SECTION 43 23 19

HORIZONTAL CENTRIFUGAL CHOPPER PUMPS

# GENERAL

## THE REQUIREMENT

### The Contractor shall furnish, install, and place into satisfactory operation horizontal centrifugal chopper pumps at the locations shown on the Drawings and as specified herein. All pumps specified herein shall be supplied by the same manufacturer.

### Equipment shall be provided in accordance with the requirements of Section 46 00 00 – Equipment General Provisions and Section 43 20 00 – Pumps General.

01-09-2023

## reference specifications, codes, and standards

### Comply with Section 43 20 00 – Pumps General

## Action/informational submittals

### Product Data: Comply with Section 01 33 00 – Submittal Procedures

### Provide submittals identified in Specification Section 46 00 00 – Equipment General Provisions in addition to the submittals identified herein and in addition to the submittals identified in the individual pumping specification sections.

### Provide submittals identified in Specification Section 43 20 00 – Pumps – General.

### Dynamic Analysis Results Report

## Closeout Submittals

### Submit warranty documentation in compliance with:

#### Specification Section 01 33 00 – Submittal Procedures

#### Specification Section 01 61 00 - Product Requirements and Options

### Operation and Maintenance (O&M) manuals shall be submitted in accordance with Section 01 33 00 – Submittal Procedures and Section 01 78 23 Operation and Maintenance Data.

### Comply with Section 43 20 00 – Pumps General

## Maintenance materials submittals

### Operation and Maintenance (O&M) manuals shall be submitted in accordance with:

#### Section 01 33 00 – Submittal Procedures

#### Section 01 78 23 Operation and Maintenance Data.

### Comply with Section 01 78 43 – Spare Parts and Extra Materials

### Comply with Section 01 79 00 – Instructions to Owner’s Personnel.

### Comply with Section 46 00 00 – Equipment General Provisions.

### Comply with Section 43 20 00 – Pumps General.

## Quality Assurance Submittals

### Comply with Section 43 20 00 – Pumps General

### Comply with Section 01 75 00 – Check Out and Start Up Procedures

## General information and description

### Comply with Specification Section 46 00 00 – Equipment General Provisions.

## dynamic analysis

### ***SEE HAZEN “DYNAMIC ANALYSIS DECISION MATRIX” TO DETERMINE APPROPRIATE TYPES AND LEVELS OF ANALYSES REQUIRED. TYPES OF ANALYSIS INCLUDE “LATERAL” (SOMETIMES REFERRED TO AS “ROTOR LATERAL”), “TORSIONAL” (SOMETIMES REFERRED TO AS “ROTOR TORSIONAL”) AND “STRUCTURAL”. LEVELS OF ANALYSIS CONFORM TO THE LEVEL 1, 2 & 3 TERMINOLOGY IN ANSI/HI 9.6.8. THE DECISION MATRIX CALCULATIONS MAY ALSO INDICATE LEVEL “NONE”, MEANING THAT NO ANALSISIS IS REQUIRED. DECISION MATRIX CALCULATIONS SHOULD BE REVIEWED WITH A MEMBER OF THE PUMPING SERVICE GROUP OR AN EXPERIENCED PUMP DESIGN ENGINEER.***

### Dynamic analyses shall be performed to determine the potential for a critical natural frequency (lateral, torsional, or structural) occurring within the normal operating speed range of the pumps. All dynamic analyses shall be performed in accordance with the latest edition of ANSI/HI 9.6.8 – Rotodynamic Pumps Guideline for Dynamics of Pumping Machinery and as specified in Section 43 20 00 – Pumps General.

### Level of analysis required, minimum frequency separation margin, and other parameters of the analyses shall be as follows:

Dynamic Analysis Schedule 43 23 19 - 01

|  | **Service 1** | **Service2** |
| --- | --- | --- |
| Lateral Analysis |  |  |
| Level of Analysis | [None] [Level 1] [Level 2/3] | [None] [Level 1] [Level 2/3] |
| Separation Margin | [25%] [20%] [15%] | [25%] [20%] [15%] |
| Torsional Analysis |  |  |
| Level of Analysis | [None] [Level 1] [Level 2/3] | [None] [Level 1] [Level 2/3] |
| Separation Margin | [25%] [20%] [15%] | [25%] [20%] [15%] |
| Structural Analysis |  |  |
| Level of Analysis | [None] [Level 1] [Level 2/3] | [None] [Level 1] [Level 2/3] |
| Separation Margin | [25%] [20%] [15%] | [25%] [20%] [15%] |
| Include Concrete Base/Pedestal in FEA Model (Level 2/3 analysis only) | [Yes] [No] [N/A] | [Yes] [No] [N/A] |
| Include Elevated Slab in FEA model (Level 2/3 analysis only) | [Yes] [No] [N/A] | [Yes] [No] [N/A] |

### ***TYPICAL SEPARATION MARGINS ARE 25% FOR LEVEL 1 AND 20% FOR LEVEL 2/3. A SEPARATION MARGIN OF 15% IS SOMETIMES ACCEPTABLE FOR LEVEL 2/3 BUT THE PUMPING SERVICE GROUP OR AN EXPEREINCED PUMP DESIGN ENGINEER SHOULD BE INVOLVED IN DECISION TO REDUCE TO 15%***

### ***CONCRETE PIERS/PEDESTAL AND ELEVATED SLAB (IF APPLICABLE) SHOULD TYPICALLY BE INCLUDED IN THE FEA MODEL FOR VERTICAL PUMP APPLICATIONS***

READ THE LATEST VERSIONS OF THE DESIGN GUIDELINE – PUMP VIBRATION AND WORK THROUGH THE DYNAMIC ANALYSIS DECISION MATRIX.XLSX (IN COLLABORATION WITH EACH BASIS OF DESIGN PUMP MANUFACTURER) IN ORDER TO DETERMINE THE LEVEL OF ANALYSIS THAT NEEDS TO BE SPECIFIED IN THE RESPECTIVE INDIVIDUAL PUMP SPECIFICATION SECTION. DYNAMIC ANALYSIS DECISION MATRIX.XLSX CAN BE FOUND AT THE FOLLOWING LOCATION: <https://hazenandsawyer.sharepoint.com/sites/DesignResources/Design%20Guidelines%20and%20Checklists/Mechanical>

## Warranty

### Warranty requirements shall be as specified in Section 01 61 00 – Product Requirements and Options. Warranty requirements are supplementary to the individual equipment specifications.

### Comply with the Equipment Warranties requirements specified in Section 46 00 00 – Equipment General Provisions.

### Warranty shall be as specified in Section 46 00 00 – Equipment General Provisions with the exception that the warranty period shall be for two (2) years.

## OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

### Horizonal Centrifugal Chopper Pump Performance Criteria Schedule 43 23 19-02

Horizontal Centrifugal Chopper Pump Performance Criteria Schedule 43 23 19 - 02

|  | Digester Mixing Pumps | Sludge Recirculation Pumps | Digested Sludge Mixing Pumps |
| --- | --- | --- | --- |
| Number of Units | 4 | 4 |  |
| Pump Identification Numbers | X |  |  |
| Pump Shutoff Head (Allowable Range) (ft) | Xx-xx |  |  |
| Rating Point (at Full Speed) |  |  |  |
| Manufacturer | Vaughan | Vaughan |  |
| Flow (gpm) | 2600 | 450 |  |
| Total Head (ft) | 30 | 30 |  |
| Minimum Pump Efficiency (%) | Xx |  |  |
| Rating Point shall be within the following range as % of BEP Flow | XX% to XXX% |  |  |
| Maximum Flow Operating Point (at Full Speed) |  |  |  |
| Flow (gpm) | Xx |  |  |
| NPSH Required shall not exceed (ft) | XX |  |  |
| Operating Point shall be within (AOR/POR) | AOR |  |  |
| Minimum Flow Operating Point (at Full Speed) |  |  |  |
| Flow (gpm) | Xx |  |  |
| Acceptable Total Head Range (ft) | Xx to XX |  |  |
| Operating Point shall be within (AOR/POR) | AOR |  |  |
| Minimum Flow Operating Point (at Reduced Speed) |  |  |  |
| Flow (gpm) | 1500 | 200 |  |
| Total Head (ft) | 45 | 40 |  |
| Operating Point shall be within (AOR/POR) | AOR |  |  |
| Maximum Brake Horsepower for all operating points | 50 | 10 |  |
| Maximum Pump Operating Speed (rpm) | 1200 | 1800 |  |
| Fluid Pumped | Digester Sludge | Digester Sludge |  |
| Fluid Temperature (degrees F) | Ambient | Ambient |  |
| Fluid Specific Gravity | x |  |  |
| Fluid pH range | x |  |  |
| Fluid Viscosity (absolute centipoise at 60-deg F.) | xx |  |  |
| Minimum Solids Passage Size (in) | 4 | 4 |  |
| Minimum Suction Diameter (in) | 10 | 6 |  |
| Minimum Discharge Diameter (in) | 8 | 4 |  |
| Minimum Shaft Diameter | 1.5” |  |  |
| Discharge Configuration | [Tangential] [Center] |  |  |
| Drive Configuration | [Close Coupled] [Intermediate Shafting] |  |  |
| Direction of rotation when viewed from driven end | [clockwise] |  |  |
| Minimum ABMA L‑10 Bearing life [along the full length of the published operating curve] [within POR] (hours) | [100,000] [XXX] |  |  |
| Factory test acceptance grade | 1U |  |  |
| Area Classification | [Class 1, Div 1, Group D] [Unclassified] |  |  |
| Control Panel Rating | [NEMA 4X] [NEMA 7] |  |  |
| Suction Condition | Flooded | Flooded |  |
| Clearance between the impeller and cutter bar (in) | 0.010-0.015 |  |  |

REGARDING OPERATING CONDITIONS:

THE Rating Point is the operating point that must be met in order to ensure that the pUMPS can meet PROCESS design requirements. Factory testing is required to meet THE HI ACCEPTANCE GRADE at this point only. Regarding “RATING Point shall be within the following range” - this is OFTEN in the range of 85% to 100% but this should be refined based on actual pumps selected for thE APPLICATION.

THE remainder of the operating points shall be completed UPON SELECTION OF SPECIFIC PUMPS FROM MULTIPLE MANUFACTURERS. PUMP CURVES WILL VARY BETWEEN MANUFACTURERS WITH REGARD TO STEEPNESS OF CURVE AND the LOCATION OF OPERATING POINTS ON THE CURVE RELATIVE TO BEP, POR, AND AOR. TO accommodate THESE DIFFERENCES, THE SCHEDULE ALLOWS FOR SPECIFYING “RANGES” AND “NOT TO EXCEED” VALUES.

THE “Maximum Flow OPERATING Point” is the operating point for a full speed pump under minimum head conditions (typically single pump operating at minimum static head conditions and minimum friction and minor loss conditions). THIS CONDITION IDENTIFIES THE RUNOUT CONDITION FOR A PUMP IN THIS SYSTEM, WHICH WILL BE DIFFERENT FOR EACH MANUFACTURER BASED ON THE SHAPE OF THE PUMP CURVE. Specify the “not to exceed” NPSHr at this point based on the selected pump that provides worst case NPSH MARGIN. NOTE THAT In some cases, a condition with a minimum wet well level (rather than the minimum static head condition) will result in worst case NPSH margin DUE TO LIMITED SUBMERGENCE.

THE “Minimum Flow OPERATING Point (at FULL SPeed)” is the operating point associated with the maximum head conditions (typically multiple pumps operating at maximum static head conditions and maximum friction and minor loss conditions). THE “ACCEPTABLE TOTAL HEAD RANGE” IS BASED ON THE SPECIFIC PUMPS SELECTED FOR THE APPLICATION. If discharge throttling is required to achieve the minimum flow point, coordinate throttling valve sizing with the WORST CASE total head requirements at this flow condition. If the minimum flow point conditions are the same as the rating point conditions, the Minimum Flow Point may be omitted FROM THE SCHEDULE.

THE “Minimum Flow OPERATING Point (at reduced speed)” is the operating point associated with reduced speed operation to meet minimum PROCESS flow condition. For constant speed PUMP applications, this point should be eliminated FROM THE SCHEDULE. This condition typically occurs when a single pump is operating to meet minimum process condition, BUT MINIMUM FLOW PER PUMP CAN BE LESS THAN THE MINIMUM PROCESS FLOW. THIS OCCURS at the point where one pump IS AT FULL SPEED and a second pump MUST BE staRted – so each pump must deliver 50% of the flow. ]

***NTS: It is recommended to identify all basis of design pumps at the same speed in order for maximum level competition. There will be instances, where this may not be possible in which case, including of the term “maximum” allows for slower speed pumps to be allowed (though significantly less likely to be procured perhaps with the exception of packaging). It is the specifier and shop drawing reviewer’s duty to prohibit faster than basis of design speed pumps if/when proposed during construction.***

# PRODUCTS

## General

### Comply with Specification Section 43 20 00 – Pumps General, except where superseded in this Specification.

## Acceptable manufacurers

### Pump Manufacturer:

#### Vaughan

### The electrical motor shall be provided by the pump manufacturer and shall be one of the named manufacturers specified in Section [26 05 60 – Low-Voltage Electric Motors].

### All equipment for the pumps, including motors and bases, shall be provided as a complete unit by the pump manufacturer.

### All pumps for same pumping application shall be provided by one manufacturer.

#### ***DO NOT SPECIFY MODEL NUMBERS***

## Anchors and supports

### Comply with the following Specification Sections:

#### Section 05 05 23 – Metal Fastening.

#### Section 46 00 00 – Equipment General Provisions.

#### Section 43 20 00 – Pumps General.

#### This Section.

## Materials of Construction

Materials of Construction Schedule 43 23 19 - 03

| **Component** | **Materials of Construction** | |
| --- | --- | --- |
|  | Digester Mixing Pumps | Sludge Recirculation Pumps |
| Casing | [Ductile Iron A536] | [Ductile Iron A536] |
| Adapter Plate | [Ductile Iron A536] | [Ductile Iron A536] |
| Suction Cover | Cast Iron, ASTM A48, CL30 [Ductile Iron A536] | Cast Iron, ASTM A48, CL30 [Ductile Iron A536] |
| Stuffing Box Cover | Cast Iron, ASTM A48, CL30  [Ductile Iron A536] | Cast Iron, ASTM A48, CL30 [Ductile Iron A536] |
| Bearing Housing | Ductile Iron A536 [Cast Iron, ASTM A48, CL30] | Ductile Iron A536 [Cast Iron, ASTM A48, CL30] |
| Shaft | AISI 4140 heat-treated Alloy Steel, [Carbon Steel SAE1045 ][Stainless Steel xxx] | AISI 4140 heat-treated Alloy Steel, [Carbon Steel SAE1045 ][Stainless Steel xxx] |
| Shaft Sleeve | *Stainless Steel 420 Series* | *Stainless Steel 420 Series* |
| Impeller | ASTM A48 Alloy Steel, [CL30] [Ductile Iron A536] [Cast Stainless Steel xxx] Minimum Rockwell Hardness C 60 | ASTM A48 Alloy Steel, [CL30] [Ductile Iron A536] [Cast Stainless Steel xxx] Minimum Rockwell Hardness C 60 |
| Impeller Wear Ring | Stainless Steel 400 Series, BHN 300-350. Minimum Rockwell Hardness 50 Brinell softer than casing wearing ring. | Stainless Steel 400 Series, BHN 300-350. Minimum Rockwell Hardness 50 Brinell softer than casing wearing ring. |
| Cutter Bar | Steel Plate. Minimum Rockwell Hardness C 60 | Steel Plate. Minimum Rockwell Hardness C 60 |
| Cutter Nut | Cast Steel. Minimum Rockwell Hardness C 60 | Cast Steel. Minimum Rockwell Hardness C 60 |
| Upper Cutter | Cast Steel. Minimum Rockwell Hardness C 60 | Cast Steel. Minimum Rockwell Hardness C 60 |
| External Cutter | Cast Steel. Minimum Rockwell Hardness C 60 | Cast Steel. Minimum Rockwell Hardness C 60 |
| Casing Wear Ring | Stainless Steel 400 Series, BHN 400-450 | Stainless Steel 400 Series, BHN 400-450 |
| Pump & Motor Base | *Carbon Steel* | *Carbon Steel* |
| Fasteners | Stainless Steel 316L | Stainless Steel 316L |

## COMPONENTS

### Impeller

#### Impeller Type: One-piece, semi-open, single-suction, enclosed, solids-handling, mixed flow type with pump-out vanes.

#### Impeller Construction

##### Solids Passage

###### Shall be designed with smooth flow passages to pass a spherical solid of the specified size and to prevent clogging by stringy materials.

##### Impeller-Shaft Connection shall be:

###### Bolted and locked to the pump shaft at the factory.

###### Require no axial adjustment and no set screws.

#### Impeller Balancing: Impeller shall be statically, hydraulically, and dynamically balanced.

#### Fabricated: Pumps with fabricated impellers shall not be accepted.

#### Chopping/maceration of materials:

##### Accomplished by the action of the cupped and sharpened leading edges of the impeller blades moving across the cutter bar at the intake opening.

### Casing/Volute

#### Casing/Volute Type: end suction, side discharge construction and shall be capable of being rotated in 45-degree increments.

#### Casing/Volute Construction:

##### Pullout assembly shall be designed so that the impeller can be withdrawn without disturbing the suction or discharge piping.

##### Mounting:

###### Casting shall incorporate feet or an integral base plate for mounting.

###### Separate sole plates to span slab openings or pump supports shall not be acceptable.

##### Solids Passage:

###### Passages shall be smooth unobstructed passages for solids.

###### Passage Size. large enough to pass a spherical solid of the sized specified in Horizontal Centrifugal Chopper Pump Performance Criteria – Schedule 43 23 19 - 01.

##### Cleanouts:

###### Provide cleanout handhole near cutwater.

###### Cover shall be removable.

###### The inner contours of the handhole cover shall match the contours of the casing in which it fits.

##### Flanges: Integrally cast with an ANSI Standard flat faced flange with 125-lb drilling.

##### Lifting: Shall be provided with lifting bolts and eye lugs for installation and maintenance of the pumps.

##### Fabrication: Pumps with fabricated cutter bars or casing shall not be accepted. Add-on cutting mechanisms below the pump inlet shall not be accepted.

##### Design: Semi-concentric

###### The first half of the circumference being cylindrical beginning after the pump outlet.

###### The remaining circumference spiraling outward to the 150 lb. flanged centerline discharge.

##### Back pull-out adapter plate

###### Allow removal of pump components from above the casing.

###### Allow external adjustment of impeller-to-cutter bar clearance, without requiring disconnection from piping.

###### All water passages shall be smooth, and free of blowholes and imperfections for good flow characteristics.

### Fronthead / Suction Cover

#### Shall be a separate casting designed with a machined self‑centering fit with the pump casing.

#### Removable to provide access to impeller without disturbing discharge piping.

#### Ends: Integrally cast with an ANSI Standard flat faced flange with 125-lb drilling.

#### Shall be equipped with a cleanout handhole to allow for removal of any foreign material blocking or impeding performance of the pump. The inner contours of the handhole cover shall match the contours of the suction cover.

### Backhead / Stuffing Box Cover

#### Shall be a separate casting designed with a machined self‑centering fit with the pump casing.

#### Shall be integrally cast with stuffing box suitable for either packing or mechanical seal.

#### Stuffing box shall be readily accessible and equipped with removable gland.

### Connections:

#### Casing drain and vent connections shall be provided, minimum ¾-inch diameter (or larger per manufacturer recommendations).

#### Gauge taps, ¾-inch diameter, shall be provided on suction and discharge nozzles.

#### Tapped holes shall be provided in stuffing box as required for specified sealing arrangement and stuffing box drain.

### Wearing Rings

#### Provide on casing and impeller.

#### Corrosion Resistance: Wearing rings and fasteners shall be galvanically compatible with casing and impeller materials and resistant to corrosion and erosion by the pumped fluid

#### Type: [Removable] [Non-removable]

specifier to coordinate with basis of design pump manufacurers to confirm wear rings are removable before specifying as such.

### Shaft

#### Refer to Section 43 20 00 – Pumps General for standard pump shaft requirements.

#### Minimum Diameter: 1.5”

### [Shaft Sleeve]

#### Shaft Sleeves shall be:

##### Protected through the stuffing box by a renewable, removable shaft sleeve.

##### Secured to shaft and a seal shall be provided to prevent leakage under the sleeve.

##### Not be threaded.

shaft sleeves shall only be included where non-stainless shaft materials are spcified in schedule 43 23 19-003

### Bearing Housing & Bearings

#### Type: Bearings shall be of the anti‑friction ball or tapered roller

#### ABMA L-10 life: As specified in this Section.

#### Construction:

##### Bearing housing shall fully enclose the bearings to prevent entrance of contaminants and shall be designed to provide for axial adjustment of rotating assembly.

##### Bearing housing shall be designed with a machined self‑centering fit with the stuffing box cover.

##### Thrust Bearing: Two back-to back mounted single-row angular contact ball bearings.

##### Radial Bearings: Two single-row

##### Lubrication: Grease or oil-lubrication

##### Fittings: Zerk-type grease fittings

##### Comply with Section 46 00 00 – Equipment General Provisions.

##### Oil Bath Lubricated Bearing Construction:

###### Lubricant: ISO Gr. 46 turbine oil

###### Side-mounted site glass

###### Seals: Viton double lip seals riding on shaft sleeves at each end of the bearing house. This is to provide sealing at each end of the bearing housing.

##### Orientation: Machined with piloted bearing fits for concentricity of all components.

### Base

#### Equipment Support: Combination pump and motor base.

#### Material: As scheduled herein. If not scheduled, heavy-duty fabricated steel or steel open channel design with openings to facilitate grouting.

### Coupling

#### Refer to Section 43 20 00 – Pumps General for shaft coupling requirements.

#### Provide coupling guards in accordance with Section 46 00 00 – Equipment General Provisions.

### Cutting Mechanism

#### Cutter Bar

##### Location: Recessed into the pump bowl

##### Extend diametrically across entire pump suction opening.

#### Cutter Nut

##### The impeller shall be secured to the shaft using a special cutter nut, designed to cut stringy materials and prevent binding.

#### Upper Cutter

##### Construction:

###### Threaded into the back pull-out adapter plate above the impeller

###### Cut against the pump-out vanes and the impeller hub

###### Remove stringy materials from the mechanical seal area.

#### External Cutter:

##### Cut against the outside surface of the cutter bar.

## structural steel

### Comply with Section 43 20 00 – Pumps General.

## Dissimilar metals

### Comply with Section 43 20 00 – Pumps General.

## Galvanizing

### Where applicable, galvanizing shall be performed in accordance with Section 05 05 13 – Galvanizing.

## standardization of grease fittings

### Grease Fittings: Comply with Section 46 00 00 – Equipment General Provisions.

## appurtenances

### Shaft Seals: Shaft sealing shall be accomplished by one of the following methods as identified in the schedule below.

#### Packing and lantern ring. A minimum of 5 rings of packing shall be provided.

#### Single mechanical cartridge seals shall be AW Chesterton, John Crane, or equal. If specified, a throat bushing shall be provided. Throat bushing shall have spiral grooves and shall be Enviroseal SpiralTrac or equal.

#### Split single mechanical seals shall be AW Chesterton, John Crane, or equal. If specified, a throat bushing shall be provided. Throat bushing shall have spiral grooves and shall be Enviroseal SpiralTrac or equal.

#### Mechanical seals shall be designed not require flush water

#### Location: Immediately behind the impeller hub to minimize the depth of the stuffing box and maximize the flushing available from the impeller pumpout vanes.

### Shaft Seal Schedule 43 23 19-04

Shaft Seal Schedule 43 23 19-04

|  | **Service 1** | **Service2** |
| --- | --- | --- |
| Shaft Sealing Arrangement | [Packing]  [Single Mechanical Cartridge Seal]  [Split Single Mechanical Seal] | [Packing]  [Single Mechanical Cartridge Seal]  [Split Single Mechanical Seal] |
| Throat Bushing | Yes | Yes |
| Seal Flush Source / API Flush Plan | [External / Plan 32]  [None / Plan 02]  [Product / Plan 11] | [External / Plan 32]  [None / Plan 02]  [Product / Plan 11] |
| Seal Face Material | Silicon Carbide | Silicon Carbide |
| Metallic Components | 316 SST | 316 SST |
| Flexible Components | EPDM | EPDM |

SHAFT SEALING AND FLUSHWATER ARRANGEMENT SHOULD BE DISCUSSED WITH PM AND OWNER. for applications with solids in flow stream (most applications for solids-handling pumps), An external flush water source is recommended. for ras/was pumping, it is possible to eliminate external flush and provide a throat bushing with spiral grooves but this arrangement will reduce seal life as compared with an externally flushed arrangement. PRODUCT flushing (plan 11) should be used only with clean water applications which are uncommon for solids handling pumps.

## ELECTRICAL AND CONTROL REQUIREMENTS

Include this paragraph A only for equipment in classified areas – change area classification listed below as required

### Comply with Specification Section 43 20 00 – Pumps General.

### All electrical appurtenances furnished by the equipment manufacturer shall be rated for installation in a Class I, [Division 1] [Division 2], Group D, hazardous location.

### Electrical and Instrumentation Requirements Schedule 43 23 19-05:

Electrical and Instrumentation Requirements Schedule 43 23 19 - 05

| Service | Mixing Pumps | Recirculation Pumps |
| --- | --- | --- |
| Motors |  |  |
| Type | [Direct Coupled - Orientation] | [Direct Coupled - Orientation] |
| Rating | 460V, 3 ph, 60 Hz | 460V, 3 ph, 60 Hz |
| Horsepower | 50 | 10 |
| Speed, rpm | 1200 | 1200 |
| Maximum Speed, rpm | XXX | XXX |
| Minimum Reduced Speed, RPM | XXX | XXX |
| Enclosure | TEFC | TEFC |
| Insulation | Class F | Class F |
| Inverter Duty | [Yes] [No] | [Yes] [No] |
| Service Factor | 1.15 | 1.15 |
| Bearing Thermal Protection | [RTDs] [None] | [RTDs] [None] |
| Motor Speed Control | [Constant][VFD] | [Constant][VFD] |
| Maximum Sound at 3 feet, dBA | [xx] [80] | [xx] [80] |
| Space Heater | Yes | Yes |
| Motor Winding Temperature Protection | [Temperature Switches] [RTDs] | [Temperature Switches] [RTDs] |
| Motor Differential Current Transformers / Six-Lead External Wye Connection | [Yes] [No] | [Yes] [No] |
| Separate Cooling Fan | [Yes] [No] | [Yes] [No] |
| Miscellaneous | See Note | See Note |
| Note: [Provide oversized Terminal Box.] [Provide breathers and drains for TEFC enclosures.] [Provide motor shaft brushes.] | | |

### Other

#### An automatic oil level switch shall be provided to stop the pump in the event of low oil level.

include any other motor control devices that need to be furnished by the equipment supplier, e.g. current monitors, zero speed switches, limit switches, etc. Coordinate w/ electrical group. If a local control panel must be provided by the manufacturer, include a separate paragraph 2.xx entitled “Insert Equipment Name Control Panel”.

## SPARE PARTS and special tools

### Comply with Section 43 20 00 – Pumps General.

### Spare parts shall be provided in accordance with Section 46 00 00 – Equipment General Provisions and shall include the following for each series of pumps.

### Spare Parts Schedule 43 23 19-06

**Spare Parts Schedule 43 23 19 – 06**

|  |  |  |
| --- | --- | --- |
|  | **Quantity** | |
| Component | Mixing Pumps | Recirculation Pumps |
| Complete rotating assembly | 1 | 1 |
| Impeller | 1 | 1 |
| Cutter bar | 1 | 1 |
| Shaft sleeve | 1 | 1 |
| Set of motor bearings | 1 | 1 |
| Sets of gaskets and O ring seals | 2 | 2 |

## equipment identification

### Comply with Section 43 20 00-Pumps General

# EXECUTION

## shop testing

### Factory testing shall be in accordance with Section 43 20 00 – Pumps General, and shall include items in Shop Testing Schedule 43 23 19-07:

Witnessed shop tests are typically required only for larger pumps but may be Owner driven. See Hazen Design Guideline for Specifying and Witnessing Shop Tests.

Shop Testing Schedule 43 23 19 - 07

|  | XXXXX Pumps | XXXXX Pumps |
| --- | --- | --- |
| Hydraulic Performance Testing | [Yes] [No] | [Yes] [No] |
| Witnessed Performance Testing | [Yes] [No] | [Yes] [No] |
| Certified Performance Curves | [Yes] [No] | [Yes] [No] |
| Vibration Testing | [Yes] [No] | [Yes] [No] |
| Mechanical Test | [Yes] [No] | [Yes] [No] |
| String Test | [Yes] [No] | [Yes] [No] |
| NPSH Test | [Single Point] [Full Curve] [No] | [Single Point] [Full Curve] [No] |
| Hydrostatic Test | [Yes] [No] | [Yes] [No] |
| Casing Hardness Test | [Yes] [No] | [Yes] [No] |

## Shipment, delivery, handling and storage

### Shipment, delivery and handling of equipment and materials shall be in accordance with Section 01 65 00 – Product Delivery Requirements.

### Storage of equipment shall be in accordance with Section 01 66 00 – Product Storage and Protection Requirements.

## MANUFACTURER’S FIELD SERVICES

### The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 43 20 00 – Pumps General. For each series of pumps, field services shall include the following Site Visits Schedule 43 23 19 - 08:

Site Visits Schedule 43 23 19 - 08

| Service | Number of Trips | Number of Days/Trip |
| --- | --- | --- |
| Installation and Testing | 2 | 1 |
| Startup and Training | 2 | 1 |
| Services after Startup | 2 | 1 |

## installation

### Install pump in strict accordance with manufacturer’s recommendations and Section 43 20 00 – Pumps General.

## alignment

### Comply with Section 43 20 00 – Pumps General.

## FIELD TESTING

### Field testing shall be in accordance with Section 43 20 00 – Pumps General, and Field Testing Schedule 43 23 19-09:

Field Testing Schedule 43 23 19 - 09

|  | XXXXX Pumps | XXXXX Pumps |
| --- | --- | --- |
| Field Performance Testing | [Yes] [No] | [Yes] [No] |
| Vibration Testing | [Yes] [No] | [Yes] [No] |
| Natural Frequency “Bump” Test | [Yes] [No] | [Yes] [No] |

Natural Frequency Tests are very uncommon for horizontal pump applications.

Natural Frequency Tests should typically be included if Level 2/3 dynamic analysis was completed.

## failure of equipment to perform

### Comply with Section 46 00 00 – Equipment General Provisions.

## painting

### Comply with Section 46 00 00 – Equipment General Provisions.

### Comply with Section 09 90 00 – Painting.

## additional requirements

add any additional requirements here

END OF SECTION