SECTION 43 21 00
PUMPING EQUIPMENT: BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Pumping equipment.

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

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ANSI/Hydraulic Institute (ANSI/HI):
      a. 9.6.3, Rotodynamic (Centrifugal and Vertical) Pumps – Guideline for Allowable Operating Region.
      b. 9.6.4, Rotodynamic Pumps for Vibration Measurements and Allowable Values.
      c. 9.6.6, Rotodynamic Pumps for Pump Piping.
      d. 11.6, Rotodynamic Submersible Pump for Hydraulic Performance, Hydrostatic Pressure, Mechanical, and Electrical Acceptance Tests.
      e. 14.6, Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.

B. Coordinate all mechanical seal systems specified to ensure pump and seal compatibility.

1.3 DEFINITIONS

A. The abbreviations used in this section are defined as follows:
   1. AOR: Allowable Operating Range.
   2. BEP: Best Efficiency Point.
   3. IPS: Iron Pipe Size.
   4. NPSH3: Net Positive Suction Head for 3 PCT head loss.
   5. POR: Preferred Operating Range.
   6. TDH: Total Dynamic Head.
   7. TEFC: Totally Enclosed Fan Cooled.
   8. VFD: Variable Frequency Drive.

B. Pump Service Category: Pump or pumps having identical names (not tag numbers) used for specific pumping service.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Performance data and curves with flow (gpm), head (FT), horsepower, hydraulic efficiency, rotating speed (rpm), AOR, BEP, POR, NPSH3 requirements, minimum bowl submergence requirements for vertical mixed flow, axial and turbine pumps.

b. Pump accessory data.
c. Bearing supports, shafting details and lubrication provisions.
1) Bearing life calculations.
2) Critical speed calculations.
d. Solids passage information.
3. Certifications:
a. Certified pump performance curves as described in the SOURCE QUALITY CONTROL Article.
b. Verification of Primary and Secondary conditions in POR and AOR.
4. Test reports:
a. Factory hydrostatic test.

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

C. Informational Submittals:
1. Certifications:
a. Provide a written statement that manufacturer's equipment has been installed properly, started up and is ready for operation by Owner's personnel.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Pumps:
a. See schedule on drawings.

2.2 CENTRIFUGAL PUMP DESIGN

A. Provide units with increasing head characteristics from the end run out portion of the curve to:
1. Shut-off condition.
2. For Mixed flow, Axial Flow and Propeller pumps to the right hand edge of the AOR.

2.3 ACCESSORIES

A. Each Unit:
1. Lifting eye bolts or lugs.
2. Plugged gage cock connection at suction and discharge nozzles.
3. Tapped and plugged openings for casing and bearing housing vents and drains.
4. Fittings for properly adding flushing lubricant.
5. Pressure relief fittings for grease lubrication.

B. Packing Seal:
1. Provide packing unless mechanical seal is specified in narrow-scope pump sections.
2. Minimum of five (5) rings graphite impregnated synthetic packing.

3. Provide minimum 1/4 IN DIA supply tap and 1/2 IN DIA minimum drain tap.
4. Provide split Teflon or bronze water seal ring.
5. Adjustable split follower cast iron or bronze gland.

C. Mechanical Seals:
1. Provide as specified in the narrow-scope pump sections.
2. Provide stationary balanced O-ring type.
3. Provide water lubrication – cooling.
4. Materials:
a. Metal parts except springs: 316 stainless steel.
b. Springs: Hastelloy C.
c. Seal faces: Unfilled carbon graphite versus silica-free Grade 99.5 ceramic.
d. Elastomers: Viton.

D. Seal Water Station:
1. Provide one (1) unit per pump with manual shut-off valve on all pumps with seals.
2. Features:
a. Pressure regulating.
b. Flow regulating.
c. Cleanable flow tube(s) while in service.
d. Hose barb connection.
e. Liquid filled pressure gage.
3. Materials of construction:
a. Flowmeter tubes: Polysulfone.
b. Unit body: Polyoxymethylene.
c. Pressure gage: 316 stainless steel case and wetted parts.
d. Pressure regulating valve: 316 stainless steel.
e. Flow regulating valve: 316 stainless steel.
f. Tube fittings: 316 stainless steel.
g. Mounting brackets: 316 stainless steel.
4. Service:
a. Temperatures up to 150 DEGF.
b. Pressure up to 140 PSIG.
5. Connection:
a. Hose barb threaded to pump.
b. Hose barb to seal water unit.
c. Reinforced polyurethane hose:
1) Minimum size: 3/8 IN ID.
2) Minimum pressure rating:
a) At 180 DEGF: 115 PSI.
b) At 73 DEGF: 200 PSI.
3) Minimum wall thickness: 1/8 IN.
d. Non-potable water to shut-off valve: See Section 40 05 00 with isolation ball valve.
6. Mounting:
a. To pump or pipe flange with stainless steel bracket.
b. Maximum distance from non-potable water to shut-off ball valve to seal water station and seal water station to pump seal, 2 FT each direction.

2.4 FABRICATION

A. Pump Support:
1. Design base to support weight of drive, shafting and pump.
2. Comply with HI vibration limitations.

3. Mount horizontal pump, motor and coupling on single piece drip lip type baseplate.
4. Mount vertical pumps on single piece pedestal baseplate.
5. Fabricate to withstand all operating loads transmitted from the pump and drive.
6. On vertically configured end suction centrifugal pumps when supplied with a fabricated steel mounting frame and suction elbow, the suction elbow shall be a long radius reducing elbow with greater than 50 PCT area reduction to comply with Table 9.6.6.3.2 of ANSI/HI 9.6.6 standard for straight pipe lengths.

2.5 SOURCE QUALITY CONTROL

A. Verification primary design condition in POR.

B. Verification secondary design condition in AOR.

14.6.3.4 Performance test acceptance grades and tolerances

Six pump performance test acceptance grades: 1B, 1E, 1U, 2B, 2U, and 3B are defined below.

Grade 1 is the most stringent, with acceptance grade 1U having a unilateral tolerance band and 1B having a bilateral tolerance band. Acceptance grade 1E is also bilateral and is important to those concerned with energy efficiency. Grades 2 and 3 have wider tolerance bands, with 2B and 3B being bilateral and 2U unilateral. Note that all grade 1 tolerances have the same tolerance bandwidth for flow and head; the same is true for grades 2 and 3.

The purchaser and manufacturer can agree to use any grade to judge if a specific pump will meet a guarantee point. If a guarantee point is given, but no acceptance grade is specified, then this standard reverts to a default test acceptance grade, as described in Section 14.6.4.

Guarantee point acceptance grades for pump head, flow, power, and efficiency are provided in Table 14.6.3.4.

Table 14.6.3.4 — Pump test acceptance grades and corresponding tolerance band

Test parameter	Guarantee requirement	Grade	Grade 1			Grade 2		Grade 3
		Δt_Q	10%			16%		18%
		Δt_H	6%			10%		14%
		Symbol	Acceptance grade					
			1B	1E	1U	2B	2U	3B
Rate of flow	Mandatory	t_Q (%)	± 5%	± 5%	0% to + 10%	± 8%	0% to +16%	± 9%
Total head	Mandatory	t_H (%)	± 3%	± 3%	0% to + 6%	± 5%	0% to +10%	± 7%
Power[a]	Optional (either/or)	t_P (%)	+ 4%	+ 4%	+ 10%	+ 8%	+ 16%	+ 9%
Efficiency[a]	Optional (either/or)	t (%)	− 3%	− 0%	− 0%	− 5%	− 5%	− 7%

[a] The power and efficiency tolerances are not the result of an exact calculation using the maximum values of a related column. They are instead reflecting real life experience. For grade 1E and 1U, no negative tolerance on efficiency is allowed.

NOTE: All tolerances are percentages of values guaranteed.

Other specified duty points, including their tolerances, shall be per separate agreement between the supplier and buyer. If other specified duty points are agreed on, but no tolerance is given for these points, then the default acceptance grade for these points shall be grade 3B.

14.6.3.4.1 Tolerances for pumps with an input power of 10 kW (13 hp) and below

For pumps with a shaft power input up to 10 kW (13 hp) but larger than 1 kW (1.3 hp), the tolerance factors given in Table 14.6.3.4 may be too stringent. If not otherwise agreed on between manufacturer and purchaser, the tolerance factors shall be as follows for pumps falling within this range:

rate of flow $t_Q = \pm 10\%$
pump total head $t_H = \pm 8\%$

C. Factory hydrostatic test all pumps at 150 PCT of shut-off head for a minimum of 5 minutes.

D. If specifically required in the individual pump specification sections, provide factory tests:
   1. All units:
      a. Conduct tests in accordance with HI.
         1) Shut-off head and design condition: Positive unilateral performance tolerance meeting Grade 1U per ANSI/HI 14.6 for Rotodynamic Pumps.
         2) Shut-off head and design conditions: Positive unilateral performance tolerances meeting Grade 1U per ANSI/HI 11.6 for Rotodynamic Submersible Pumps.
   2. All pumps:
      a. Head (FT) versus flow (gpm) pump curves:
         1) Efficiencies along curve.
         2) Brake horsepower along each curve.
   3. Results certified by a registered professional engineer.

E. Statically and dynamically balance each pump per ANSI/HI standards.
   1. If specifically required in the individual pump specification sections or in Specification Section 01 61 03, field vibration test pumps:
      a. To meet requirements of ANSI/HI 9.6.4 for Rotodynamic Pumps at any point on the pumps and motor.

F. To meet requirements of ANSI/HI 11.6 for Submersible Pumps.

PART 3 - EXECUTION

3.1 INSTALLATION

A. See Specification Section 01 61 03.

B. Floor or Pad-Mounted Units (Non-Submersible):
   1. Align vertically and horizontally level, wedge and plumb units to match piping interfaces.
   2. Assure no unnecessary stresses are transmitted to equipment flanges.
   3. Tighten flange bolts at uniform rate and manufacturer's recommended torque for uniform gasket compression.
   4. Support and match flange faces to uniform contact over entire face area prior to bolting pipe flange and equipment.
   5. Permit piping connecting to equipment to freely move in directions parallel to longitudinal centerline when and while bolts in connection flange are tightened.
   6. Grout equipment into place prior to final bolting of piping but not before initial fitting and alignment.
   7. Assemble connecting piping with gaskets in place and minimum of four (4) bolts per joint installed and tightened.
      a. Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange.
      b. Realign as necessary, install flange bolts and make equipment connection.
   8. Field paint units as defined in Specification Section 09 96 00.

9. Provide pressure gage, visible from grade or operating floor, on discharge of all pumps and on suction and discharge of all non-submersible units.

C. Submersible Units:
1. Assemble connecting piping with gaskets in place and minimum of four (4) bolts per joint installed and tightened.
   a. Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange.
   b. Realign as necessary, install flange bolts and make equipment connection.
2. Field paint units as defined in Specification Section 09 96 00.
3. Provide discharge pressure gage visible from grade or operating floor.

3.2 FIELD QUALITY CONTROL

A. Provide services of equipment manufacturer's field service representative(s) to:
1. Inspect equipment covered by this Specification Section.
2. Supervise pre-start adjustments and installation checks.
3. Conduct initial start-up of equipment and perform operational checks.
4. Instruct Owner's personnel for the specified minimum number of hours at jobsite per Specification Section 01 30 00 on operation and maintenance of each of following pumping equipment:

END OF SECTION