscellaneous metal fabrications as required by this Section.
3. Section 09 90 00 - Painting and Coating: Product and execution requirements for painting specified by this Section.

4. Section 26 29 23 - Variable-Frequency Motor Controllers: Three-phase variable-frequency motor controllers of pulse-width-modulated design for variable-speed drives.

5. Section 40 05 13 - Common Work Results for Process Piping: Execution requirements for piping specified by this Section.

6. Section 40 05 13.13 - Steel Process Pipe: Steel piping materials and appurtenances.

7. Section 40 05 13.19 - Stainless Steel Process Piping: Stainless steel piping materials and appurtenances.

8. Section 40 05 13.53 – Ductile Iron Process Piping: Ductile iron piping materials and appurtenances.

9. Section 40 05 13.73 - Thermoplastic Process Piping: Plastic piping materials and appurtenances.

10. Section 40 05 51 - Common Work Results for Process Valves: Execution requirements for valves specified by this Section.

11. Section 40 05 51.12 - Ball Valves: Execution requirements for ball valves as required by this Section.

12. Section 40 05 51.15 - Gate Valves: Execution requirements for gate valves as required by this Section.

13. Section 40 05 51.18 - Butterfly Valves: Execution requirements for butterfly valves as required by this Section.

14. Section 40 05 51.21 - Plug Valves: Execution requirements for plug valves as required by this Section.

15. Section 40 05 51.24 - Check Valves: Execution requirements for check valves as required by this Section.

16. Section 40 05 78 - Miscellaneous Valves: Execution requirements for miscellaneous valves as required by this Section.

17. Section 40 05 13.07 - Hangers and Supports for Process Piping: Hangers, anchors, sleeves, and sealing of piping to adjacent structures.

18. Section 43 05 48 - Vibration and Seismic Controls for Process Gas and Liquid Handling Equipment: Inertial bases and vibration isolation equipment used for vibration and seismic control.

19. Section 43 05 53 - Identification for Process Gas and Liquid Handling Equipment: Nameplates and equipment identification as required by this Section.

20. Section 43 21 13 - Centrifugal Liquid Pumps: Horizontal, vertical, and screw centrifugal pumps.

21. Section 43 21 23 - Drum Liquid Pumps: Positive-displacement drum pumps.

22. Section 43 21 26 - Gear Liquid Pumps: Positive-displacement external gear pumps.

23. Section 43 21 36 - Positive Displacement Liquid Pumps: Progressing cavity and plunger pumps.

Commented [JW1]: We do not have these in our specifications library. Verify with Technical Lead.

24. Section 43 21 39 – Deep Well Submersible Pumps: Submersible sludge pumps and accessories.

25. Section 43 21 43 - Sump Liquid Pumps: Submersible and non-submersible sump pumps.

26. Section 46 05 13 - Common Motor Requirements for Water and Wastewater Equipment: Electric motors and their accessories normally supplied as part of equipment assemblies.

1.2 REFERENCE STANDARDS

List reference standards included within text of this Section, with designations, numbers, and complete document titles.

A. American Society of Mechanical Engineers:

1. ASME B1.20.1 - Pipe Threads, General Purpose (Inch).

2. ASME B1.20.2M - Pipe Threads, 60 deg. General Purpose (Metric).

3. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

4. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.

B. NSF International:

1. NSF 61 - Drinking Water System Components - Health Effects.

2. NSF 372 - Drinking Water System Components - Lead Content.

Twenty-five states, Puerto Rico, and the Virgin Islands have OSHA-approved state plans and have adopted their own standards and enforcement policies. Generally, these states have adopted standards that are identical to federal OSHA, although some states have adopted different standards or may have different enforcement policies.

C. Occupational Safety and Health Administration (OSHA):

1. 29 CFR 1910 - Occupational Safety and Health Standards.

1.3 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with location and placement of utilities and piping.

1.4 PREINSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.

B. Convene minimum [one week] [<_____> weeks] prior to commencing Work of this Section.

1.5 SUBMITTALS

Only request submittals needed to verify compliance with Project requirements.

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data:

1. Submit Manufacturer information for:

a. Drive assemblies, pumps, tanks, mixers, panels, and other major components.

b. Schematics, diagrams, panel layouts, ladder diagrams, and sequence of operation.

c. Electric motors and variable-frequency drives.

C. Shop Drawings:

1. Indicate assembly, foundation, and installation with location including critical dimensions, sizes, and support locations.

2. Characteristic Pump Curves: Plot against flow rate and indicate total dynamic head, pump efficiency, brake horsepower [, net positive suction head] [, power input to motor] [, and] [overall efficiency].

3. For multi-speed service, indicate characteristic curves for maximum and minimum speeds specified.

4. Submit pump name, identification tag number, and Specification Section number.

5. Submit elevation of local control panel, indicating panel-mounted devices, power single-line diagram, and input/output list.

6. Submit electrical schematic diagram and wiring diagram of field connections.

D. Manufacturer's Certificate:

1. Certify that pumping systems meet or exceed specified requirements.

2. Pumping Systems Rated Greater than 5 hp (3.7 kW):

a. Certify that pumping system has been installed satisfactorily and is ready for operation.

b. Indicate date of field tests and furnish test data.

E. Test and Evaluation Reports:

1. Performance Data Curves:

a. Indicate head, flow rate, power demand, net positive suction head (NPSH) required, and pump efficiency over entire operating range of pump.

b. Indicate head, power demand, overall efficiency at design, and maximum and minimum flow rates.

c. For variable-frequency-driven pumps, indicate performance at intervals of 100 rpm from minimum to maximum speed.

2. NPSH:

a. Indicate test results of NPSH required, as required by specific pump Section.

b. Otherwise, submit Manufacturer's NPSH calculation.

Include separate Paragraphs for additional certifications.

F. Source Quality-Control Submittals: Indicate results of [shop] [factory] tests and inspections.

G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

H. Qualifications Statements:

Coordinate following Subparagraphs with requirements specified in QUALIFICATIONS Article.

1. Submit qualifications for Manufacturer.

2. Submit Manufacturer's approval of installer.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.

B. Spare Parts:

1. Furnish [one set] [two sets] of Manufacturer's recommended spare parts.

******** [OR] ********

2. Furnish [two] <_____> of <_____>.

C. Tools: Furnish special [wrenches] <_____> and other devices required for Owner to maintain and calibrate pumping systems [and] <_____>.

1.7 QUALITY ASSURANCE

Include this Article to specify compliance with overall reference standards affecting products and installation included in this Section.

A. Materials in Contact with Potable Water: Certified to NSF Standards 61 and 372.

In following Paragraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

B. Perform Work according to <_____> standards.

Include following Paragraph only when cost of acquiring specified standards is justified.

C. Maintain <_____> [copy] [copies] of each standard affecting Work of this Section on Site.

1.8 QUALIFICATIONS

Coordinate following Paragraphs with requirements specified in SUBMITTALS Article.

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum [three] <_____> years' [documented] experience.

B. Installer: Company specializing in performing Work of this Section with minimum [three] <_____> years' [documented] experience [and approved by Manufacturer].

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.

C. Store materials according to Manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

2. Provide additional protection according to Manufacturer instructions.

1.10 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.

2. Indicate field measurements on Shop Drawings.

1.11 WARRANTY

This Article extends warranty period beyond one year. Extended warranties may increase construction costs and Owner enforcement responsibilities. Specify warranties with caution.

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

B. Furnish [five] <_____>-year Manufacturer's warranty for pumping systems.

PART 2 PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

A. Provide pumping systems designed and constructed for continuous service within specified range of operation, without overheating, cavitation, or excessive vibration.

2.2 LUBRICATION

A. Water-Lubricated Pumps: Provide flow meter and differential pressure switch to de-energize pumping unit in low-water-flow conditions.

B. Ball Bearings and Roller Bearing: Lubricate materials as recommended by Pump Manufacturer.

C. Lubrication Equipment: Provide pumps, piping, tankage, and filters as required to supply lubrication to pumping units.

2.3 PUMP PIPING, FITTINGS, AND VALVES

A. For piping, fittings, and valves furnished with pumps, comply with relevant Section referenced in this Section under "Related Requirements" Paragraph.

B. Drainage Piping:

1. Exposed [**Galvanized Steel Piping**] [**Copper Tubing**] <_____>:

a. Support as required.

b. Provide cleanout plugs.

2. Buried or Concealed: Cast iron pipe with cleanouts.

3. Route drainage piping to nearest sink or floor drain.

2.4 PIPING CONNECTIONS

A. Flanges:

1. Comply with ASME [**B16.1**] [**B16.5**].

B. Fasteners:

1. As specified in Section 05 50 00 - Metal Fabrications.

C. Screwed Fittings: Comply with ASME B1.20.1 (B1.20.2M).

2.5 SHAFT COUPLING GUARDS

A. Comply with OSHA requirements.

2.6 FINISHES

A. As specified in Section 09 90 00 - Painting and Coating.

2.7 ACCESSORIES

A. Nameplates:

1. As specified in Section 43 05 53 - Identification for Process Gas and Liquid Handling Equipment.

2. Identify individual pumps with a stainless-steel nameplate, indicating assigned equipment number, serial number, rated head and flow rate, impeller size, speed, and Manufacturer's name and model number.

B. Solenoid Valves:

1. As specified in Section 40 05 78 - Miscellaneous Valves.

2. Provide solenoid valves on water or oil lubrication lines and on cooling water lines.

3. Electrical Ratings: Compatible with motor control voltage.

2.8 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Drive Units:

1. Test electric drive motors as specified in Section 46 05 13 - Common Motor Requirements for Water and Wastewater Equipment.

2. Test variable-frequency drives as specified in Section 26 29 23 - Variable-Frequency Motor Controllers.

3. Furnish test results to Pump Manufacturer prior to pump testing.

C. Hydrostatic Testing:

1. Hydrostatically test each pump.

2. Provide Architect/Engineer minimum two weeks' notification prior to testing.

3. Tests of pumps of same model, speed, head, and capacity rating are acceptable if drive unit is rated at 5 hp (3.7 kW) or less.

4. Perform witnessed hydrostatic and performance tests on pumps where specified and on pumping systems rated at 125 hp (92 kW) or greater.

5. Test Pressure:

a. [**Centrifugal**] [**Vortex**] [**and**] [**Turbine**] Pumps: Minimum 150 percent of shutoff head.

b. Positive Displacement Pumps: Minimum 150 percent of maximum head.

D. Performance Testing (Non-positive-displacement Pumps):

1. Test over entire operating range of pump; obtain measurements of head, flow rate, power demand, NPSH required, and pump efficiency.

2. Obtain measurements of head, maximum and minimum flow rates, power demand, and overall efficiency at design.

3. For variable-frequency-driven pumps, test pumps at intervals of 100 rpm from minimum to maximum speed.

4. Demonstrate that pump is free from overheating, cavitation, and excessive vibration overflow rate range.

5. For centrifugal pumps, demonstrate no contact between impeller ring and casing ring overflow rate range.

E. Performance Testing (Positive-Displacement Pumps):

1. Operate pump at least 30 minutes for each specified speed and capacity to demonstrate compliance with specified requirements and to establish that pumping unit is free from overheating and excess vibration.

2. Test pump at maximum rated speed and at minimum, rated, and maximum flow rates, and measure respective head and ampere draw.

3. For pumps with drive unit rated at 5 hp (3.7 kW) or less, test only for excess current draw [**and**] <_____>.

F. Drive Units:

1. Perform tests using complete pump system to be furnished, including Project motor and variable-frequency drive [**if specified**].

2. For pumps with motors rated less than 100 hp (74 kW), Manufacturer's certified test motor is acceptable.

G. NPSH:

1. Perform test of NPSH required as required by specific pump Section.

H. Do not ship equipment until test data have been accepted by Architect/Engineer.

Include one or both of following Paragraphs to require Owner's inspection or witnessing of test at factory.

I. Owner Inspection:

1. Make completed pumping system available for inspection at Manufacturer's factory prior to packaging for shipment.

2. Notify Owner at least [**seven**] <_____> days before inspection is allowed.

J. Owner Witnessing:

1. Allow witnessing of factory inspections and test at Manufacturer's test facility.

2. Notify Owner at least [seven] <_____> days before inspections and tests are scheduled.

Include following Paragraph if reliance on fabricator's approved quality-control program is sufficient for Project requirements.

K. Certificate of Compliance:

1. If fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.

2. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that designated areas, clearances, structural requirements, piping, utility connections, and electronic signals are ready to receive equipment.

3.2 PREPARATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Disconnect electrical systems scheduled for removal.

C. Provide temporary wiring and connections to maintain existing systems in service during construction.

D. Remove, relocate, and extend existing installations as necessary to accommodate new construction.

3.3 INSTALLATION

A. According to Manufacturer instructions.

B. Ensure that equipment is secure in position.

C. Equipment Bases and Supports:

1. Provide [housekeeping pads] <_____> of concrete, minimum 3-1/2 inches (87 mm) thick and extending 6 inches (150 mm) beyond supported [equipment] <_____> [, as specified in Section 03 30 00 - Cast-in-Place Concrete] [, as indicated on Drawings].

2. Install anchor bolts and accessories for mounting and anchoring equipment.

3. Supports:

a. Construct supports of [steel members] [formed steel channel] [steel pipe and fittings] <_____>.

b. Brace and fasten with flanges bolted to equipment structure.

c. Provide flexible connections as required to isolate equipment from piping.

D. Provide rigid anchors for pipes after vibration isolation components are installed, as specified in Section 43 05 48 - Vibration and Seismic Controls for Process Gas and Liquid Handling Equipment.

E. Gauges:

1. Except for [sample pumps] [and] [sump pumps], provide pressure gauges at pump discharge piping and compound gauges on pump suction piping.

2. If subject to shock or vibrations, wall-mount gauges or attach gauges to galvanized channel floor stands and connect with flexible connectors.

F. Lubricants: Provide necessary oil and grease for initial operation.

G. Coat materials and equipment as specified in Section 09 90 00 - Painting and Coating.

3.4 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.

******** [OR] ********

B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.

C. Testing:

1. Test for proper alignment and freedom from binding, scraping, shaft runout, or other defects.

2. Where specified by individual Specification Section, field test equipment to demonstrate operation without undue noise, vibration, or overheating.

3. [Architect/Engineer] <_____> will witness field testing.

4. Start control system by energizing system equipment and testing operation of hardware and process control logic under supervision of Manufacturer's representative and in presence of [Architect/Engineer] <_____>.

5. Field-test each pump system after installation in order to demonstrate:

a. Satisfactory operation without excessive noise and vibration overflow rate range; if pump driven by variable-frequency drive, test at 100-rpm increments.

b. Required head, flow rate, and efficiency at design point.

6. Certify in writing that pump system has been satisfactorily tested.

D. Manufacturer Services: Furnish services of Manufacturer's representative experienced in installation of products furnished under this Section for not less than <_____> [days] [hours] on Site for installation, inspection, startup, field testing, and instructing Owner's personnel in maintenance of equipment.

E. Equipment Acceptance:

1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.

2. Make final adjustments to equipment under direction of Manufacturer's representative.

F. Furnish installation certificate from Equipment Manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.5 DEMONSTRATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.

B. Demonstrate equipment startup, shutdown, routine maintenance, alarm condition responses, and emergency repair procedures to Owner's personnel.

END OF SECTION

SECTION 43 21 00 - LIQUID PUMPS GENERAL

Updated by Eddie Kreipe and Tofor Snider Dec. 2022 with lessons learned from 10th St Water Improvements and Pressure Zone 1A Pump Station.

This Section includes basic materials and other requirements for pumps and is segregated from other such equipment Sections to permit rapid editing and to eliminate the necessity of repeating text within other liquid handling equipment Sections. If any pump specification is used in section 43 21 xx, include this specification in the specification documents.

This Section includes performance, proprietary, and descriptive type specifications. Edit to avoid conflicting requirements.

See Drawing Coordination Considerations for information needed to coordinate this Specification Section with Drawings.

Some of the paragraphs may be deleted. When deleting, do not renumber all the paragraphs. Simply leave the section number and title as is, delete the text, and add the words "Not Used".

1.1 SUMMARY

A. The provisions of this Section shall apply to all pumps and pumping equipment except where otherwise indicated.

B. Where two or more pump systems of the same type or size are required, all pumps shall all be produced by the same Manufacturer.

C. Provide all labor, equipment and materials and perform all operations in connection with the installation and testing of pumps selected by the Owner.

D. Coordinate and utilize all factory testing, installation, start-up, and field-testing services supplied in conjunction with the pumping equipment.

E. All work performed under this Section shall be in accordance with all approved trade practices and Manufacturer's recommendations.

F. Section includes:

1. General pump material, components and appurtenances for liquid pumps.

2. Quality control factory and field testing.

G. Related Sections:

Edit listings below as may be required for Project.

List other Sections directly related to or affecting Work of this Section. Include Sections specifying information expected to be found in this Section as well as Sections required to describe complete system or assembly requirements.

For Division 26, input required from electrical/control subconsultant.

These sections are referenced in this section:

1. Section 03 30 00, Cast-in-Place Concrete (Listed as a choice in Part 3 under Installation)
2. Section 05 50 00, Metal Fabrications (Listed in Part 2 under General and Piping Connections)
3. Section 09 90 00, Painting and Coating (Listed in Part 2 under Piping Connections and Part 3 under Installation)
4. Section 26 29 23, Variable-Frequency Motor Controllers (Listed in Part 2 under Source Quality Control)
5. Section 40 05 78, Miscellaneous Valves (Listed in Part 2 under Accessories)
6. Section 43 05 48, Vibration and Seismic Controls for Process Gas and Liquid Handling Equipment (Listed in Part 3 under Installation)
7. Section 43 21 13, Centrifugal Liquid Pumps (In a NTS in Part 2 under Factory Testing)

The following are not referred to in the body of this section. Edit or delete as necessary.

8. Section 40 05 13, Common Work Results for Process Piping
9. Section 40 05 13.07, Hangers and Supports for Process Piping
10. Section 40 05 13.13, Steel Process Pipe
11. Section 40 05 13.19, Stainless Steel Process Piping
12. Section 40 05 13.53, Ductile Iron Process Piping
13. Section 40 05 13.73, Thermoplastic Process Piping
14. Section 40 05 51, Common Work Results for Process Valves
15. Section 40 05 51.12, Ball Valves
16. Section 40 05 51.15, Gate Valves
17. Section 40 05 51.18, Butterfly Valves
18. Section 40 05 51.21, Plug Valves
19. Section 40 05 51.24, Check Valves
20. Section 43 21 23, Drum Liquid Pumps

21. Section 43 21 26, Gear Liquid Pumps

22. Section 43 21 36, Positive Displacement Liquid Pumps

23. Section 43 21 39, Deep Well Submersible Pumps

24. Section 43 21 43, Sump Liquid Pumps

25. Section 43 21 52, Deep Well Vertical Turbine Pumps

26. [Add individual pump specification(s) that are used on the project.]

1.2 REFERENCE STANDARDS

List reference standards included within text of this Section, with designations, numbers, and complete document titles.

A. American Society of Mechanical Engineers (ASME):

1. ASME B1.20.1 - Pipe Threads, General Purpose (Inch).

2. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

3. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.

B. NSF International:

1. NSF 61 - Drinking Water System Components - Health Effects.

2. NSF 372 - Drinking Water System Components - Lead Content.

3. NSF 600 - Health Effects Evaluation and Criteria for Chemicals in Drinking Water.

Twenty-five states, Puerto Rico, and the Virgin Islands have OSHA-approved state plans and have adopted their own standards and enforcement policies. Generally, these states have adopted standards that are identical to federal OSHA, although some states have adopted different standards or may have different enforcement policies.

C. Occupational Safety and Health Administration (OSHA):

1. 29 CFR 1910 - Occupational Safety and Health Standards.

Include for large pump station applications. Generally, not needed.

1.3 COORDINATION

A. Section 01 30 00, Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with location and placement of utilities and piping.

1.4 PREINSTALLATION MEETINGS

Preinstallation meetings should be specified as required for project. Typically, weekly meetings may be adequate to discuss requirements for pump installation, or a separate meeting may be required. Confirm with client or design lead or PM of project.

A. Section 01 30 00, Administrative Requirements: Requirements for preinstallation meeting.

B. Convene minimum [one week] [< > weeks] prior to commencing Work of this Section.

1.5 SUBMITTALS

Only request submittals needed to verify compliance with Project requirements.

A. Submit in accordance with Section 01 33 00, Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Provide the following information:

1. Pump name, identification number, and applicable Section number from Project specifications.

2. Performance Data Curves:

a. Provide performance curve showing head, capacity, horsepower demand, net positive suction head (NPSH) required and pump efficiency over the entire operating range of the pump.

b. Pump Manufacturer shall indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the design flow conditions and the maximum and minimum flow conditions.

c. A family of performance curves at intervals of 100 revolutions per minute (rpm) from minimum speed to maximum speed shall be provided for each pump equipped with a variable speed drive, and a curve for each speed on two-speed pumps.

3. The limits on the performance curves recommended for stable operation without surge, cavitation, or excessive vibration, known as the Acceptable Operating Range (AOR), per the Hydraulic Institute.

4. Assembly and Installation Drawings: Including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights.

C. Pump anchorage calculations and analysis. Seismic anchorage calculations shall be provided by a registered Engineer in the State of [ ].

D. All pump motor information as required in Division 26, including complete motor nameplate data as defined by NEMA, motor manufacturer and any motor modifications.

E. Head lateral analysis as specified herein and where required by individual pump sections.

F. Provide lateral and torsional analysis as specified herein and where required by individual pump specifications.

G. Operation and Maintenance Manual: Containing the required information for each pump section.

H. Spare Parts List: Containing the required information for each pump section.

I. Factory Test Data: Signed, dated, and certified for each pump system which requires factory testing submitted before shipment of equipment. Requirements for factory test data are specified below.

J. Certifications:

1. Manufacturer's certification of proper installation.

2. Contractor's certification of satisfactory field testing.

All pump motor information as required in Division 26 or Division 43. Coordinate with Electrical Design Lead.

K. All pump motor information as required in Division [26] [43].

Include separate Paragraphs for additional certifications.

L. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

Qualification statements are for large, complex wells and pump stations. Delete when not applicable.

M. Qualifications Statements:

Coordinate following Subparagraphs with requirements specified in QUALIFICATIONS Article.

1. Submit qualifications for Manufacturer.

2. Submit Manufacturer's approval of installer.

N. Certificate of Compliance:

1. Submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. See Section 01 78 23, Operation and Maintenance Data for requirements.

1.7 QUALITY ASSURANCE

Include this Article to specify compliance with overall reference standards affecting products and installation included in this Section.

A. Materials in Contact with Potable Water: Certified to NSF Standards 61 and 372.

In following Paragraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

B. Perform Work according to [ ] standards.

Include following Paragraph only when cost of acquiring specified standards is justified.

C. Maintain [ ] [copy] [copies] of each standard affecting Work of this Section on Site.

1.8 QUALIFICATIONS

Coordinate following Paragraphs with requirements specified in SUBMITTALS Article.

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum [three] [ ] years' [documented] experience.

B. Installer: Company specializing in performing Work of this Section with minimum [three] [ ] years' [documented] experience [and approved by Manufacturer].

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00, Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.

C. Store materials according to Manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

2. Provide additional protection according to Manufacturer instructions.

1.10 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.

2. Indicate field measurements on Shop Drawings.

1.11 WARRANTY

This Article extends warranty period beyond one year. Extended warranties may increase construction costs and Owner enforcement responsibilities. Specify warranties with caution and as required by Owner.

A. Section 01 70 00, Execution and Closeout Requirements: Requirements for warranties.

B. Furnish [five] [ ]-year Manufacturer's warranty for pumping systems.

PART 2 PRODUCTS

2.1 GENERAL

A. Materials and equipment shall be standard products of a manufacturer and distributor regularly engaged in the manufacture and distribution of such products for at least [2] years and shall be suitable for the service intended.

B. All materials and equipment shall be new and unused except for the testing specified herein.

C. Compliance with the requirements of the individual pump sections may necessitate modifications to the Manufacturer's standard equipment.

D. All centrifugal pumps shall have a continuously rising performance curve. In no case shall the required horsepower at any point on the performance curve exceed the rated horsepower of the motor or engine or encroach on the service factor.

E. All components of each pump system provided under the pump sections shall be entirely compatible. Each unit of pumping equipment shall incorporate all basic mechanisms, couplings, electric motors or engine drives, variable speed controls, necessary mountings, and appurtenances.

Coordinate with Owner on preference this can be less distance or increased as needed based on available vendors.

F. The pumps shall be supplied by a distributor authorized to service them throughout the warranty period and beyond. The distributor shall be located within a [100]-mile radius of the site.

G. The pumps shall be warranted by the Manufacturer for a minimum of 1-year from the date of installation.

The following item is specific for potable water projects.

H. All materials and coatings coming in contact with potable water shall be ANSI/NSF Standard 61 approved.

I. The pumping units shall all be supplied by one vendor (unit responsibility) and shall be complete including pumps, motors, column assemblies, suction cans, baseplates, couplings, guards, and other accessories.

J. The complete pump assembly shall be designed and built for continuous service at any and all points within the specified range of operation, without overheating, without damaging cavitation, and without excessive vibration or noise.

2.2 MATERIALS

A. All materials shall be suitable for the intended application; materials not specified shall be high-grade, standard commercial quality, free from all defects and imperfection that might affect

the serviceability of the product for the purpose for which it is intended, and shall conform to the following requirements:

1. Cast iron pump casings and bowls shall be of close-grained gray cast iron, conforming to ASTM A 48 - Gray Iron Casings, Class 30, or equal.

2. Stainless steel pump shafts shall be Type 416 or 316.

3. Miscellaneous stainless steel shall be of Type 316, except in a septic environment.

4. Anchor bolts, washers, and nuts supplied by the Contractor for non-corrosive applications shall be galvanized steel in accordance with the requirements of Section 05 50 00, Metal Fabrications. Anchor bolts, washers, and nuts in corrosive service applications shall be stainless steel in accordance with that Section.

2.3 PUMP COMPONENTS, GENERAL

A. Flanges: Suction and discharge flanges shall conform to ANSI/ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 12, 125, 250, and 800 or B16.5 - Flanges and Flanged Fittings dimensions.

B. Handholes: Handholes on pump casings shall be shaped to follow the contours of the casing to avoid any obstructions in the water passage.

2.4 PUMP APPURTENANCES

A. Nameplates: Each pump shall be equipped with a stainless steel nameplate indicating serial numbers, rated head and flow, impeller size, pump speed, and Manufacturer's name and model number.

Confirm that design is providing the pressure gauges on the Drawings. If not needed, this section can be deleted.

B. Gauges: Provide and install pressure gauges as shown on the Drawings.

1. All pumps (except sample pumps, sump pumps, hot water circulating pumps, and chemical metering pumps) shall be equipped with pressure gauges on the pump discharge.

2. Pump suction lines shall be provided with compound gauges.

3. Gauges shall be located in a representative location, where not subject to shock or vibrations, in order to achieve true and accurate readings.

4. Isolation diaphragms shall be provided for all gauges except where pumping potable water.

5. Where subject to shock or vibrations, the gauges shall be wall-mounted or attached to galvanized channel floor stands and connected by means of flexible connectors.

2.5 SHAFT COUPLING GUARDS

A. Comply with OSHA requirements.

2.6 FINISHES

A. As specified in Section 09 90 00, Painting and Coating.

2.7 SOURCE QUALITY CONTROL

A. Factory Testing:

Typically do factory testing for 100hp and above, or if specified in an individual spec. Adjust as needed if factory testing is desired for smaller pump sizes. Add additional HI tests for pump types as required.

1. Pump Systems: All centrifugal pump systems 100 horsepower (hp) and larger, and as specified in individual pump specification sections, shall be tested at the pump factory in accordance with the American National Standard for Centrifugal Pump Tests (ANSI/HI 1.6) or the American National Standard for Vertical Pump Tests (ANSI/HI 2.6) as approved by American National Standards Institute (ANSI) and published by the Hydraulic Institute.

For deep well pumps, only the bowl assembly needs to be factory tested, NOT THE MOTOR.

2. For motors smaller than 100 hp, the Manufacturer's certified test motor shall be acceptable. For motors larger than 100 hp, tests shall be performed using the complete pump system to be furnished, including the motor. The following minimum test data shall be submitted:

   a. Hydrostatic test data.

   b. A minimum of five hydraulic test readings between shutoff head and 25 percent beyond the maximum indicated capacity, recorded on data sheets as defined by the Hydraulic Institute.

   c. Pump test data curves showing head, flowrate, bhp, and efficiency. Acceptance level shall be Grade 1U as defined by ANSI/HI 14.6.

   d. Certification that the pump horsepower demand did not exceed the rated motor hp beyond the 1.0 service rating at any point on the curve.

   e. Mechanical test data per ANSI/HI 14.6 Appendix E, including testing for vibration, lack of leakage at shaft seals, gaskets and other lubricated areas, and satisfactory operation of rotating parts at the rated pump operating conditions.

   f. Vibration test results meeting ANSI/HI 9.6.4 requirements.

The following paragraph is project specific. Edit or delete and renumber as required. Factory testing may be desired by client or for certain applications.

3. Factory Witnessed Tests: Factory witnessed testing for this Project not required.

4. Acceptance: In the event of failure of any pump to meet any of the requirements, the Contractor and Pump Manufacturer shall make all necessary modifications, repairs, or replacements to conform to the requirements of the Contract Documents and the pump shall be retested at no additional cost to the Owner until found satisfactory.

B. Lateral and Torsional Analysis

1. Where specified in the individual pump sections, the Pump Manufacturer with system responsibility shall perform a complete lateral and torsional analysis of each distinct pump-motor system to be provided on this Project.

2. This analysis shall identify the dry and wet lateral critical and the torsional critical speeds.

3. This analysis shall be performed prior to fabrication of the machinery and shall be submitted for review as part of the pump submittal.

4. The pump and motor manufacturers shall furnish detailed mass elastic data to the Engineer, to be used for an independent evaluation of the lateral and torsional natural frequency analysis.

Confirm if the following is needed and update the individual section to reflect that. This is often only required on pumps with long shafts.

5. Appropriate lateral and torsional critical speed maps shall be produced, and no active critical speed shall be allowed within 25 percent of the operating speed range. Any encroachment within that range shall be eliminated to the satisfaction of the Engineer.

C. Head Lateral Analysis

1. Where specified in the individual pump sections, the pump manufacturer with system responsibility shall perform a complete head lateral analysis of each distinct pump-motor system that analyzes the head and motor combination.

2. This analysis shall include a Finite Element Analysis (FEA) to determine the natural frequencies of the above grade head and motor assembly, assuming a rigid foundation. The analysis shall show that the natural frequencies do not encroach within plus or minus 25 percent of any normal operating speed.

D. Drive Units:

1. Test electric drive motors as specified in Division [26] [43].

2. Test variable-frequency drives as specified in Division 26.

3. Perform tests using complete pump system to be furnished, including Project motor and variable-frequency drive, if specified above.

4. Furnish test results to Pump Manufacturer prior to pump testing.

The NPSH test is very rare and expensive and should only be included if specifically needed for your project. Delete if not needed.

E. NPSH:

1. Perform test of NPSH required as required by specific pump Section.

F. Do not ship equipment until test data have been accepted by Engineer.

Owner inspection usually not required. Delete the above section unless required by client.

G. Owner Inspection:

1. Make completed pumping system available for inspection at Manufacturer's factory prior to packaging for shipment.

2. Notify Owner at least [seven] [ ] days before inspection is allowed.

Owner witnessed testing usually not required. Delete the above section unless Factory Witnessed Testing is required in section 2.7.A above.

H. Owner Witnessing:

1. Allow witnessing of factory inspections and test at Manufacturer's test facility.

2. Notify Owner at least [seven] [< >] days before inspections and tests are scheduled.

PART 3 EXECUTION

3.1 SERVICES OF PUMP MANUFACTURER

The following paragraph is project specific to a project that had pre-procurement of equipment. Edit or delete and renumber as required. Reference 01 75 00, Testing, Training, and Commissioning to align.

A. As part of this construction contract, the Contractor shall utilize the full value of the Owner-acquired services for start-up and testing services from the Pump Supplier.

B. An authorized service representative of the Manufacturer shall visit the Site to witness the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation:

1. Installation of the equipment.

2. Inspection, checking, and adjusting the equipment.

3. Startup and field testing for proper operation.

4. Performing field adjustments to ensure that the equipment installation and operation comply with requirements.

5. Requirements are more specifically detailed herein and in individual pump specifications.

C. Instruction of the Owner’s Personnel:

1. An authorized training representative of the Manufacturer shall visit the Site to instruct the Owner’s personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment.

2. Instruction shall be specific to the models of equipment provided.

3. The Pump Manufacturer's representative shall have at least 2 years' experience in training.

4. Training shall be scheduled a minimum of 3 weeks in advance of the first session.

5. Proposed training material and a detailed outline of each lesson shall be submitted for review. Comments shall be incorporated into the training materials.

6. The training materials shall remain with the trainees.

7. The Owner may digitally record the training for later use with the Owner's personnel.

3.2 EXAMINATION

A. Section 01 70 00, Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that designated areas, clearances, structural requirements, piping, utility connections, and electronic signals are ready to receive equipment.

3.3 PREPARATION

A. Section 01 70 00, Execution and Closeout Requirements: Requirements for installation preparation.

B. Disconnect electrical systems scheduled for removal.

C. Provide temporary wiring and connections to maintain existing systems in service during construction.

D. Remove, relocate, and extend existing installations as necessary to accommodate new construction.

3.4 INSTALLATION

A. General: Pumping equipment shall be installed in accordance with the Manufacturer's written recommendations.

B. Alignment:

1. All equipment shall be field tested to verify proper alignment, operation as specified, and freedom from binding, scraping, vibration, shaft runout, or other defects.

2. Pump drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing.

3. Equipment shall be secure in position and neat in appearance.

C. Equipment Bases and Supports:

1. Provide [**pump bases as shown on Drawings**] [**< > of concrete, minimum < > inches thick and extending [6] inches]** beyond supported [**equipment**] [ ] [**, as specified in Section 03 30 00, Cast-in-Place Concrete**] [**, as indicated on the Drawings**].

2. Install anchor bolts and accessories for mounting and anchoring equipment.

3. Supports:

   a. Construct supports of [steel members] [formed steel channel] [steel pipe and fittings] [ ].

   b. Brace and fasten with flanges bolted to equipment structure.

   c. Provide flexible connections as required to isolate equipment from piping.

D. Provide rigid anchors for pipes after vibration isolation components are installed, as specified in Section 43 05 48, Vibration and Seismic Controls for Process Gas and Liquid Handling Equipment.

E. Lubricants: Provide the necessary lubricants for initial operation, as required by individual pump sections or as recommended by the Manufacturer.

3.5 FIELD TESTS

A. Engineer shall be notified of witness field testing and shall witness portions of the testing, as determined by the Engineer.

B. Each pump system shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, cavitation, or overheating of bearings.

C. Test for proper alignment and freedom from binding, scraping, shaft runout, or other defects.

D. Field testing methods and allowable tolerances shall comply with current version of the Hydraulics Institute standards for the type of pumps installed.

E. The following field testing shall be conducted:

1. Startup, check, and operate the pump system over its entire speed range. Where vibration analysis and measurement are required, it shall be within the amplitude limits specified and recommended by the Hydraulic Institute Standards at a minimum of four pumping conditions defined by the Engineer.

2. Obtain concurrent readings of motor voltage, amperage, pump suction head and pump discharge head for at least four pumping conditions at each pump rotational speed. Check each power lead to the motor for proper current balance.

3. Determine bearing temperatures by contact type thermometer. A run time of at least 20 minutes shall precede this test unless insufficient liquid volume is available.

4. Electrical and instrumentation tests shall conform to the requirements of the Section under which that equipment is specified.

5. Field vibration readings shall be conducted by an Owner-selected certified testing agency, paid for by the Contractor, with readings taken at the following positions with the average not exceeding the current Hydraulic Institutes standards for the type of pump installed.

a. Measurements shall be taken at the locations as specified in the current Hydraulic Institute standards for the type of pump installed. Provide written proof of vibration readings and provide test data.

Max sound decibels should be confirmed with specified pump suppliers.

6. Sound test not to exceed [83] dbA at [3] feet from motor in any direction.

F. Field testing will be witnessed by the Engineer. The Contractor shall furnish 3 days' advance notice of field testing.

G. Equipment Acceptance:

1. Acceptance shall include a comparison of measured installed pump performance with the Manufacturer's curve values. Any discrepancy shall be resolved prior to acceptance by the Owner.

2. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests until the performance is verified.

3. Make final adjustments to equipment under direction of Manufacturer's representative.

4. After each pumping system has satisfied the requirements, the Contractor shall certify in writing that it has been satisfactorily tested and that all final adjustments have been made. Certification shall include the date of the field tests, a listing of all persons present during the tests, and the test data.

H. Contractor shall bear all costs of field tests, including additional services of the Manufacturer's representative required beyond those specified.

3.6 DEMONSTRATION

A. Section 01 70 00, Execution and Closeout Requirements: Requirements for demonstration and training.

B. Demonstrate equipment startup, shutdown, routine maintenance, alarm condition responses, and emergency repair procedures to Owner's personnel.

END OF SECTION

SECTION 43 21 13 - CENTRIFUGAL LIQUID PUMPS

This Section includes horizontal, vertical, and screw centrifugal pumps for use in water and wastewater treatment plants.

Check state and local requirements regarding design, installation, and permitting of sludge pumping systems. Add specific state and local requirements as they apply to this Section.

Manufacturers found in SpecAgent for this Section were identified as representative and not as an endorsement for meeting the requirements of this Specification.

This Section includes performance, proprietary, and descriptive type specifications. Edit to avoid conflicting requirements.

This Section includes the term "Architect/Engineer." "Architect" is used in AIA contract documents; "Engineer" is used in EJCDC contract documents. Retain appropriate term.

See the Drawing Coordination Considerations for information needed to coordinate this Specification Section with the Drawings.

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Horizontal end suction pumps.
2. Horizontal non-clog pumps.
3. Horizontal recessed impeller pumps.
4. Horizontal split-case pumps.
5. Horizontal axial-flow pumps.
6. Vertical non-clog pumps.
7. Screw centrifugal pumps.

B. Related Sections

List other Sections directly related to or affecting Work of this Section. Include Sections specifying information expected to be found in this Section as well as Sections required to describe complete system or assembly requirements.

For Division 26, input required from electrical/control subconsultant.

1. Section 26 05 03 - Equipment Wiring Connections: Conduit and electrical power to pumps.
2. Section 26 29 23 - Variable-Frequency Motor Controllers: Execution and product requirements for equipment specified by this Section.

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3. Section 40 05 13 - Common Work Results for Process Piping: Execution requirements for piping specified by this Section.

4. Section 40 05 23 - Common Work Results for Process Valves: Execution requirements for valves specified by this Section.

5. Section 40 95 13 - Process Control Panels and Hardware: Pump control panel and accessories for a duplex wastewater lift station.

Commented [JW1]: We do not have these in our specifications library. Verify with Technical Lead.

6. Section 43 05 20 - Common Work Results for Liquid Handling Equipment: Pump components, appurtenances, and identification requirements common to liquid-handling systems.

7. Section 46 05 13 - Common Motor Requirements for Water and Wastewater Equipment: Electric motors and accessories normally supplied as part of equipment assemblies.

1.2 REFERENCE STANDARDS

List reference standards included within text of this Section, with designations, numbers, and complete document titles.

A. American Bearing Manufacturers Association:

1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. American Society of Mechanical Engineers:

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings.

C. ASTM International:

1. ASTM A29 - Standard Specification for Steel Bars, Carbon and Alloy, Hot-Wrought, General Requirements for.

2. ASTM A29M - Standard Specification for Steel Bars, Carbon and Alloy, Hot-Wrought, General Requirements for.

3. ASTM A48 - Standard Specification for Gray Iron Castings.

4. ASTM A48M - Standard Specification for Gray Iron Castings.

5. ASTM A322 - Standard Specification for Steel Bars, Alloy, Standard Grades.

6. ASTM A532 - Standard Specification for Abrasion-Resistant Cast Irons.

7. ASTM A532M - Standard Specification for Abrasion-Resistant Cast Irons.

8. ASTM A536 - Standard Specification for Ductile Iron Castings.

9. ASTM A606 - Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance.

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10. ASTM A743 - Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.

11. ASTM A743M - Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.

12. ASTM A744 - Standard Specification for Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service.

13. ASTM A744M - Standard Specification for Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service.

14. ASTM B148 - Standard Specification for Aluminum-Bronze Sand Castings.

15. ASTM B505 - Standard Specification for Copper Alloy Continuous Castings.

16. ASTM B505M - Standard Specification for Copper Alloy Continuous Castings.

1.3 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate installation and startup of Work of this Section with [**plant operations**] [**Owner's operations**] <_____>.

1.4 SCHEDULING

A. Section [**01 30 00 - Administrative Requirements**] [**01 32 16 - Construction Progress Schedule**]: Requirements for scheduling.

B. Schedule Work of this Section to install pumps prior to connecting piping work.

1.5 SEQUENCING

A. Section 01 10 00 - Summary: Requirements for sequencing.

B. Sequence Work of this Section to prevent interference with [**plant operations**] [**Owner's operation**] <_____>.

1.6 SUBMITTALS

Only request submittals needed to verify compliance with Project requirements.

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit information concerning materials of construction and fabrication.

C. Shop Drawings:

1. Submit detailed dimensions for materials and equipment, including wiring and control diagrams, performance charts and curves, installation and anchoring requirements, fasteners, and other details.

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2. Include Manufacturer's specified displacement tolerances for vibration at operational speed specified for pumps.

D. Product Data: Submit information concerning materials of construction and fabrication.

Include separate Paragraphs for certifications.

E. Manufacturer's Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures, anchoring, and layout.

F. Source Quality-Control Submittals: Indicate results of [**shop**] [**factory**] tests and inspections.

G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

H. Manufacturer Reports: Indicate that equipment has been installed according to Manufacturer's instructions.

1.7 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout procedures.

B. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

C. Operation and Maintenance Data: Submit maintenance instructions for equipment and accessories.

1.8 WARRANTY

This Article extends warranty period beyond one year. Extended warranties may increase construction costs and Owner enforcement responsibilities. Specify warranties with caution.

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

B. Furnish [**five**] <_____>-year manufacturer's warranty for <_____>.

PART 2 PRODUCTS

2.1 HORIZONTAL END SUCTION PUMPS

A. Manufacturers:

1. <**Click link above to find, evaluate, and insert list of manufacturers from SpecAgent**>.

2. Substitutions: [**Section 01 60 00 - Product Requirements**] [**Not permitted**].

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****** [OR] ******

In following Subparagraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

3. Furnish materials according to <_____> standards.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

B. Description: Frame-mounted, centrifugal, horizontal end suction pump, with [direct-coupled] [variable-speed] electric motor.

Repeat following Subparagraphs as necessary to describe all pumps of this type in Project.

1. Pump Name: <_____>.
2. Pump Designation:
   a. [P-<____>.]
   b. [P-<____>.]
   c. [P-<____>.]

C. Performance and Design Criteria:

1. Design Flow Rate: <_____> gpm (<_____> L/s).
2. Design Flow Total Dynamic Head: <_____> feet (<_____> m).
3. Minimum Efficiency at Design Flow Rate: <_____> percent.
4. Minimum Flow Rate: <_____> gpm (<_____> L/s).
5. Minimum Flow Total Dynamic Head: <_____> feet (<_____> m).
6. Minimum Efficiency at Minimum Flow Rate: <_____> percent.
7. Maximum Flow Rate: <_____> gpm (<_____> L/s).
8. Maximum Flow Total Dynamic Head: <_____> feet (<_____> m).
9. Minimum Efficiency at Maximum Flow Rate: <_____> percent.
10. NPSH Available: <_____> feet (<_____> m).
11. Service Liquid: <_____>.
12. Specific Gravity: <_____>.
13. Temperature: <_____>.

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14. Maximum Pump Speed: <_____> rpm.

15. Maximum Motor Speed: <_____> rpm.

D. Pump Casing:

1. Type: Volute.

2. Material: [Cast iron] [ASTM A536, ductile iron].

3. Connections: Gauge and drain.

4. Furnish backhead to permit removal of impeller, shaft, and bearings without affecting piping.

E. Impeller:

1. Type: Single stage, end suction centrifugal.

2. Material: [Cast iron] [Ductile iron] [Cast steel] [Bronze] [Same material as pump casing].

3. Statically and dynamically balanced after assembly.

F. Pump Shaft:

1. [ASTM A29, steel.] [Stainless steel.]

2. Couplings: Keyed to shaft.

G. Coupling:

1. Connect pump shaft to drive motor with universal flexible coupling to compensate for minor misalignment and to permit removal of pump-rotating assembly and motor without removing piping.

2. Shaft Guard: Enclose shaft and universal joint with enclosed-type metal shaft guard complying with OSHA Standards.

H. Wearing Rings:

1. Material: [ASTM B505, bronze] [Stainless steel].

I. Bearings:

Bearing life is percent failure at rated hours, i.e., L-10 life at 50,000 hours means 10 percent of bearings may be expected to fail at 50,000 hours.

1. Type: [Ball] [or] [roller].

2. Minimum L-10 Life: [40,000] <_____> hours at continuous maximum load and speed, according to ABMA [9] [11].

J. Seals: [Split mechanical] <_____>.

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K. Lubrication: [**Grease**] [**Oil**].

L. Base:

1. Heavy [**cast-iron**] [**fabricated structural-steel**] base with drip rim and drain connection.

2. Pump and Drive Mating Surfaces: Machine finished.

M. Operation:

1. Electrical Characteristics: As specified in Section [**26 05 03 - Equipment Wiring Connections**] [**26 29 23 - Variable-Frequency Motor Controllers**] and following:

   a. [**<_____> hp (<_____> W)**.] [**<_____> rated load amperes.**]

   b. Voltage: <_____> V, [**single**] [**three**] phase, 60 Hz.

   c. Maximum [**Fuse Size**] [**Circuit Breaker Size**] [**Overcurrent Protection**]: <_____> A.

   d. Minimum Circuit Ampacity: <_____>.

   e. Minimum Power Factor: <_____> percent at rated load.

2. Motors: As specified in Section 46 05 13 - Common Motor Requirements for Water and Wastewater Equipment.

3. Controls: As specified in Section 40 95 13 - Process Control Panels and Hardware.

4. Disconnect Switch: Factory mounted [**in control panel**] [**on equipment**].

5. Operation Sequences: [**As indicated on Drawings**] <_____>.

2.2 HORIZONTAL NON-CLOG PUMPS

A. Manufacturers:

1. <**Click link above to find, evaluate, and insert list of manufacturers from SpecAgent**>.

2. Substitutions: [**Section 01 60 00 - Product Requirements**] [**Not permitted**].

******** [OR] ********

In following Subparagraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

3. Furnish materials according to <_____> standards.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

B. Description: Centrifugal, horizontal non-clog pump, with coupling and [**constant-speed**] [**two-speed**] electric motor, mounted on a common base.

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Repeat following Subparagraphs as necessary to describe all pumps of this type in Project.

1. Pump Name: <_____>.
2. Pump Designation:
   a. [**P-<____>.**]
   b. [**P-<____>.**]
   c. [**P-<____>.**]

C. Performance and Design Criteria:

1. Design Flow Rate: <_____> gpm (<_____> L/s).
2. Design Flow Total Dynamic Head: <_____> feet (<_____> m).
3. Minimum Efficiency at Design Flow Rate: <_____> percent.
4. Minimum Flow Rate: <_____> gpm (<_____> L/s).
5. Minimum Flow Total Dynamic Head: <_____> feet (<_____> m).
6. Minimum Efficiency at Minimum Flow Rate: <_____> percent.
7. Maximum Flow Rate: <_____> gpm (<_____> L/s).
8. Maximum Flow Total Dynamic Head: <_____> feet (<_____> m).
9. Minimum Efficiency at Maximum Flow Rate: <_____> percent.
10. NPSH Available: <_____> feet (<_____> m).
11. Minimum Diameter Solid Sphere Passing through Pump: <_____> inch (<_____> mm).
12. Maximum Pump Speed: <_____> rpm.
13. Maximum Motor Speed: <_____> rpm.

D. Pump Casing:

1. Design:
   a. One-piece.
   b. End suction.
   c. Back pullout and rotation in 45-degree increments to accommodate piping orientation.
   d. Register fit mating surfaces.

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2. Material: [**Cast iron**] [**Ductile iron**] <_____>.

3. Flange: ASME B16.1, Class [**125**] [**150**] <_____>, tangential side discharge.

4. Wearing Rings: Replaceable.

5. Connections: Gauge, cleanout port, prime, air vent, and drain/flush.

6. Furnish backhead, with drain, to permit removal of impeller, shaft, and bearings without affecting piping.

E. Impeller:

1. Design:

   a. Enclosed, two ports, back vanes.

   b. Radial flow.

   c. Solids Handling: 3-inch (75-mm) spherical solids.

2. Material: [**Cast iron**] [**Ductile iron**] [**Cast steel**] [**Bronze**] <_____>.

3. Wearing Rings: Replaceable.

4. Keyed to shaft; stainless-steel locknut.

5. Statically and dynamically balanced after assembly.

6. Backhead: Separate one-piece casting, register fit to pump casing and bearing housing; cast stuffing box.

F. Pump Shaft:

1. [**Stainless steel**] [**Magnesium alloy steel**] <_____>.

2. Tapered and keyed at both ends.

G. Coupling:

1. Connect pump shaft to drive motor with universal flexible coupling to compensate for minor misalignment and to permit removal of pump-rotating assembly and motor without removing piping.

2. Shaft Guard: Enclose shaft and universal joint with enclosed-type metal shaft guard complying with OSHA Standards.

H. Bearings:

Bearing life is percent failure at rated hours, i.e., L-10 life at 50,000 hours means 10 percent of bearings may be expected to fail at 50,000 hours.

1. Inboard radial-load bearing; outboard radial-thrust bearing.

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2. Minimum L-10 Life: [54,000] <_____> hours thrust; [300,000] <_____> hours radial; at continuous maximum load and speed; according to ABMA [9] [11].

3. Furnish inboard and outboard bearing retainers, grease seals, water deflectors, and grease fittings.

I. Seals: [Mechanical] <_____>.

J. Lubrication: [Grease] [Oil].

K. Base:

1. Heavy [cast-iron] [fabricated structural-steel] base with drip rim and drain connection.

2. Pump and Drive Mating Surfaces: Machine finished.

L. Operation:

1. Electrical Characteristics: As specified in Section 26 05 03 - Equipment Wiring Connections and following:

a. [<_____> hp (<_____> W).] [<_____> rated load amperes.]

b. Voltage: <_____> V, [single] [three] phase, 60 Hz.

c. Maximum [Fuse Size] [Circuit Breaker Size] [Overcurrent Protection]: <_____> A.

d. Minimum Circuit Ampacity: <_____>.

e. Minimum Power Factor: <_____> percent at rated load.

2. Motors: As specified in Section 46 05 13 - Common Motor Requirements for Water and Wastewater Equipment.

3. Controls: As specified in Section 40 95 13 - Process Control Panels and Hardware.

4. Disconnect Switch: Factory mounted [in control panel] [on equipment].

5. Operation Sequences: [As indicated on Drawings] <_____>.

2.3 HORIZONTAL RECESSED IMPELLER PUMPS

A. Manufacturers:

1. <Click link above to find, evaluate, and insert list of manufacturers from SpecAgent>.

2. Substitutions: [Section 01 60 00 - Product Requirements] [Not permitted].

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******** [OR] ********

In following Subparagraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

3. Furnish materials according to <_____> standards.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

B. Description: Frame-mounted, centrifugal, horizontal recessed impeller pump, with [direct-coupled] [variable-speed] <_____> electric motor.

Repeat following Subparagraphs as necessary to describe all pumps of this type in Project.

1. Pump Name: <_____>.
2. Pump Designation:
   a. [P-<____>.]
   b. [P-<____>.]
   c. [P-<____>.]

C. Performance and Design Criteria:

1. Design Flow Rate: <_____> gpm (<_____> L/s).
2. Design Flow Total Dynamic Head: <_____> feet (<_____> m).
3. Minimum Efficiency at Design Flow Rate: <_____> percent.
4. Minimum Flow Rate: <_____> gpm (<_____> L/s).
5. Minimum Flow Total Dynamic Head: <_____> feet (<_____> m).
6. Minimum Efficiency at Minimum Flow Rate: <_____> percent.
7. Maximum Flow Rate: <_____> gpm (<_____> L/s).
8. Maximum Flow Total Dynamic Head: <_____> feet (<_____> m).
9. Minimum Efficiency at Maximum Flow Rate: <_____> percent.
10. NPSH Available: <_____> feet (<_____> m).
11. Service Liquid: <_____>.
12. Specific Gravity: <_____>.
13. Temperature: <_____>.

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14. Maximum Pump Speed: <_____> rpm.

15. Maximum Motor Speed: <_____> rpm.

D. Pump Casing:

1. Material: [**Nickel iron**] [**Chrome iron**].

2. Minimum Hardness: 600 Brinell.

3. Two-piece; removable suction end.

E. Impeller:

1. Material: [**Nickel iron**] [**Chrome iron**].

2. Minimum Hardness: 600 Brinell.

3. Fully recessed cup type.

4. Statically and dynamically balanced after assembly.

F. Pump Shaft:

1. Forged steel, AISI 1045.

2. Sleeve: Removable; [**stainless steel**] [**chrome-plated steel**].

G. Coupling:

1. Connect pump shaft to drive motor with universal flexible coupling to compensate for minor misalignment.

2. Shaft Guard: Enclose shaft and universal joint with enclosed-type metal shaft guard complying with OSHA Standards.

H. Bearings:

Bearing life is percent failure at rated hours, i.e., L-10 life at 50,000 hours means 10 percent of bearings may be expected to fail at 50,000 hours.

1. Type: [**Ball**] [**or**] [**roller**].

2. Minimum L-10 Life: [**40,000**] <_____> hours at continuous maximum load and speed, according to ABMA [**9**] [**11**].

I. Seals: [**Stuffing box**] <_____>.

J. Lubrication: [**Grease**] [**Oil**].

K. Base:

1. Heavy [**cast-iron**] [**fabricated structural-steel**] base with drip rim and drain connection.

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2. Pump and Drive Mating Surfaces: Machine finished.

L. Operation:

1. Electrical Characteristics: As specified in Section [26 05 03 - Equipment Wiring Connections] [26 29 23 - Variable-Frequency Motor Controllers] and following:

a. [<_____> hp (<_____> W).] [<_____> rated load amperes.]

b. Voltage: <_____> V, [single] [three] phase, 60 Hz.

c. Maximum [Fuse Size] [Circuit Breaker Size] [Overcurrent Protection]: <_____> A.

d. Minimum Circuit Ampacity: <_____>.

e. Minimum Power Factor: <_____> percent at rated load.

2. Motors: As specified in Section 46 05 13 - Common Motor Requirements for Water and Wastewater Equipment.

3. Controls: As specified in Section 40 95 13 - Process Control Panels and Hardware.

4. Disconnect Switch: Factory mounted [in control panel] [on equipment].

5. Operation Sequences: [As indicated on Drawings] <_____>.

2.4 HORIZONTAL SPLIT-CASE PUMPS

A. Manufacturers:

1. <Click link above to find, evaluate, and insert list of manufacturers from SpecAgent>.

2. Substitutions: [Section 01 60 00 - Product Requirements] [Not permitted].

******** [OR] ********

In following Subparagraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

3. Furnish materials according to <_____> standards.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

B. Description: Horizontal split-case pump, with [direct-coupled] [variable-speed] electric motor.

Repeat following Subparagraphs as necessary to describe all pumps of this type in Project.

1. Pump Name: <_____>.

2. Pump Designation:

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a. [P-<____>.]

b. [P-<____>.]

c. [P-<____>.]

C. Performance and Design Criteria:

1. Design Flow Rate: <_____> gpm (<_____> L/s).
2. Design Flow Total Dynamic Head: <_____> feet (<_____> m).
3. Minimum Efficiency at Design Flow Rate: <_____> percent.
4. Minimum Flow Rate: <_____> gpm (<_____> L/s).
5. Minimum Flow Total Dynamic Head: <_____> feet (<_____> m).
6. Minimum Efficiency at Minimum Flow Rate: <_____> percent.
7. Maximum Flow Rate: <_____> gpm (<_____> L/s).
8. Maximum Flow Total Dynamic Head: <_____> feet (<_____> m).
9. Minimum Efficiency at Maximum Flow Rate: <_____> percent.
10. NPSH Available: <_____> feet (<_____> m).
11. Service Liquid: <_____>.
12. Specific Gravity: <_____>.
13. Temperature: <_____>.
14. Maximum Pump Speed: <_____> rpm.
15. Maximum Motor Speed: <_____> rpm.

D. Pump Casing:

1. Material: [Nickel iron] [Chrome iron] <_____>.
2. Connections: Air vent and drain.
3. Split; removable top portion.

E. Impeller:

1. Material: [ASTM A744, stainless steel] [ASTM B148, aluminum-bronze].
2. Double suction; enclosed; keyed to pump shaft.
3. Statically and dynamically balanced after assembly.

F. Pump Shaft:

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1. Materials: [**ASTM A29, steel**] <_____>.

2. Furnish positioners to center impeller on shaft.

G. Coupling:

1. Connect pump shaft to drive motor with universal flexible coupling to compensate for minor misalignment.

2. Shaft Guard: Enclose shaft and universal joint with enclosed-type metal shaft guard complying with OSHA Standards.

H. Wearing Rings:

1. Replaceable.

2. Stainless-steel fasteners.

I. Seals: [**Mechanical**] <_____>.

J. Lubrication: [**Grease**] [**Oil**].

K. Bearings:

Bearing life is percent failure at rated hours, i.e., L-10 life at 50,000 hours means 10 percent of bearings may be expected to fail at 50,000 hours.

1. Minimum L-10 Life: [**100,000**] <_____> hours at continuous maximum load and speed, according to ABMA [**9**] [**11**].

L. Base:

1. Heavy [**cast-iron**] [**fabricated structural-steel**] base with drip rim and drain connection.

2. Pump and Drive Mating Surfaces: Machine finished.

M. Operation:

1. Electrical Characteristics: As specified in Section [**26 05 03 - Equipment Wiring Connections**] [**26 29 23 - Variable-Frequency Motor Controllers**] and following:

a. [**<_____> hp (<_____> W).**] [**<_____> rated load amperes.**]

b. Voltage: <_____> V, [**single**] [**three**] phase, 60 Hz.

c. Maximum [**Fuse Size**] [**Circuit Breaker Size**] [**Overcurrent Protection**]: <_____> A.

d. Minimum Circuit Ampacity: <_____>.

e. Minimum Power Factor: <_____> percent at rated load.

2. Motors: As specified in Section 46 05 13 - Common Motor Requirements for Water and Wastewater Equipment.

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3. Controls: As specified in Section 40 95 13 - Process Control Panels and Hardware.

4. Disconnect Switch: Factory mounted [in control panel] [on equipment].

5. Operation Sequences: [As indicated on Drawings] <_____>.

2.5 HORIZONTAL AXIAL-FLOW PUMPS

A. Manufacturers:

1. <Click link above to find, evaluate, and insert list of manufacturers from SpecAgent>.

2. Substitutions: [Section 01 60 00 - Product Requirements] [Not permitted].

******** [OR] ********

In following Subparagraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

3. Furnish materials according to <_____> standards.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

B. Description: Horizontal axial-flow pump, with [direct-coupled] [variable-speed] electric motor.

Repeat following Subparagraphs as necessary to describe all pumps of this type in Project.

1. Pump Name: <_____>.

2. Pump Designation:

a. [P-<____>.]

b. [P-<____>.]

c. [P-<____>.]

C. Performance and Design Criteria:

1. Design Flow Rate: <_____> gpm (<_____> L/s).

2. Design Flow Total Dynamic Head: <_____> feet (<_____> m).

3. Minimum Efficiency at Design Flow Rate: <_____> percent.

4. Minimum Flow Rate: <_____> gpm (<_____> L/s).

5. Minimum Flow Total Dynamic Head: <_____> feet (<_____> m).

6. Minimum Efficiency at Minimum Flow Rate: <_____> percent.

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7. Maximum Flow Rate: <_____> gpm (<_____> L/s).

8. Maximum Flow Total Dynamic Head: <_____> feet (<_____> m).

9. Minimum Efficiency at Maximum Flow Rate: <_____> percent.

10. NPSH Available: <_____> feet (<_____> m).

11. Service Liquid: <_____>.

12. Specific Gravity: <_____>.

13. Temperature: <_____>.

14. Minimum Diameter Solid Sphere Passing through Pump: <_____> inch (<_____> mm).

15. Maximum Pump Speed: <_____> rpm.

16. Maximum Motor Speed: <_____> rpm.

D. Pump Casing:

1. Material: [**ASTM A48, cast iron**] [**Type 316 stainless steel**] [**ASTM A606, corrosion-resistant steel**].

2. Flange: ASME B16.1, Class [**125**] [**150**] <_____>.

3. Connections: Air vent and drain.

4. Suction Inlet: Top side, with flow guide vanes.

E. Propeller:

1. Material: [**ASTM A48, cast iron**] [**Type 316 stainless steel**] [**ASTM A606, corrosion-resistant steel**].

2. Double suction; enclosed; keyed to pump shaft.

3. Statically and dynamically balanced after assembly.

F. Pump Shaft:

1. Material: [**Type 316 stainless steel**] <_____>.

2. Fully cantilevered into pump elbows.

G. Coupling:

1. Connect pump shaft to drive motor with universal flexible coupling to compensate for minor misalignment.

2. Shaft Guard: Enclose shaft and universal joint with enclosed-type metal shaft guard complying with OSHA Standards.

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H. Bearings:

Bearing life is percent failure at rated hours, i.e., L-10 life at 50,000 hours means 10 percent of bearings may be expected to fail at 50,000 hours.

1. Thrust and radial roller bearings with split-bearing housing.

2. Minimum L-10 Life: [100,000] <_____> hours at full load, according to ABMA [9] [11].

I. Seals: [Mechanical] [Packing] <_____>.

J. Lubrication: Oil.

K. Base:

1. Heavy [cast-iron] [fabricated structural-steel] base with drip rim and drain connection.

2. Pump and Drive Mating Surfaces: Machine finished.

L. Operation:

1. Electrical Characteristics: As specified in Section [26 05 03 - Equipment Wiring Connections] [26 29 23 - Variable-Frequency Motor Controllers] and following:

a. [<_____> hp (<_____> W).] [<_____> rated load amperes.]

b. Voltage: <_____> V, [single] [three] phase, 60 Hz.

c. Maximum [Fuse Size] [Circuit Breaker Size] [Overcurrent Protection]: <_____> A.

d. Minimum Circuit Ampacity: <_____>.

e. Minimum Power Factor: <_____> percent at rated load.

2. Motors: As specified in Section 46 05 13 - Common Motor Requirements for Water and Wastewater Equipment.

3. Controls: As specified in Section 40 95 13 - Process Control Panels and Hardware.

4. Disconnect Switch: Factory mounted [in control panel] [on equipment].

5. Operation Sequences: [As indicated on Drawings] <_____>.

2.6 VERTICAL NON-CLOG PUMPS

A. Manufacturers:

1. <Click link above to find, evaluate, and insert list of manufacturers from SpecAgent>.

2. Substitutions: [Section 01 60 00 - Product Requirements] [Not permitted].

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******** [OR] ********

In following Subparagraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

3. Furnish materials according to <_____> standards.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

B. Description: Centrifugal, vertical non-clog pump, with [direct-coupled] [close-coupled] [two-speed] [variable-speed] electric motor[, with extension shaft].

Repeat following Subparagraphs as necessary to describe all pumps of this type in Project.

1. Pump Name: <_____>.
2. Pump Designation:
   a. [P-<____>.]
   b. [P-<____>.]
   c. [P-<____>.]

C. Performance and Design Criteria:

1. Design Flow Rate: <_____> gpm (<_____> L/s).
2. Design Flow Total Dynamic Head: <_____> feet (<_____> m).
3. Minimum Efficiency at Design Flow Rate: <_____> percent.
4. Minimum Flow Rate: <_____> gpm (<_____> L/s).
5. Minimum Flow Total Dynamic Head: <_____> feet (<_____> m).
6. Minimum Efficiency at Minimum Flow Rate: <_____> percent.
7. Maximum Flow Rate: <_____> gpm (<_____> L/s).
8. Maximum Flow Total Dynamic Head: <_____> feet (<_____> m).
9. Minimum Efficiency at Maximum Flow Rate: <_____> percent.
10. NPSH Available: <_____> feet (<_____> m).
11. Minimum Diameter Solid Sphere Passing through Pump: <_____> inch (<_____> mm).
12. Maximum Pump Speed: <_____> rpm.

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13. Maximum Motor Speed: <_____> rpm.

D. Pump Casing:

1. Material: [**ASTM A536, ductile iron**] <_____>.

2. Type: [**Single**] [**Double**] volute.

3. Connections: Air vent and drain.

4. Split; removable top portion.

5. Flange: ASME B16.1, Class [**125**] [**150**] <_____>.

E. Impeller:

1. Material: [**ASTM A744, stainless steel**] [**ASTM A536, ductile iron**] <_____>.

2. Design to pass sand, grit, and solids normally encountered in a wastewater treatment plant without clogging.

3. Keyed to pump shaft.

4. Statically and dynamically balanced after assembly.

F. Pump Shaft:

1. Material: [**ASTM A29, steel**] <_____>.

2. [**Key**] [**or**] [**spline**] couplings to shaft.

3. Furnish shaft wearing sleeve.

G. Coupling:

1. Connect pump shaft to drive motor with universal flexible coupling to compensate for minor misalignment.

2. Shaft Guard: Enclose shaft and universal joint with enclosed-type metal shaft guard complying with OSHA Standards.

H. Wearing Rings:

1. Replaceable.

2. Stainless-steel fasteners.

I. Bearings:

Bearing life is percent failure at rated hours, i.e., L-10 life at 50,000 hours means 10 percent of bearings may be expected to fail at 50,000 hours.

1. Minimum L-10 Life: [**100,000**] <_____> hours at continuous maximum load and speed, according to ABMA [**9**] [**11**].

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J. Seals: [Split mechanical] <_____>.

K. Lubrication: [Grease] [Oil].

L. Base:

1. Heavy [cast-iron] [fabricated structural-steel] base with drip rim and drain connection.

2. Pump and Drive Mating Surfaces: Machine finished.

M. Operation:

1. Electrical Characteristics: As specified in Section [26 05 03 - Equipment Wiring Connections] [26 29 23 - Variable-Frequency Motor Controllers] and following:

a. [<_____> hp (<_____> W).] [<_____> rated load amperes.]

b. Voltage: <_____> V, [single] [three] phase, 60 Hz.

c. Maximum [Fuse Size] [Circuit Breaker Size] [Overcurrent Protection]: <_____> A.

d. Minimum Circuit Ampacity: <_____>.

e. Minimum Power Factor: <_____> percent at rated load.

2. Motors: As specified in Section 46 05 13 - Common Motor Requirements for Water and Wastewater Equipment.

3. Controls: As specified in Section 40 95 13 - Process Control Panels and Hardware.

4. Disconnect Switch: Factory mounted [in control panel] [on equipment].

5. Operation Sequences: [As indicated on Drawings] <_____>.

2.7 SCREW CENTRIFUGAL PUMPS

A. Manufacturers:

1. <Click link above to find, evaluate, and insert list of manufacturers from SpecAgent>.

2. Substitutions: [Section 01 60 00 - Product Requirements] [Not permitted].

******** [OR] ********

In following Subparagraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

3. Furnish materials according to <_____> standards.

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Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

B. Description:

1. Horizontal, screw centrifugal pump, with [V-belt drive] <_____> electric motor.

Repeat following Subparagraphs as necessary to describe all pumps of this type in Project.

2. Pump Name: <_____>.

3. Pump Designation:

   a. [P-<____>.]

   b. [P-<____>.]

   c. [P-<____>.]

C. Performance and Design Criteria:

1. Maximum Shutoff Head: <_____> feet (<_____> m).

2. Design Flow Rate: <_____> gpm (<_____> L/s).

3. Design Flow Total Dynamic Head: <_____> feet (<_____> m).

4. Design Flow Minimum Efficiency: <_____> percent.

5. Minimum Flow Rate: <_____> gpm (<_____> L/s).

6. Minimum Flow Total Dynamic Head: <_____> feet (<_____> m).

7. Minimum Flow Minimum Efficiency: <_____> percent.

8. Maximum Flow Rate: <_____> gpm (<_____> L/s).

9. Maximum Flow Total Dynamic Head: <_____> feet (<_____> m).

10. Maximum Flow Minimum Efficiency: <_____> percent.

D. Pump Casing:

1. ASTM A48, Class 30, cast iron.

2. Heavy-duty construction, with removable and replaceable suction cone and backplate.

E. Impeller:

1. Type: Screw centrifugal.

2. Material: ASTM A532, cast iron.

3. Fully open.

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4. Minimum 450 Brinell hardness.

5. Statically and dynamically balanced after assembly.

6. Secured to shaft by key.

F. Suction Liner:

1. Material: ASTM A 532, Class III, Type A1, 450 Brinell, high-chrome cast iron.

2. Liner shall be externally adjustable by means of three Type 316 stainless-steel regulating screws. Each adjusting screw shall incorporate a mechanism for positively advancing, retracting, and locking the position of the liner, so that the necessary running clearances between the liner and impeller can be maintained without disassembly of the pump and/or piping.

3. The suction liner shall be provided with a spiral groove on the inside to minimize clogging with fibrous material between the impeller and the suction liner.

G. Pump Shaft:

Consider AISI forged steel if shaft is non-wetted; otherwise, consider stainless steel.

1. Shaft Material: ASTM [**A29**] [**A322**], steel.

2. Shaft Sleeve: [**ASTM A743, stainless steel**] [**Chrome-plated steel**] <_____>; removable.

H. Bearings:

1. Radial and thrust.

2. Type: [**Roller**] [**or**] [**ball**].

Bearing life is percent failure at rated hours, i.e., L-10 life at 50,000 hours means 10 percent of bearings may be expected to fail at 50,000 hours.

3. Minimum L-10 Life: [**50,000**] [**100,000**] <_____> hours at continuous maximum load and speed, according to ABMA [**9**] [**11**].

I. Seals: [**Single-cartridge type, balanced mechanical**] [**mechanical**] <_____>.

J. Lubrication: [**Oil**] [**or**] [**grease**].

K. Base:

1. Heavy [**cast-iron**] [**fabricated structural-steel**] base with drip rim and drain connection.

2. Pump and Drive Mating Surfaces: Machine finished.

L. Operation:

1. Electrical Characteristics: As specified in Section 26 05 03 - Equipment Wiring Connections and following:

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a. [<_____> hp (<_____> W).] [<_____> rated load amperes.]

b. Voltage: <_____> V, [single] [three] phase, 60 Hz.

c. Maximum [Fuse Size] [Circuit Breaker Size] [Overcurrent Protection]: <_____> A.

d. Minimum Circuit Ampacity: <_____>.

e. Minimum Power Factor: <_____> percent at rated load.

2. Motors: As specified in Section [46 05 13 - Common Motor Requirements for Water and Wastewater Equipment] [26 29 23 - Variable-Frequency Motor Controllers].

3. Controls: As specified in Section 40 95 13 - Process Control Panels and Hardware.

4. Disconnect Switch: Factory mounted [in control panel] [on equipment].

5. Operation Sequences: [As specified in Section 40 95 13 - Process Control Panels and Hardware] [As indicated on Drawings] <_____>.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install pumps where indicated on Drawings and in accordance with Manufacturer's instructions.

B. Provide and connect piping, power, and control conduit, and wiring to make system operational and ready for startup.

C. Flush piping with clean water.

******** [OR] ********

In following Paragraph insert "State of _____ Department of Transportation," "Municipality of _____ Department of Public Works," or other agency as appropriate.

D. Installation Standards: Install Work according to <_____> standards.

3.2 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.

******** [OR] ********

B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.

C. Pre-operational Check: Before operating system or components, perform the following:

1. Check pump and motor alignment.

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2. Check for proper motor rotation.

3. Check pump and drive units for proper lubrication.

D. Startup and Performance Testing:

1. Operate pump on clear water at design point for continuous period of two hours, under supervision of Manufacturer's representative and in presence of Architect/Engineer.

E. Verify pump performance by performing time-drawdown test or time-fill test.

F. Check pump and motor for high bearing temperature and excessive vibration in accordance with the Manufacturer's recommendations. Check for motor overload by taking ampere readings.

G. Equipment Acceptance:

1. Adjust, repair, modify, or replace system components that fail to perform as specified, and rerun tests. Make final adjustments to equipment under direction of Manufacturer's representative.

3.3 ATTACHMENTS

Include schedule when Project includes more than one pump of each type.

When relying on separate schedules, tables, illustrations, or forms to specify product requirements, include list of each attachment. Include identical list of attachments in Project Manual table of contents.

Insert attachments following END OF SECTION.

Consider following examples when developing Project schedule.

A. Pump Schedule:

LOCATION	CAPACITY (GPM)	DISCHARGE HEAD (TDH)	MAXIMUM SPEED (RPM)	MAXIMUM MOTOR SIZE		
				HP	VOLT	PHASE

END OF SECTION

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SECTION 43 23 13

PACKAGE SKID-MOUNTED WATER PUMP STATION

PART 1 GENERAL

1.1 SCOPE

The work shall consist of supplying and installing ~~multi-pump~~multi-pump packaged pump station units, complete with controls as defined by these specifications.

A. Contractor is responsible for making all necessary field measurements and coordinating with the packaged pump station manufacturer/supplier to provide a complete working pump station per these specifications and meeting defined layout confines on the Drawings. The layout of the prefabricated building defined on the Drawings are based on Grundfos CR vertical, multistage, centrifugal in-line pumps, and do not purport to show all the necessary measurements and details for installation. Contractor shall prepare their bid in close coordination with the packaged pump station unit manufacturer/supplier so that all components necessary for satisfactory operation are included in the bid. Contractor is responsible for the complete working operation of the proprietary installations.

B. The manufacturer/supplier shall furnish a factory assembled packaged water pump station. The packaged pump station shall be furnished and delivered to the site as a packaged unit.

Factory assembly of the package station shall include, but shall not be limited to, an epoxy coated steel base support system, pumps, motors, suction manifold, discharge manifold, shut-off valves, control valves, tank level sensors, separately mounted control panel (MCP), separately mounted or integrated variable frequency drives (VFD) and all needed appurtenances as shown on the Drawings.

C. All equipment specified in this Section shall be furnished by the Packaged Pump Station manufacturer/supplier.

D. In these specifications and on the accompanying Drawings, there is specified and shown material and equipment deemed most suitable for the equipment and service anticipated. Contractors shall prepare their bid on basis of particular equipment and materials that is specified.

E. After execution of contract, substitution of equipment of makes other than those named in the contract shall be considered if the equipment proposed for substitution is superior in construction and/or efficiency to that named in the contract and that high quality, low maintenance and satisfactory service have been demonstrated by at least 10 years of service in prefabricated booster installations.

1.2 EXPERIENCE REQUIREMENTS

A. The package skid-mounted water pump station shall be the product of a manufacturer who has the financial resources, technical qualifications, experience, organization and facilities adequate to design and manufacture package water pump stations of the constant pressure style.

The pump station shall be manufactured by:

Subject to conformance with the Contract Documents, the packaged pump station to be based on Grundfos vertical, multistage, centrifugal in-line pumps as assembled by

Grundfos

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B. Proof of experience shall be included in the submittal package and shall include facility locations, names and phone numbers of operators or persons familiar with system performance, dates of operation, number and size of pumps, and other pertinent information required by the ENGINEER.

C. Lack of required experience will be grounds for rejection of a submitted package water pump station.

D. The manufacturer of the specified equipment shall be regularly engaged in the manufacturing of packaged water boosters, packaged water control vaults, packaged water meter vaults and packaged sewage lift stations. The manufacturer shall have completed at least four prior successful installations of package skid-mounted constant pressure pump stations for public works applications similar in size and scope to the installation specified herein during the last five years.

1.3 DEFINITION OF TERMS AND RESPONSIBILITY

Packaged Pump Station Supplier~~: A~~: A manufacturer who supplies the factory assembled packaged water pump station. The factory built pump station includes all inherent systems as delineated in the plans and specifications. Packaged Pump Station Supplier shall provide start-up and training services to the OWNER's personnel and coordinate instrument and control testing and start-up with the ENGINEER.

Commented [JF1]: AEI – Is this needed since not connecting into the City's SCADA?

A. Contractor: The Contractor shall prepare site and make all provisions for the installation of the packaged water pump station and provide all additional materials and work necessary and, thereby, satisfy all requirements specified herein. The Contractor is responsible for the site preparation, concrete slab foundation for the pump station, locating the site conduit and piping as it relates to the packaged water pump station. Contractor shall provide crane for offloading and placing the packaged water pump station and securing it to the slab. The Contractor is responsible for providing proper wiring and conduit to connect the electrical equipment provided by

the packaged pump station supplier with the electrical equipment provided with the prefabricated building. The Contractor is also responsible for providing and/or installing additional electrical equipment in the prefabricated building as shown on the Drawings. Contractor shall be ultimately responsible for the performance of the packaged pump station.

Commented [JF2]: Need to update to coordinate with electrical completing work.

Commented [MR3R2]: Updated

B. The Contractor shall install the packaged water pump station and all other components and equipment as necessary to provide an operational pump station as specified herein and as shown on the Drawings.

C. The Contractor shall make all final power connections to all equipment provided under this and other sections.

D. The Contractor and Packaged Pump Station manufacturer/supplier shall participate in the field testing of all instrument and control equipment as specified herein.

E. The manufacturer/supplier is responsible for meeting the requirements of Section 33 05 96, Seismic Requirements for Non-Structural Components and Systems for the Packaged Pump Station, and coordinating with the Contractor on installation requirements.

1.4 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Codes and Standards - Comply with the provisions of the following codes, standards and specifications, except as otherwise shown and specified:

AISC - “Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings”, including “Commentary of the AISC Specifications”

AISC - “Specifications for the Design of Cold-Formed Steel Structural Members”

AWS - “Structural Welding Code”

IEEE – “Institute of Electrical and Electronic Engineers”

NEC – “National Electrical Code” with State and Local amendments

UL – “Underwriter's Laboratory”

B. Welding of Aluminum - Conduct in accordance with Section 10 of the “Specifications for the Design and Construction of Structural Supports for Highway Luminaries”, AASHTO, 1971. Welding method shall be either gas tungsten arc or gas metal arc. Rods shall be 4043.

C. Shop Assembly - Pre-assemble items in the shop to the greatest extent possible, so as to minimize field assembly of units at the project site. Disassemble units only to the

extent necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installation.

D. Commercial Standards:

ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys
ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys
ANSI/ASME B1.20.1	General Purpose Pipe Threads (Inches)
ASTM A 36	Specification for Structural Steel
NEMA ICS 6	1988 (Rev. 1) Enclosures for Industrial Control and Systems
NFPA 70	Current National Electrical Code
SSPC-SP1	Solvent Cleaning
SSPC-SP2	Hand Tool Cleaning
SSPC-SP3	Power Tool Cleaning
SSPC-SP6	Commercial Blast Cleaning
ASTM A 125	Hot Dipped Galvanizing
IEEE 519	Recommended Practices and Requirements for Harmonic Control in Electrical Systems

1.5 SUBMITTALS

The information listed below shall be submitted to the ENGINEER for review. The submittal shall, as a minimum, include the following data drawings and other descriptive materials.

A. AutoCAD shop drawings to describe and show booster pump station construction and materials.

B. Pump performance curves showing the head, capacity, speed, efficiency, NSPH, and brake horsepower required when operating at specified conditions. A family of performance curves at intervals of 100 rpm from minimum speed to maximum speed shall be provided for each vertical, multistage, centrifugal in-line pumps pump. Each performance curve shall show a minimum of four points including shut-off head and maximum capacity.

C. The limits on the performance curves recommended for stable operation without surge, cavitation or excessive vibration.

D. Complete motor nameplate data as defined by NEMA, motor manufacturer and any motor modifications.

E. Information on all pump station equipment outlined by this specification.

F. Manufacturer experience as outlined in Section 1.2

G. Operations and maintenance manual

H. Manufacturer/supplier shall arrange for the services of a structural engineer registered in the State of Washington to design seismic restraint for packaged pump station equipment in accordance with Section 33 05 96 Seismic Requirements for Non-Structural Components and Systems and shall provide submittals in accordance with that Section.

1.6 QUALITY ASSURANCE

A. Pumping Station Responsibility and Coordination

1. The Package Pump Station Supplier shall be responsible for the adequacy and compatibility of all pumping station components. All components provided by the Package Pump Station Supplier should be designed, fabricated, tested, and installed by factory-authorized representatives experienced in the design and manufacture of the pumping station equipment specified herein.

2. The Package Pump Station Supplier shall coordinate design of the pumping station such that all equipment is compatible and capable of achieving the performance requirements specified herein.

B. Design Requirements

The pumping station arrangement shown on the Drawings is based upon the best information available to the ENGINEER at the time of design and is not intended to show exact dimensions peculiar to any specific equipment unless otherwise shown or specified. All necessary calculations and drawings for any related design shall be submitted to the ENGINEER for approval prior to beginning the work.

The booster pumps shall be designed to operate without cavitation or damaging vibration over the entire specified range of flow and head conditions. Booster pumps shall not produce undue noise or vibrations during reductions in flow from the specified operating capacity range to zero flow.

1.7 WARRANTY

The Contractor shall warranty the package pumping station to be of quality construction, free from defects in material and factory workmanship. The pump station support structure shall be warranted for a period of one (1) year to be free from defects, resistant to rust, corrosion, or physical failures occurring in normal service, when installed in accordance with the manufacturer's recommendations.

The interior equipment, pumps, motors, and apparatus shall be warranted for a period of one (1) year, excepting only those items normally consumed in service, such as light bulbs, oil, grease, gaskets, or O-rings. The Contractor shall be solely responsible for the pump station and all related components; warranties and guarantees by the suppliers of various components will not be accepted.

Major components which fail to perform as specified by the ENGINEER or prove defective in service during the warranty period shall be replaced, repaired, or satisfactorily modified by the Contractor without cost of parts or labor to the OWNER. After start-up service has been performed, labor to replace accessory items such as blowers, heaters, or other accessible and easily serviced parts, shall be the responsibility of the OWNER. Such components, parts, or repairs determined to have failed because of defects in workmanship or materials will be replaced or repaired F.O.B. factory or other designated location.

PART 2 PRODUCTS

2.1 GENERAL

The package water pumping station shall include pumps, valving and piping, MCC/VFD ~~mounted separately~~, control panel mounted separately, and other equipment specified in this Section.

Commented [JF4]: Confirm this can be referenced together.

A. The package pump station shall be delivered to the jobsite requiring no additional fabrication or similar work, other than mounting on a concrete pad, connections to supply and discharge pipes, and electrical connections necessary for a fully functional unit. All piping and valving shall be designed for a minimum working pressure of 200 psi.

B. All materials and coatings coming in contact with potable or non-potable water shall be ANSI/NSF Standard 61 approved.

Maximum skid dimensions are ~~11 feet long and 9 feet wide~~as shown to fit in space as shown on Drawings, excluding ~~hydropneumatic tanks and~~ suction/discharge pipe connections. All suction and discharge header centerlines shall be dimensioned as shown on the Drawings, with final suction/discharge pipe connection locations per final approved Packaged Pump Station submittal. Minimum spacing between equipment is shown on Drawings.

C. In the event the Contractor obtains Engineer's approval on equipment other than that which was specified, contractor shall, at Contractors own expense, make any changes in structures, buildings or piping necessary to accommodate equipment.

It will be assumed that cost to Contractor of equipment proposed to be substituted is less than that of the equipment in the contract, and if a substitution is approved, the contract price shall be reduced by an amount equal to savings.

2.2 STATION SUPPORT STRUCTURE

A reinforced fabricated steel base system shall provide rigid support and bracketing for the pumps, motors, suction manifold, discharge manifold, and all necessary appurtenances. Appropriate mounting holes shall be provided for attachments to a concrete pad. The base system shall be polyester polyurethane powder coated after fabrication. The base shall consist of a steel floor plate and reinforcing box beam, channel and flat as required. All steel members shall be joined by electric arc welding, with welds of adequate section for the joint involved. Where possible, all joints shall be welded on both sides of the base. These welds shall be continuous and watertight. Reinforcing members may be chain welded in an approved manner.

A. CORROSION PROTECTION: After all welding has been completed, all surfaces of the structure and piping shall be factory blasted to remove all rust, mill scales and weld slag. All weld spatter and surface roughness shall be removed by grinding. Surface preparation will comply with SSPC-SP10 specifications. The blast profile on the steel should be 1.5 to 2.5 mils in depth and be of a sharp, jagged nature. Surfaces must be free of grit dust.

Following the blasting procedure a final iron phosphate treatment will be completed to ensure total adhesion of the powder top coat.

The structure and other exposed metal shall receive 3-5 mils of Cardinal Industries P008-GR21 High Gloss Gray Polyester Polyurethane Powder Coating or approved equal.

A touch-up kit ~~containing~~ for powder coatings, as specified above, shall be provided for the coating of all field welds and for repair of any scratches or abrasions that have occurred during shipment or installation.

2.3 FABRICATED STEEL PIPE

Piping shall be steel and conform to material specification ASTM A-53(CW) for nominal pipe size 4-inch and smaller and ASTM A-53(ERW) Grade B for nominal pipe size 5 inches and larger. Steel butt-welding fittings shall conform to material specification ASTM A-234 Grade WPB and to the dimensions and tolerances of ANSI Standards B16.9 and B16.28 respectively.

Individual pump suction and discharge piping shall be sized by the manufacturer to suit the pumps provided, unless otherwise specified on the Drawings. All pipes shall terminate with connections as shown on the Drawings.

Forged steel flanges shall conform to material specification ASTM A-105 Class 60 and/or ASTM A-181 for carbon steel forgings and to the dimensions and tolerances of ANSI Standards B16.5 as amended in 1992 for Class 150 and Class 300 flanges.

The piping sizes shall be as shown on the Drawings

Size 2" or smaller – Schedule 40 316SS
Size 2.5"-10 inch - Schedule 40 Steel
Size 12" and larger – Standard Weight (.375" wall) Steel

The steel piping in the station shall be supported by rectangular, 3/8" (minimum) flat, or round tubing that shall be bolted to the steel floor and bolted to flanged joints in the piping system. The size of the welded pipe supports shall be determined by the Manufacturer. The welded / flanged joint connection shall allow for lateral and transverse pipe support while allowing for necessary restraint and ease of removal. Kick bracing shall be provided as necessary.

Suction and discharge header piping shall be fabricated utilizing the cut and cope technique to maintain smooth water flows and minimize hydraulic losses in the transition from the branch piping to the header piping. Under no circumstances shall any pump branch or bypass piping connections be made by cutting a hole in the pipe and welding in straight end or a non-coped branch take off. No protrusions from the branch into the header will be allowed.

A single, right angle outlet, smooth nose, sample tap shall be supplied for each suction and discharge header pipe. A standard hose bib with valve and vacuum breaker shall be provided on the pump station suction header piping.

A. CORROSION PROTECTION: After all welding has been completed, all surfaces of the structure and piping shall be factory blasted to remove all rust, mill scales and weld slag. All weld spatter and surface roughness shall be removed by grinding. The interior of all welded steel pipes shall be given a white-metal blast cleaning conforming to SSPC-SP5 by the pipe manufacturer and given the protective coating specified hereinafter. Exterior of "wet" exposure piping shall be prepared per SSPC-SP5, white metal blast. Exterior of "dry" exposure piping shall be prepared per SSPC-SP10, near white metal blast. Exterior coating to be as described below.

   The interior of the pipe shall receive a 4-8 mils dry coating of 3M Scotchkote 134 Fusion Bonded Epoxy or approved equal. The high solids powder coating shall be an advance technology Fusion Bonded epoxy coating and have exceptional corrosion protection. The coating shall be suitable for fresh water immersion and meet NSF 61 for pipes.

Commented [JF5]: Still need to confirm:

The interior of the pipe shall receive a 4-8mils dry coating of 3M Scotchkote 134 Fusion Bonded Epoxy. The high solids powder coating shall be an advance technology fusion bonded epoxy coating and have exceptional corrosion protection. The coating shall be suitable for fresh water immersion and meet NSF 61 for pipes.

The exterior of the pipe shall receive a 16 mils dry coating of 3M Scotchkote 134 Fusion Bonded Epoxy or approved equal. The high solids coating shall be an advance technology epoxy and have exceptional corrosion protection.

A touch-up kit containing epoxy coatings, as specified above, shall be provided for the coating of all field welds and for repair of any scratches or abrasions that have occurred during shipment or installation.

2.4 PUMPS

A. General Requirements

The package water booster pump station shall contain ~~five~~ vertical, multistage, centrifugal in-line pumps, mounted vertically. Each pump must have continuously rising performance curves to shut-off and be designed for continuous running duty. The pumps shall be Grundfos CRE vertical, multistage, centrifugal in-line pump or approved equal meeting the ~~following~~ design conditions included in the drawings~~:~~.

~~1. Pumps No. 1, No. 2, No. 3~~

~~Minimum Design Capacities:~~	
~~Point A on Pump Curve~~	~~450 gpm at 126 Feet TDH.~~
~~Point B on Pump Curve~~	~~800 gpm at 146 Feet TDH.~~
~~Maximum Speed~~	~~3600 rpm~~
~~Maximum Shutoff Head~~	~~320 Feet~~
~~Minimum Efficiencies at Design Points:~~	
~~Point A on Pump Curve~~	~~80 Percent~~
~~Point B on Pump Curve~~	~~70 Percent~~
~~Maximum Motor Size~~	~~50 HP~~

~~38. Pumps No. 4, No. 5~~

~~Minimum Design Capacities:~~	
~~Point A on Pump Curve~~	~~100 gpm at 123 Feet TDH.~~
~~Point B on Pump Curve~~	~~25 gpm at 123 Feet TDH.~~
~~Maximum Speed~~	~~3600 rpm~~
~~Maximum Shutoff Head~~	~~280 Feet~~
~~Minimum Efficiencies at Design Points:~~	
~~Point A on Pump Curve~~	~~70 Percent~~
~~Point B on Pump Curve~~	~~50 Percent~~
~~Maximum Motor Size~~	~~10 HP~~

~~75.~~1. The package pump station minor losses shall be accounted for in the TDH for each of the by the package pump station manufacturer/supplier.

B. Pump Construction

1. All pumps shall be ANSI NSF 61 / NSF372 Listed for drinking water and low lead requirements.

2. The head-capacity curve shall have a steady rise in head from maximum to minimum flow within the preferred operating region.

3. The pump shall be of an in-line vertical multistage design, with the suction and discharge ports located on the pump base at the same level on opposite sides of the pump base.

4. The pump head and base shall be cast iron conforming to ASTM A48, Class 30 for pumps producing equal to or less than 125 gpm nominal flow rate. The pump head and base shall be ductile iron conforming to ASTM A536 65-45-12 for pumps producing greater than 125 gpm nominal flow rate. The pump shall be capable of withstanding a hydrostatic pressure equal to twice the pressure at rated flow or 1.5 times shut-off head, whichever is greater.

5. The impellers, intermediate chambers and outer sleeve shall be constructed from 304 stainless steel. The impellers shall be free from defects and must be accurately cast, machined and filed for optimum performance and minimum vibration.

6. The pump shaft shall be constructed from type 316 or type 431 stainless steel. It shall be precision ground and polished.

7. Shaft seal shall be a mechanical seal of the cartridge type. Bearing rings shall be silicon carbide. Rubber components shall be EPDM or FKM material.

C. Motors

1. Motors are to be provided with the following basic features:

   a. Motors shall be designed for continuous duty operation, NEMA design B with a 1.15 S.F.

   b. Totally Enclosed Fan Cooled Motors are to be furnished with minimum class F insulation.

   c. Nameplate shall have, as a minimum, all information as described in NEMA Standard MG 1-20.40.1.

   d. Open Drip Proof (ODP) motors shall have drip covers.

Commented [JF6]: Is this needed?

e. Motors over 50 lbs shall having lifting provisions.

f. Motors shall have a NEMA C-Flange for vertical mounting.

g. Drive end bearings shall be adequately sized so that the minimum L10 bearing life is 17,500 hours at the minimum allowable continuous flow rate for the pump.

h. Motors shall be standard premium efficiency for use with variable speed drives. Motors shall be suitable for 460 volts, 60 Hertz, 3 phase power. Motors shall be inverter ready.

2.5 VALVES

A. Actuators -- Unless otherwise indicated, all valves and gates shall be furnished with manual actuators. Valves in sizes up to and including six (6) inches shall have direct acting lever or handwheel actuators. Larger valves and gates shall have gear-assisted manual actuators, with an operating pull of maximum 60 pounds on the rim of the handwheel. Actuators shall be sized for the valve design pressure in accordance with AWWA C504. All valves six (6) inches to 30 inches in diameter may have traveling-nut actuators, worm-gear actuators, spur- or bevel-gear actuators, as appropriate for each valve.

B. Butterfly Valves

Butterfly valves shall be lug style. Valves shall be oriented to close bubble tight. Butterfly valves shall be cast or ductile iron body, with BUNA-N seat, bronze disc, and stainless steel valve stem, and shall be drilled and tapped to 125# ANSI dimensions. Spools shall be provided as required to prevent butterfly interference with control valves, etc. Butterfly Valve shall be Bray Series 31H or equal.

C. Check Valves

Check valves shall be non-slam, full flow, silent check valve with cast iron ASTM A126 Class B body, seat and disc ASTM B584 Alloy C87600 cast bronze, a stainless steel spring ASTM A313 Type 316. Silent Check Valve shall be Val Matic Series 1400A/1400THR or approved equal.

D. Combination Air/Vacuum Valves

The air/vacuum valve shall be two (2) independent valves, an air/vacuum valve and an air release valve, combined in a dual housing designed to withstand 300 psi. The valve shall be designed to exhaust large volumes of air when filling the pipeline, to release

small quantities of air during operation, and to admit large volumes of air upon impending vacuum during draining.

Body and cover materials shall be cast iron ASTM A126, Class B. Orifice floats and orifices shall be ASTM A240 stainless steel type 316. Valve seats shall be Buna-N. Combination air/vacuum valves shall be as manufactured by Val Matic 100S, or approved equal.

E. Pressure Relief Valve

A pilot controlled, hydraulically operated, diaphragm actuated pressure relief valve shall be installed off the discharge header as shown on the Drawings in order to release excess pressure within the discharge header to the suction header. The pilot systems shall be equipped with shut-off cocks and Y-strainers. Pressure relief valve shall be 2" Cla-Val 50G-01BKC or approved equal, globe pattern, with 150# ANSI flanges. The valve shall include a fusion bonded internal and exterior coating.

F. Ball Valves

Ball valves 2 1/2 inches and under shall be 400 lb. WOG with bronze body and trim, TFE seat ring, and fluorocarbon O-ring seals. The valve shall be of three-piece construction so that maintenance can be performed without disturbing the valve body after installation. Valves shall be Nibco T-590-Y or approved equal.

2.6 HYDROPNEUMATIC DIAGPHRAM TANKS

WELL-X-TROL WX 350 or approved equal.

2.7 PRESSURE INSTRUMENTATION

Manufactured to provide 3/4" tap, isolation valve, reducers, 1/4" tubing to instrumentation elements, and Bronze, brass or stainless steel stop cocks shall be provided for removal of gauges without shutting the system off.

A. Pressure Gauges: Gauges will be 4.5" in diameter per ASME B40.100 and shall be graduated in psi. Rated accuracy will be ± .5% of full scale and the operating temperature shall be -40°F to +150°F. Additional error when temperature changes from referenced temperature of 60°F ±0.4% for every 18°F rising or falling (percentage of span). Standard features shall include a black fiberglass-reinforced thermoplastic case, black aluminum pointer, white aluminum with black lettering, dampened movement option, copper alloy C-type bourdon tube, copper alloy (0.6 mm) restrictor, copper alloy with 1/2" NPT lower mount pressure connection with M4 internal tap and be weather resistant (NEMA 3 / IP54).

The 1/2" high pressure ball isolation valve standard features shall include a one piece brass body (UNI 5705-65), PTFE self-lubricating seats with flexible-lip design, double

seal system to all the valve to be operated in both directions, chrome plated brass ball, blowout-proof brass stem with Viton O-ring, nylon black wedge handle that clearly shows ball position, and NPT taper ANSI

B. Pressure Transducers

Adjacent to each pressure gauge, an electronic pressure transducer shall be installed using a ½-inch or ¼-inch NPT connection with a bronze, brass or stainless steel stop cock to provide for removal of transducer without shutting the system off. Pressure transducers shall be able to transmit a 4-20mAdc signal and shall be a Rosemount model 3051 Series or equal, configured for 0-200 psi range, with 4-digit LCD display.

Commented [JF7]: AIE – any input on this? Need to confirm with pump vendor on model.

2.8 PRESSURE SWITCH

A. Pressure switches shall have two external adjustments. One for high pressure operating point and one for deadband reset. Contact shall close on rising pressure and open upon reset. Provide pressure range and withstand appropriate for the application. Rated Class 1, Division 2. Switch shall be United Electric Controls H22 series, or approved equal.

2.9 TANK LEVEL INSTRUMENTATION

Commented [JF8]: AEI input on tank level instrumentation, need to define specification for each.

Commented [MR9R8]: AEI should specify the tank level sensor and the tank level switch.

A. Pressure Transducers

1. The Packaged Pump Station manufacturer/supplier shall furnish a submersible level pressure transmitter for measurement of hydrostatic liquid levels in the water tank.

2. Output Signal: 4 to 20 mA proportional, for zero to FS pressure.

3. DRUCK Model PTX-1830 with lightning surge arrestor, or approved equal.

B. Low Level and High Level Float Switches

1. Mechanically-activated, snap action contacts
2. High impact, corrosion resistant, polypropylene float housing.
3. Normally Closed and Open operation (3 wire).
4. SJE Rhombus, or approved equal.

C. Level sensor and flow switch to be installed by Contractor.

2.10 INTRUSION SWITCH

A. Provide door security switches at locations indicated on the plan drawings.

B. Ratings:

1. UL listed.
2. Armored or jacketed cable
3. Weather resistant aluminum housing

C. Manufacturer and model: GRI, 4400 or approved equal.

2.11 INTRUSION DETECTION SYSTEM

A. Provide an intrusion detection switch with time delay relay and push button as part of the PCP located on the door panel.

B. The pushbutton shall be momentary and unmarked.

C. The time delay relay shall be field programmable on-delay adjustable.

D. The operation of the system shall be as follows: if the door is opened, the door switch shall start the timer (0-60 seconds); the Operator has up to 60 seconds to push the unmarked pushbutton on the control enclosure and once pushed the time delay relay stops timing and ignores any additional inputs for an adjustable time (initially 60 minutes). If the pushbutton is not pushed with in the 60 second period, the time delay relay shall close an input contact to the auto dialer which will initiate an intrusion alarm callout.

2.12 ALARM DIALER

Commented [JF10]: Input from AEI on control Narrative for both Package Pump Station, Well Pump, and Alarms with wireless auto dialer.

A. Auto-dialer shall allow for minimum of 16 inputs that are configurable for either dry contacts, 0-5V, or 4-20mA current loops.

B. The auto-dialer shall have at least one form C output contact that is rated for 2A and 250 VAC.

C. The auto-dialer must have sufficient memory to allow up to 30 seconds of voice recorded alarms to be programmed.

D. The auto-dialer shall be capable of being programmed to dial at least four telephone numbers until the alarm is acknowledged.

E. The system shall provide programmable security.

F. The unit shall be mounted in clear front, NEMA 4 enclosure and have a battery backup for 4 hours' minimum.

1. Provide an enclosure large enough to contain 40 terminal blocks for field wiring interface; or provide a separate hinged enclosure with terminal strip. Terminal block shall din rail mounted and shall have box type lugs capable of terminating 2 #14 AWG stranded wires.

G. A battery charger shall also be provided.

H. Provide a dry contact output for low battery voltage.

I. Unit shall be UL. Listed.

J. Unit shall be as manufactured by Sensaphone, Express II, or approved equal.

2.13 CELLULAR RADIO

A. Provide a Janus LTE910PS POTSwap Cellular Radio, or approved equal.
B. Provide Cellular Radio backup battery compatible with Cellular Radio.
C. Coordinate with City IT department for cellular network preference.

2.14 SMOKE DETECTOR

A. Two dry contact outputs.
B. 110VAC w/ Battery Backup.
C. Sensaphone, FGD-0049-B, or equal.

2.15 ELECTRICAL PUMP CONTROL REQUIREMENTS

A. Pump Control Panel.

1. The packaged pump station supplier shall provide a separately mounted pump control panel (PCP) or a separately mounted distribution panel and individual pump controllers to be installed by Contractor. The Control Panel shall be rated for 480-volts and have a short circuit ampere interrupting rating of 42,000 amperes, RMS.

2. Provide surge protection for PCP or distribution panel.

3. The PCP shall be provided in a steel NEMA 12 enclosure and meet the requirements of UL508A. The enclosure door shall be hinged and equipped with closure latching hardware. The enclosure shall bear a UL label from the enclosure manufacturer.

4. The PCP shall be provided with a main circuit breaker property sized for the application in accordance with the NEC.

5. All components shall be securely mounted in the enclosure, with the components labeled and wires numbered to indicate functions and provide a means of tracing. All components shall bear a UL label. All wiring, workmanship and schematics shall comply with standards set forth by the NEC and UL. The controls shall bear a UL label for "ENCLOSED INDUSTRIAL CONTROL PANEL" before being shipped from the manufacturer.

6. All pilot duty control wiring inside the control panel shall be of MTW, 600 volt rated, 18 gauge min., 90 C. temperature rating, with stripped ends "tinned" to prevent fraying in accordance with UL standards. All analog signal wiring shall be twisted shielded pair, 18 gauge, 600 volt rated. All control or accessory wiring entering, exiting, or to the door shall terminate on a terminal block mounted on the back panel. Main motor power conductors shall be wired continuously between the motor and VFD output terminal blocks.

7. Operator Interface Module

    a. Door mounted.

    b. Provide an operator interface for access to various control points in the Digital Controller/PLC. The interface shall be capable of being programmed using Windows based software to provide alarm and event annunciation based on Digital Controller/PLC register contents, shall have a graphical screen capable of displaying various sized text and bitmaps, provide a backlit touch screen display, and shall be capable of communicating with Digital Controller/PLC equipment as shown on the drawings.

    c. Operator Interface shall be Red lion, 8” G308A230 color touch screen, or approved equal.

8. Digital Controller

    a. Provide a digital pump controller or PLC to provide the monitoring and control function indicated on the P&ID drawings and as indicated herein.

    b. The unit shall be of modular construction allowing replacement of boards and control interface without removal of the entire control panel.

    c. Digital controller shall be the packaged pump station supplier’s standard controller.

9. Variable Frequency Drives

    a. Mounted in PCP.
    b. 460V, 3 phase.
    c. Provide digital keypad.
    d. Ethernet TCP/IP communication.
    e. Local and remote control.
    f. ABB, ACS800, or approved equal.

10. Harmonic Mitigation

    a. The motor control system shall meet the requirements of IEEE Standard 519.

2.16 CONTROL NARRATIVE

Commented [JF11]: Input from AEI on control Narrative for both Package Pump Station, Well Pump, and Alarms with wireless auto ddilerdialer.

A. Packaged Pump Station

1. The packaged pump station shall incorporate a digital control system that operates as a constant pressure pump station, based on input from a pressure transducer on the discharge pipe. The pumps shall be VFD controlled and shall operate by maintaining a pressure set point, which will be approximately 65 psi. Normal discharge pressure range is 65 to 85 psi at the pump station discharge using all available pumps.

   a. Lead pump shall be cycled for pump station start.

   b. Pressure control shall incorporate two 119-gallon bladder tanks for low flow conditions.

   c. Low water level shut off of 5 feet from floor in bolted steel tank. Shut off the packaged pump station under low water level in the bolted tank.

2. The package skid-mounted water pump station manufacturer shall provide all controls, relays, color touch screen, alarm indicating lights and other appurtenances necessary to indicate the status of the package water booster pump station.

3. An adjustable, high discharge pressure switch shall be mounted on the discharge manifold. If discharge pressure remains above a preset level for an adjustable time period, the pump station shall be automatically shut off, a high discharge pressure shall be indicated on the control panel, and a telemetry alarm relay shall be activated.

Commented [JF12]: Should this be a pressure transducer?

Commented [JW13R12]: P&ID currently drawn with PSH. Perhaps this is unnecessary though, as there is also a discharge PT.

Commented [JF14]: Call out for low pressure shutdown?

4. Provision shall be made for automatic pump failure protection. If lead pump fails, the lag pump shall be automatically activated to provide uninterrupted service. A pump fail indication on touchscreen and an alarm relay shall be activated.

5. Provide dry contact alarm outputs as indicated on the P&ID and described herein.

B. Existing Well Pump

1. Control of the existing well pump is based on the water level within the ground level tank as part of the package water pump station control. Normal tank water level operational range is 25 to 27.5 feet above the tank floor. Well pump control points, based on input from a pressure transducer in the ground level water tank, are:

   a. Low Level Alarm – Water level 24.5 feet above tank floor
   b. On – Water level 25 feet above tank floor

Commented [JF15]: Need to confirm with AEI

c. Off – Water level 27.5 feet above tank floor
d. High Level Alarm – Water level 28 feet above tank floor

2. The pressure transducer shall be positioned as specified on the Drawings. In addition, adjustable high- and low-level float switches - providing redundant level control - shall be mounted in the tank as defined on the Drawings. If triggered, the float-switches shall latch for an adjustable time delay. A low-level alarm relay shall be activated if the low-level float switch has latched or the pressure transducer has indicated low-level. Activation of the low-level alarm relay shall correspond with the automatic shutdown of the booster pump station and a signal for the well pump to run. In addition, a low tank level indicator shall display on the touch screen. The booster pump station shall remain off until a manual reset button is pushed.

3. If the high-level float switch has latched or the pressure transducer indicates high-level, then the well pump shall automatically shut off, an alarm relay shall activate, and a high tank level indicator shall display on the touch screen. The well pump control points, based on input from the level float switches, are:

   a. Low Level Alarm (On) – Water level 5’-0” above tank floor
   b. High Level Alarm (Off) – Water level 28’-0” above tank floor

C. Operator Interface (Color Touchscreen)

1. Located on the front of the panel and shall include, but not be limited to, the following:

   a. Main Screen shall include well and booster pump statuses and a screen navigation menu.

   b. Well Pump and Booster Pump status screens shall include pump run/stop status, hand/auto switch status, runtime hours, number of starts, speed and a screen navigation menu.

   c. The System Alarm Screen shall include access to current and past alarm events and a screen navigation menu. The Operator shall have the ability to reset, disable and acknowledge individual alarms from this screen.

   d. Setpoint Screen shall include access to all available Operator adjustable system setpoints. Setpoints shall be password protected.

   e. The System Trend Screen shall include daily and monthly system logs for all relevant data including, but not limited to, the following:

      1) Discharge pressure.
      2) Tank level.

D. Alarms

1. The following alarms outputs are required from the package water pump station control system are:

   a. Tank High Level/Overflow: Triggered by high-level signal from ground level tank pressure transducer or latching of the high-level float switch.

   b. Tank Low Level: Triggered by low-level signal from ground level tank pressure transducer or latching of the low-level float switch.

   c. Well Pump Failure: Triggered by motor over temperature, FVNR fault, or motor called to run without run signal for 10 seconds.

   d. Booster Pump Station Failure: Triggered by one or more of the pumps indicating motor over temperature, VFD fault, or motor called to run without run signal within 10 seconds.

2. The following additional field wired alarm inputs to the auto dialer are required:

   a. Tank High Level/Overflow: Triggered by the high-level float switch.

   b. Tank Low Level: Triggered by the low-level float switch.

   c. High System Pressure: Triggered by activation of a high discharge pressure switch in the discharge header of booster station.

   d. Low System Pressure: Triggered by activation of a low discharge pressure switch in the discharge header of booster station.

   e. Intrusion Alarm: Triggered by activation of a door switch which is not acknowledged by operator code entered on the touchscreen within an adjustable time delay (initially set at 60 seconds).

   f. Heat Trace Failure: Triggered by heat trace failure of one or more of the three heat trace sections.

   g. Low Building Temperature: Triggered by activation of an adjustable low temperature switch in the booster pump station enclosure.

   h. Mixer Fail: Triggered by a fault signal from the submersible mixer controller.

3. Auto Dialer/Wireless Connection

   a. All alarms listed above shall be routed to the alarm dialer.

   b. Each alarm shall be programmed with a descriptive alarm notification.

Commented [JF16]: AEI – Need to define an alarm panel
Need to define
- Smoke/fire
- Building temperature
- Heat trace
- Mixer failure
- Intrusion (not defined on P&ID)

Commented [RW17]:

Commented [RW18]:

c. Program the dialer for a minimum of four on-call phone numbers.

d. Configure auto dialer for cellular modem connection.

PART 3 EXECUTION

3.1 FACTORY TESTING

The package system shall be tested with water at the manufacturer's factory for leaks in the pumps and piping, excessive vibration, correct operation of all electrical appurtenances, and to ensure that all of the pump controls are operating properly. These tests shall, as closely as shop conditions permit, simulate field design conditions as specified under OPERATING CONDITIONS. Pump shall be tested, to ensure compliance with it's published head-capacity curve and insure full pumping capability. As applicable, pump tests shall include motor running amperage checks, at the design conditions, shut-off and other points along the curve, insuring non-overloading performance and pump efficiency.

A. The following tests shall be conducted on the assembled packaged pump system

1. Piping and valving --After the station piping and valves have been manufactured, the station piping system, including pumps, piping, fittings and all valves that make up the entire station piping shall be first tested with air to test for leaks. High-pressure air shall be pumped into the piping system and a soap solution shall then be sprayed on any welded joints for leak indication. After final assembly of the pumps, piping and valves, the entire system shall be hydrostatically tested to test for leaks at all joints, connections and weld seams. Any deficiencies found during the air test or the hydrostatic test shall be repaired, and the system shall be retested.

2. Pump Systems -- The pump shall be tested at the pump factory in accordance with the American National Standard for Centrifugal Pump Tests (ANSI/HI 1.6) as approved by ANSI and published by the Hydraulic Institute. Tests shall be performed using the complete pump system to be furnished, including the motor. For motors smaller than 100 hp, the manufacturer's certified test motor shall be acceptable. The following minimum test data shall be submitted:

a. Hydrostatic test data

b. A minimum of five hydraulic test readings between shutoff head and 25 percent beyond the maximum indicated capacity, recorded on data sheets as defined by the Hydraulic Institute.

c. Pump curves showing head, flow, bhp, efficiency and NPSH requirements.

Commented [JF19]: Confirm with PumpTech
Pump curves showing head, flow, and amps at each test point requirements.

d. Certification that the pump horsepower demand did not exceed the rated motor hp beyond the 1.0 service rating at any point on the curve.

Commented [JF20]: PumpTech confirmation Certification that the pump full load amps (FLA) demand did not exceed the rated motor FLA beyond the 1.0 service rating at any point on the curve.

3.2 PACKAGED PUMP STATION

A. The Contractor shall furnish, install, test, and adjust the complete packaged pump station, consisting of the pumps, controls, and manifolds mounted on a base.

B. When the station plumbing is completed, the pressure piping within the station (including valves, pumps, control valves, and fittings), connections as make up the entire system shall be hydrostatically tested at a pressure of 250 psi or a pressure equal to the lowest test pressure rating of the equipment within the tested system, whichever is lesser pressure. The test pressure shall be applied for a minimum of 20 minutes, during which time all joints, connections and seams shall be checked for leaking. Any deficiencies found shall be repaired and the system shall be retested.

C. The results of this testing shall be transmitted in writing to the ENGINEER prior to shipment of the station and shall note test pressure, time at full pressure and be signed by the Quality Control Manager or test technician.

D. Anchors for the unit shall be set in the concrete slab, and the unit shall be mounted to the pad as instructed by the manufacturer. The manufacturer shall supervise installation to ensure that the unit is properly aligned and leveled, that all electrical and water connections are properly made, and that lubricants have been provided and installed.

E. Do not field cut, drill, bond, and weld or alter structural members without approval from manufacturer and ENGINEER.

3.3 SERVICES OF MANUFACTURER

A. An authorized service representative of the manufacturer shall visit the project site to witness the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted and readied for operation:

1. Installation of the equipment

2. Inspection, checking and adjusting the equipment

3. Startup and field testing for proper operation

   a. All pumps and equipment shall be field operated and signed off of by manufacturer in the presence of the Owners Representative.

4. Performing field adjustments to ensure that the equipment installation and operation comply with requirements.

a. Field verification and checking of proper pump alignment and balance.

5. Copy of modifications to pump control PLC program (if applicable)

The manufacturer shall provide the services of a service representative for minimum of 16 hours.

B. Instruction of the Owner's Personnel

1. An authorized training representative of the manufacturer shall visit the project site to instruct the Owner's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the models of equipment provided.

2. The representative shall have at least two year's experience in training.

3. Training shall be scheduled a minimum of three weeks in advance of the first session.

4. Proposed training material and a detailed outline of each lesson shall be submitted for review. Comments shall be incorporated into the material.

5. The training materials shall remain with the trainees.

6. The Owner may videotape the training for later use with the Owner's personnel.

The manufacturer shall provide the services of a service representative for minimum of 8 hours.

C. Certifications

1. Certification that the pumping station is fully in conformance with the requirements described and depicted in these Contract documents

2. Manufacturer/ Package Pump Station Supplier's certification of proper installation

3. Certified factory test data

4. Contractor's certification of satisfactory field testing

PART 4 MEASUREMENT AND PAYMENT

Commented [HP21]: Joe: Should all electrical work be covered under the common work specification with bid item "Site Electrical Work"? This will only include providing the tank level sensors and mixer? Just clarifying because the common electrical specifications calls out installing these items.

A. The pay item "**Packaged Pump Station**", lump sum, shall include all labor and materials associated with design, fabrication, and installation of the packaged pump station system as defined on the Drawings and in the specifications, including but not limited to, the following:

1. Installation of packaged pump station system, including anchoring, pipe supports, and appurtenances as defined on the Drawings and in the specifications including connection of the 12-inch ductile iron suction and discharge pipe flanges.

2. Coordination of packaged pump station manufacturer/supplier with the Contractor on the installation of electrical components that include the pump motors, pump control panel with VFDs, tank level sensors, alarm and intrusion panel, and appurtenances.

3. Programming of the packaged pump station Digital Controller/PLC controls per the specifications, including existing well pump control, intrusion panel, alarm RTU, and wireless auto dialer.

4. Startup testing, commissioning, and training.

5. Installation and connection of packaged pump station electrical components as well as tank level sensors, tank mixer, and heat tracing at the load center, pump control panel, intrusion panel, and alarm RTU are included in the bid item "**Site Electrical Work**" as covered in Section 26 05 00.

B. The anticipated scope of equipment to be supplied and installed is included by not limited to the list in the Table below. This list is to aid in the anticipated responsibilities of the Contractor and suppliers.

Table of Equipment for Sudbury Landfill Water System Upgrades					
Equipment description	**Qty.**	**Provided by**	**Spec #**	**Installed by**	**Drawing #**
Utility transformers	3	Columbia REA	N/A	Columbia REA	E-3
48" X 48" X 11" CT Cabinet and CT mounting base	1 ea.	Contractor	N/A	Contractor	E-3
Meter Base	1	Contractor	N/A	Contractor	E-3
Meter	1	Columbia REA	N/A	Columbia REA	E-3
Bar type CTs	3	Columbia REA	N/A	Columbia REA	E-3
480V, 3-phase Distribution Panel DP-01	1	Contractor	26 24 16	Contractor	E-3
Main Control Panel MCP-01	1	Packaged Pump Station Supplier	43 23 13	Contractor	E-3
Variable Frequency Drives	5	Packaged Pump Station Supplier	43 23 13	Contractor	E-3
25KVA, 480-240/120V, 1-phase Transformer XFMR-01	1	Contractor	26 22 13	Contractor	E-3

Table of Equipment for Sudbury Landfill Water System Upgrades					
Equipment description	Qty.	Provided by	Spec #	Installed by	Drawing #
120V, 1-phase Panel LP-01	1	Prefabricated Building Manuf.	13 34 23	Prefabricated Building Manuf.	E-3
Tank Mixer Control Panel MIX-CP, Mixer Junction Box MIX-JB and Tank Mixer MIX-01	1 ea.	Contractor	N/A	Contractor	E-3
Heat Trace controllers	2	Contractor	40 41 13	Contractor	E-3
Manual Transfer Switch	1	Contractor	26 36 13	Contractor	E-3
Main Breaker (service entrance rated)	1	Contractor		Contractor	E-3
Generator Receptacle	1	Contractor		Contractor	E-3
RTU Panel (auto dialer)	1	Packaged Pump Station Supplier	13 34 23	Contractor	E-4
Surge Protection Device	1	Contractor	26 43 13	Contractor	
Intrusion Alarm	1	Contractor/Packaged Pump Station Supplier	43 23 13	Contractor	
Dehumidifier	1	Prefabricated Building Manuf.	13 34 23	Contractor	C-11, E-4
Level Sensor LT-01	1	Packaged Pump Station Supplier	43 23 13	Contractor	E-3
Float Switch LSL-01	1	Packaged Pump Station Supplier	43 23 13	Contractor	E-3
Float Switch LSH-01	1	Packaged Pump Station Supplier	43 23 13	Contractor	E-3
Building lights and outlets	Various	Prefabricated Building Manuf.	13 34 23	Prefabricated Building Manuf.	C-11
HVAC (Heater and AC unit)	1 ea.	Prefabricated Building Manuf.	13 34 23	Prefabricated Building Manuf.	C-11

END OF SECTION