

DIVISION 11 EQUIPMENT

2 **SECTION 11005**
3 **EQUIPMENT: BASIC REQUIREMENTS**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6 A. Section Includes:

- 7 1. Requirements of this Section apply to all equipment provided on the Project including that
8 found in Divisions 11, 13, 14, 15, and 16, even if not specifically referenced in individual
9 "Equipment" articles of those Specifications.

10 B. Related Sections include but are not necessarily limited to:

- 11 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
12 2. Division 1 - General Requirements.
13 3. Section 03308 - Concrete, Materials and Proportioning.
14 4. Section 05505 - Metal Fabrications.
15 5. Section 07900 - Joint Sealants.
16 6. Section 09905 - Painting and Protective Coatings.
17 7. Section 10400 - Identification, Stenciling, and Tagging Systems.
18 8. Section 13442 - Primary Elements and Transmitters.
19 9. Section 13448 - Control Panels and Enclosures.
20 10. Section 15060 - Pipe and Pipe Fittings: Basic Requirements.
21 11. Section 16010 - Electrical: Basic Requirements.

22 **1.2 QUALITY ASSURANCE**

23 A. Referenced Standards:

- 24 1. American Bearing Manufacturers Association (ABMA).
25 2. American Gear Manufacturers Association (AGMA).
26 3. ASTM International (ASTM):
27 a. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
28 4. Institute of Electrical and Electronics Engineers (IEEE):
29 a. 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
30 5. National Electrical Manufacturers Association (NEMA):
31 a. 250, Enclosures for Electrical Equipment.
32 b. ICS 6, Enclosures for Industrial Control and System.
33 c. MG 1, Motors and Generators.
34 6. National Fire Protection Association (NFPA):
35 a. 70, National Electrical Code (NEC).
36 7. U.S. Department of Labor, Occupational Safety and Health Administration (OSHA):
37 a. 29 CFR 1910, OSHA Safety and Health Standards for General Industry (referred to
38 herein as OSHA standards).

39 B. Miscellaneous:

- 40 1. A single manufacturer of a "product" to be selected and utilized uniformly throughout
41 Project even though:
42 a. More than one manufacturer is listed for a given "product" in Specifications.
43 b. No manufacturer is listed.
44 2. Equipment, electrical assemblies, related electrical wiring, instrumentation, controls, and
45 system components shall FULLY comply with specific NEC requirements related to area
46 classification and to NEMA 250 and ICS-6 designations shown on Electrical Power
47 Drawings and defined in Section 16010.

48 **1.3 DEFINITIONS**

- 1 A. Product: Manufactured materials and equipment.
- 2 B. Major Equipment Supports - Supports for Equipment:
- 3 1. Located on or suspended from elevated slabs with supported equipment weighing 2000 LBS
- 4 or greater, or:
- 5 2. Located on or suspended from roofs with supported equipment weighing 500 LBS or
- 6 greater, or:
- 7 3. Located on slab-on-grade or earth with supported equipment weighing 5000 LBS or more.
- 8 C. Equipment: One or more assemblies capable of performing a complete function. Mechanical,
- 9 electrical, instrumentation or other devices requiring an electrical, pneumatic, electronic or
- 10 hydraulic connection. Not limited to items listed under "Equipment" article within
- 11 specifications.
- 12 D. Installer or Applicator: Installer or applicator is the person actually installing or applying the
- 13 product in the field at the Project site.
- 14 1. Installer and applicator are synonymous.

15 **1.4 SUBMITTALS**

- 16 A. Shop Drawings:
- 17 1. General for all equipment:
- 18 a. See Section 01340.
- 19 b. Acknowledgement that products submitted comply with the requirements of the
- 20 standards referenced.
- 21 c. Manufacturer's delivery, storage, handling, and installation instructions.
- 22 d. Equipment identification utilizing numbering system and name utilized in Drawings.
- 23 e. Equipment installation details:
- 24 1) Location of anchorage.
- 25 2) Type, size, and materials of construction of anchorage.
- 26 3) Anchorage setting templates.
- 27 4) Manufacturer's installation instructions.
- 28 f. Equipment area classification rating.
- 29 g. Shipping and operating weight.
- 30 h. Equipment physical characteristics:
- 31 1) Dimensions (both horizontal and vertical).
- 32 2) Materials of construction and construction details.
- 33 i. Equipment factory primer and paint data.
- 34 j. Manufacturer's recommended spare parts list.
- 35 k. Equipment lining and coatings.
- 36 l. Equipment utility requirements include air, natural gas, electricity, and water.
- 37 m. Ladders and platforms provided with equipment:
- 38 1) Certification that all components comply fully with OSHA requirements.
- 39 2) Full details of construction/fabrication.
- 40 3) Scaled plan and sections showing relationship to equipment.
- 41 2. Mechanical and process equipment:
- 42 a. Operating characteristics:
- 43 1) Technical information including applicable performance curves showing specified
- 44 equipment capacity, rangeability, and efficiencies.
- 45 2) Brake horsepower requirements.
- 46 3) Copies of equipment data plates.
- 47 b. Piping and duct connection size, type and location.
- 48 c. Equipment bearing life certification.
- 49 d. Equipment foundation data:
- 50 1) Equipment center of gravity.
- 51 2) Criteria for designing vibration, special or unbalanced forces resulting from
- 52 equipment operation.
- 53 3. Electrical and control equipment:

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- a. Electric motor information:
 - 1) Documentation that motors provided are manufacturer's energy efficient type and not standard efficiency motors.
 - a) When standard efficiency motors are submitted, provide documentation why energy efficient motors are not available.
 - 2) Nameplate data as required by the NEC.
 - a) Manufacturer's name.
 - b) Rated voltage.
 - c) Full load current.
 - d) Rated frequency.
 - e) Number of phases.
 - f) Rated full load speed.
 - g) Insulation system class and rated ambient temperature or rated temperature rise.
 - h) Time rating: 5, 15, 30 or 60 minutes or continuous.
 - i) Rated HP.
 - j) Code letter or locked rotor current.
 - k) NEMA design letter.
 - l) Marked "Thermally Protected" where applicable.
 - 3) Motor service factor.
 - 4) Motor enclosure type.
 - 5) NEMA frame size.
 - 6) NEMA design code.
 - 7) Insulation type and temperature rise.
 - 8) Motor locked rotor current.
 - 9) Current, efficiency and power factor at 1/2, 3/4 and full load.
 - b. Control panels:
 - 1) Panel construction.
 - 2) Point-to-point ladder diagrams.
 - 3) Scaled panel face and subpanel layout.
 - 4) Technical product data on panel components.
 - 5) Panel and subpanel dimensions and weights.
 - 6) Panel access openings.
 - 7) Nameplate schedule.
 - 8) Panel anchorage.
4. Systems schematics and data:
 - a. Provide system schematics where required in system specifications.
 - 1) Acknowledge all system components being supplied as part of the system.
 - 2) Utilize equipment, instrument and valving tag numbers defined in the contract documents for all components.
 - 3) Provide technical data for each system component showing compliance with the Contract Document requirements.
 - 4) For piping components, identify all utility connections, vents and drains which will be included as part of the system.
 5. For factory painted equipment, provide paint submittals in accordance with Section 09905.
- B. Operation and Maintenance Manuals:
 1. See Section 01340.
 - C. Miscellaneous Submittals:
 1. Sample form letter for equipment field certification.
 2. Certification that equipment has been installed properly, has been initially started up, has been calibrated and/or adjusted as required, and is ready for operation.
 3. Certification for major equipment supports that equipment foundation design loads shown on the Drawings or specified have been compared to actual loads exhibited by equipment provided for this Project and that said design loadings are equal to or greater than the loads produced by the equipment provided.

- 1 4. Field noise testing reports if such testing is specified in narrow scope sections.
- 2 5. Field vibration testing reports if vibration testing is specified in narrow scope sections.
- 3 6. Notification, at least 1 week in advance, that motor testing will be conducted at factory.
- 4 7. Certification from equipment manufacturer that all manufacturer-supplied control panels
- 5 that interface in any way with other controls or panels have been submitted to and
- 6 coordinated with the supplier/installer of those interfacing systems.
- 7 8. Motor test reports.
- 8 9. Certification prior to Project closeout that electrical panel drawings for manufacturer-
- 9 supplied control panels truly represent panel wiring including any field-made modifications.

10 **PART 2 - PRODUCTS**

11 **2.1 ACCEPTABLE MANUFACTURERS**

- 12 A. Subject to compliance with the Contract Documents, the following manufacturers are
- 13 acceptable:
- 14 1. Motors:
- 15 a. Baldor.
- 16 b. General Electric.
- 17 c. Reliance Electric.
- 18 d. Siemens.
- 19 e. Westinghouse.
- 20 f. U.S. Motors.
- 21 2. Mechanical variable speed drives:
- 22 a. Reeves.
- 23 b. U.S. Motors (VariDrive).
- 24 B. Submit requests for substitution in accordance with Specification Section 01640.

25 **2.2 MANUFACTURED UNITS**

- 26 A. Electric Motors:
- 27 1. Where used in conjunction with adjustable speed AC or DC drives, provide motors that are
- 28 fully compatible with the speed controllers.
- 29 2. Rate for continuous duty at 40 DegC ambient. Design in accordance with the NEMA
- 30 Standards for Class F insulation with Class B temperature rise above 40 DegC ambient on
- 31 continuous operation or intermittent duty at nameplate horsepower.
- 32 3. Design for full voltage starting.
- 33 4. Design bearing life based upon actual operating load conditions imposed by driven
- 34 equipment.
- 35 5. Size for altitude of project.
- 36 6. Size motors so that, under maximum continuous load imposed by driven equipment, motor
- 37 nameplate horsepower for continuous operation is minimum of 15 percent more than driven
- 38 load or provide motor with 1.15 service factor in which case maximum continuous load
- 39 imposed shall not exceed nameplate horsepower rating of motor.
- 40 7. Provide encapsulated windings in areas designated as wet and for outdoor applications.
- 41 a. Provide encapsulation using a silicone or epoxy seal after the windings have been dried
- 42 to less than 1 percent moisture.
- 43 8. Furnish corrosion resistant motors for use in areas designated as corrosive.
- 44 9. Furnish with clamp-type grounding terminals inside motor conduit box.
- 45 10. Furnish with oversized external conduit boxes.
- 46 11. Furnish with stainless steel nameplates which include all data required by Article 430 of the
- 47 National Electrical Code.
- 48 12. Use of manufacturer's standard motor will be permitted on integrally constructed motor
- 49 driven equipment specified by model number in which a redesign of the complete unit
- 50 would be required in order to provide a motor with features specified.
- 51 13. AC electric motors less than 1/3 HP:

- 1 a. Single phase, 60 Hz, designed for the supply voltage shown on the Drawings.
 2 b. Permanently lubricated sealed bearings conforming to ABMA standards.
 3 c. Built-in manual reset thermal protector or integrally mounted manual motor starter with
 4 thermal overload element with stainless steel enclosure.
- 5 14. AC electric motors 1/3 to 1 HP:
 6 a. Single or three phase, 60 Hz, designed for the supply voltage shown on the Drawings.
 7 b. Permanently lubricated sealed bearings conforming to ABMA standards. For single
 8 phase motors, provide built-in manual reset thermal protector or integrally mounted
 9 manual motor starter with thermal overload element.
- 10 15. AC electric motors 1-1/2 to 10 HP:
 11 a. Single or three phase, 60 Hz, designed for the supply voltage shown on the Drawings.
 12 b. Permanently lubricated sealed bearings conforming to ABMA standards.
 13 c. For vertical motors provide 15 year, average-life thrust bearings conforming to ABMA
 14 standards.
- 15 16. AC electric motors greater than 10 HP:
 16 a. Single or three phase, 60 Hz, designed for the supply voltage shown on the Drawings.
 17 b. Oil or grease lubricated antifriction bearings conforming to ABMA standards. Design
 18 bearing life for 90 percent survival rating at 50,000 HRS of operation for motors up to
 19 and including 100 HP.
 20 c. For vertical motors provide 15 year, average-life thrust bearings conforming to ABMA
 21 standards.
- 22 B. NEMA Design Squirrel Cage Induction Motors:
 23 1. Provide motors designed and applied in compliance with NEMA and IEEE for the specific
 24 duty imposed by the driven equipment.
 25 2. Motors to meet NEMA MG 1 (NEMA Premium) efficiencies.
 26 3. Do not provide motors having a locked rotor kVA per HP exceeding the NEMA standard
 27 for the assigned NEMA code letter.
 28 4. For use on variable frequency type adjustable speed drives, provide induction motors that
 29 are in compliance with NEMA MG-1, Part 31.
 30 5. Design motor insulation in accordance with NEMA standards for Class F insulation with
 31 Class B temperature rise above a 40 DegC ambient.
 32 6. Design motors for continuous duty.
 33 7. Size motors having a 1.0 service factor so that nameplate HP is a minimum of 15 percent
 34 greater than the maximum HP requirements of the driven equipment over its entire
 35 operating range.
 36 a. As an alternative, furnish motors with a 1.15 service factor and size so that nameplate
 37 HP is at least equal to the maximum HP requirements of the driven equipment over its
 38 entire operating range.
 39 8. Motor enclosure and winding insulation application:
 40 a. The following shall apply unless modified by specific specification sections:
 41

UNCLASSIFIED INDOOR AREAS	WET INDOOR AREAS	WET OUTDOOR AREAS	CORROSIVE AREAS	CLASS I DIVISION I AREAS	CLASS II DIVISION I AREAS	CLASS I OR CLASS II DIVISION 2 AREAS
DPFG (for horizontal motors), WPI (for vertical motors)	TEFC, Standard Insulation	TEFC, Extra Dip and Bake for Moisture	TEFC, Severe/ Chemical Duty	Explosion Proof, Approved for Class I Division 1 Locations	Explosion Proof, Approved for Class II Division 1 Locations	Explosion Proof, Approved for Division I Locations or TEFC with maximum external frame temperature compatible with the gas or dust in the area

1 NOTE: Provide TENV motors in the smaller horsepower ratings where TEFC is not available.

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3 9. Provide oversized conduit box complete with clamp type grounding terminals inside the
4 conduit box.

5 C. Submersible Motors: Refer to individual narrow scope specifications for submersible motor
6 requirements.

7 D. V-Belt Drive:

- 8 1. Provide each V-belt drive with sliding base or other suitable tension adjustment.
9 2. Provide V-belt drives with a service factor of at least 1.6 at maximum speed.
10 3. Provide staticproof belts.

11 E. Mechanical Variable Speed Drives:

- 12 1. Oil-lubricated shaft-mounted reduction gear drive capable of 300 percent shock load and
13 providing a 1.5 service factor in accordance with AGMA.
14 2. Assure infinite speed adjustment over a 4:1 range.
15 3. Secure drive to equipment base.
16 4. Flexible coupling between drive shaft and equipment shaft.

17 2.3 COMPONENTS

18 A. Gear Drives and Drive Components:

- 19 1. Size drive equipment capable of supporting full load including losses in speed reducers and
20 power transmission.
21 2. Provide nominal input horsepower rating of each gear or speed reducer at least equal to
22 nameplate horsepower of drive motor.
23 3. Design drive units for 24 HR continuous service, constructed so oil leakage around shafts is
24 precluded.
25 4. Utilize gears, gear lubrication systems, gear drives, speed reducers, speed increasers and
26 flexible couplings meeting applicable standards of American Gear Manufacturers
27 Association.
28 5. Gear reducers:
29 a. Provide gear reducer totally enclosed and oil lubricated.
30 b. Utilize antifriction bearings throughout.
31 c. Provide worm gear reducers having a service factor of at least 1.20.
32 d. Furnish other helical, spiral bevel, and combination bevel-helical gear reducers with a
33 service factor of at least 1.50.

34 2.4 ACCESSORIES

35 A. Guards:

- 36 1. Provide each piece of equipment having exposed moving parts with full length, easily
37 removable guards, meeting OSHA requirements.
38 2. Interior applications:
39 a. Construct from expanded galvanized steel rolled to conform to shaft or coupling
40 surface.
41 b. Utilize non-flattened type 16 GA galvanized steel with nominal 1/2 IN spacing.
42 c. Connect to equipment frame with hot-dip galvanized bolts and wing nuts.
43 3. Exterior applications:
44 a. Construct from 16 GA stainless steel or aluminum.
45 b. Construct to preclude entrance of rain, snow, or moisture.
46 c. Roll to conform to shaft or coupling surface.
47 d. Connect to equipment frame with stainless steel bolts and wing nuts.

48 B. Anchorage:

- 49 1. Cast-in-place anchorage:
50 a. Provide ASTM F593, Type 316 stainless steel anchorage for all equipment.

- 1 b. Configuration and number of anchor bolts shall be per manufacturer's
- 2 recommendations.
- 3 c. Provide two nuts for each bolt.
- 4 2. Drilled anchorage:
- 5 a. Adhesive anchors per Section 05505.
- 6 b. Epoxy grout per Section 03308.
- 7 c. Threaded rods same as cast-in-place.
- 8 C. Data Plate:
- 9 1. Attach a stainless steel data plate to each piece of rotary or reciprocating equipment.
- 10 2. Permanently stamp information on data plate including manufacturer's name, equipment
- 11 operating parameters, serial number and speed.
- 12 D. Pressure Gages:
- 13 1. Acceptable manufacturers:
- 14 a. Ashcroft.
- 15 b. Ametek.
- 16 2. Provide at the following locations:
- 17 a. Inlet and outlet of all reciprocating, centrifugal and positive displacement mechanical
- 18 and process equipment.
- 19 b. At locations identified on Drawings.
- 20 3. Utilize tapping sleeves for mounting per Section 15060.
- 21 4. Materials:
- 22 a. Bourdon tube, socket, connecting tube: 316 stainless steel.
- 23 b. Case: Phenolic.
- 24 c. Diaphragm seal housing: 316 stainless steel.
- 25 d. Pressure snubber:
- 26 1) Filter disc: 316 stainless steel.
- 27 2) Housing: 316 stainless steel.
- 28 5. Accessories:
- 29 a. Provide valve at point of connection to equipment and at panel if panel mounted.
- 30 b. Utilize pressure snubbers with porous metal discs to provide pulsation dampening on
- 31 gage applications as shown on schedule.
- 32 c. Provide 1/2 IN stainless steel antisiphon pigtail inlet connection for hot water and steam
- 33 applications.
- 34 6. Design and fabrication:
- 35 a. All components suitable for service at:
- 36 1) 250 DegF.
- 37 2) The maximum process temperature to which the gage is to be exposed.
- 38 b. Provide viewer protection from element rupture.
- 39 c. Calibrate gages at jobsite for pressure and temperature in accordance with
- 40 manufacturer's instructions.
- 41 d. Unless otherwise required by codes, provide stem mounted or flush mounted, as
- 42 required, with dial diameter as follows:
- 43

PIPE SIZE	DIAL SIZE	GAGE CONNECTION
1-1/2 IN or less	2-1/2 IN	1/4 IN
Larger than 1-1/2 IN	4-1/2 IN	1/2 IN

- 44 e. Equip with white faces, black numerals and black pointers.
- 45 f. Gage tapping position to be clear of equipment functions and movements, and protected
- 46 from maintenance and operation of equipment. Gage to be readable from an accessible
- 47 standing position.
- 48 g. Gage accuracy: 1 percent of full range.
- 49 h. Select gage range so that:
- 50 1) The normal operating value is in the middle third of the dial.
- 51

- 1 2) Maximum operating pressure does not exceed 75 percent of the full scale range.
- 2 E. Lifting Eye Bolts or Lugs:
- 3 1. Provide on all equipment 50 LBS or greater.
- 4 2. Provide on other equipment or products as specified in the narrow specifications.
- 5 F. Platforms and Ladders:
- 6 1. Design and fabricate in accordance with OSHA standards.
- 7 2. Fabricate components from galvanized steel, unless specified or shown otherwise on
- 8 Drawings.
- 9 3. Provide platform surface: Non-skid grating, unless specified in narrow scope specification.

10 **2.5 FABRICATION**

- 11 A. Design, fabricate, and assemble equipment in accordance with modern engineering and shop
- 12 practices.
- 13 B. Manufacture individual parts to standard sizes and gages so that repair parts, furnished at any
- 14 time, can be installed in field.
- 15 C. Furnish like parts of duplicate units to be interchangeable.
- 16 D. Ensure that equipment has not been in service at any time prior to delivery, except as required by
- 17 tests.
- 18 E. Furnish equipment which requires periodic internal inspection or adjustment with access panels
- 19 which will not require disassembly of guards, dismantling of piping or equipment or similar
- 20 major efforts. Quick opening but sound, securable access ports or windows shall be provided for
- 21 inspection of chains, belts, or similar items.
- 22 F. Provide common, lipped base plate mounting for equipment and equipment motor where said
- 23 mounting is a manufacturer's standard option. Provide drain connection for 3/4 IN PVC tubing.
- 24 G. Machine the mounting feet of rotating equipment.
- 25 H. Fabricate equipment which will be subject to Corrosive Environment in such a way as to avoid
- 26 back to back placement of surfaces that can not be properly prepared and painted. When such
- 27 back to back fabrication can not be avoided, provide continuous welds to seal such surfaces from
- 28 contact with corrosive environment. Where continuous welds are not practical, after painting
- 29 seal the back to back surfaces from the environment in accordance with Section 07900.

30 **2.6 SHOP OR FACTORY PAINT FINISHES**

- 31 A. Electrical Equipment:
- 32 1. Provide factory-applied paint coating system(s) for all electrical equipment components
- 33 except those specified in Section 09905 to receive field painting.
- 34 2. See the following specification for additional equipment receiving factory painting:
- 35 a. Section 13448 - Control Panels and Enclosures.
- 36 B. Field paint other equipment in accordance with Section 09905.

37 **2.7 SOURCE QUALITY CONTROL**

- 38 A. Motor Tests:
- 39 1. Test motors in accordance with NEMA and IEEE standards.
- 40 2. Provide routine test for all motors.
- 41 3. The Owner reserves the right to select and have tested, either routine or complete, any motor
- 42 included in the project.
- 43 a. The Owner will pay all costs, including shipping and handling, for all motors
- 44 successfully passing the tests.
- 45 b. The Contractor shall pay all costs, including shipping and handling, for all motors
- 46 failing the tests.

- 1 c. If two successive motors of the same manufacturer fail testing, the Owner has the right
2 to reject all motors from that manufacturer.

3 PART 3 - EXECUTION

4 3.1 INSTALLATION

- 5 A. Install equipment as shown on Drawings and in accordance with manufacturer's directions.
6 B. Utilize templates for anchorage placement for slab-mounted equipment.
7 C. For equipment having drainage requirements such as seal water, provide 3/4 IN PVC or clear
8 plastic tubing from equipment base to nearest floor or equipment drain. Route clear of major
9 traffic areas and as approved by Engineer.
10 D. DO NOT construct foundations until major equipment supports are approved.
11 E. Extend all non-accessible grease fittings using stainless steel tubing to a location which allows
12 easy access of fittings.
13 F. Construct subbases, either concrete, steel or cast iron, level in both directions. Particular care
14 shall be taken at hold-down bolt locations so these areas are flat and level.
15 G. Machine Base:
16 1. Mount machine bases of rotating equipment on subbases in manner that they are level in
17 both directions according to machined surfaces on base. Use machinist level for this
18 procedure.
19 2. Level machine bases on subbases and align couplings between driver and driven unit using
20 steel blocks and shims.
21 a. Size blocks and shims to provide solid support at each anchor bolt location. Area size of
22 blocks and shims shall be approximately 1-1/2 times area support surface at each
23 anchor bolt point.
24 b. Provide blocks and shims at each anchor bolt. Blocks and shims that are square shape
25 with "U" cut out to allow blocks and shims to be centered on anchor bolts.
26 c. After all leveling and alignment has been completed and before grouting, tighten
27 anchor bolts to proper torque value.
28 d. Do not use nuts below the machine base on anchor bolts for base leveling.
29 H. Couplings:
30 1. Align in the annular and parallel positions.
31 a. For equipment rotating at 1200 rpm or less, align both annular and parallel within 0.001
32 IN tolerance for couplings 4 IN size and smaller. Couplings larger than 4 IN size:
33 Increase tolerance 0.0005 IN per inches of coupling diameter, i.e., allow 6 IN coupling
34 0.002 IN tolerance, and allow a 10 IN coupling 0.004 IN tolerance.
35 b. For equipment rotating at speeds greater than 1200 rpm allow both annular and parallel
36 positions within a tolerance rate of 0.00025 IN per inch coupling diameter.
37 2. If equipment is delivered as a mounted unit from factory, verify factory alignment on site
38 after installation and realigned if necessary.
39 3. Check surfaces for runout before attempting to trim or align units.
40 I. Grouting:
41 1. After machine base has been shimmed, leveled, couplings aligned and anchor bolts
42 tightened to correct torque value, a dam or formwork shall be placed around base to contain
43 grouting. Extend dam or formwork at least 1/2 IN above the top of leveling shims and
44 blocks.
45 2. Saturate top of roughened concrete subbase with water before grouting. Add grout until
46 entire space under machine base is filled to the top of the base underside. Puddle grout by
47 working a stiff wire through the grout and vent holes to work grout in place and release any
48 entrained air in the grout or base cavity.

- 1 3. When the grout has sufficiently hardened, remove dam or formwork and finish the exposed
2 grout surface to fine, smooth surface. Cover exposed grout surfaces with wet burlap and
3 keep covering sufficiently wet to prevent too rapid evaporation of water from the grout.
4 When the grout has fully hardened (after a minimum of 7 days) tighten all anchor bolts and
5 recheck driver-driven unit for proper alignment.

6 **3.2 INSTALLATION CHECKS**

- 7 A. See Section 01650.
- 8 B. For all equipment specifically required in detailed specifications, secure services of experienced,
9 competent, and authorized representative(s) of equipment manufacturer to visit site of work and
10 inspect, check, adjust and approve equipment installation. In each case, representative(s) shall be
11 present during placement and startup of equipment and as often as necessary to resolve any
12 operational issues which may arise.
- 13 C. Secure from equipment manufacturer's representative(s) a written report certifying that
14 equipment:
15 1. Has been properly installed and lubricated.
16 2. Is in accurate alignment.
17 3. Is free from any undue stress imposed by connecting piping or anchor bolts.
18 4. Has been operated under full load conditions and that it operated satisfactorily. Secure and
19 deliver a field written report to Owner immediately prior to leaving jobsite.
- 20 D. No separate payment shall be made for installation checks. All or any time expended during
21 installation check does not qualify as O&M training or instruction time when specified.

22 **3.3 IDENTIFICATION OF EQUIPMENT AND HAZARD WARNING SIGNS**

- 23 A. Identify equipment and install hazard warning signs in accordance with Section 10400.

24 **3.4 FIELD PAINTING AND PROTECTIVE COATINGS**

- 25 A. For required field painting and protective coatings, comply with Section 09905.

26 **3.5 WIRING CONNECTIONS AND TERMINATION**

- 27 A. Clean wires before installing lugs and connectors.
- 28 B. Coat connection with oxidation eliminating compound for aluminum wire.
- 29 C. Terminate motor circuit conductors with copper lugs bolted to motor leads.
- 30 D. Tape stripped ends of conductors and associated connectors with electrical tape. Wrapping
31 thickness shall be 150 percent of the conductor insulation thickness.
- 32 E. Connections to carry full ampacity of conductors without temperature rise.
- 33 F. Terminate spare conductors with electrical tape.

34 **3.6 FIELD QUALITY CONTROL**

- 35 A. Furnish equipment manufacturer services as specified in the individual equipment specifications.
- 36 B. Inspect wire and connections for physical damage and proper connection.
- 37 C. Bump motor to check for correct rotation:
38 1. Ensure motor has been lubricated.
39 2. Check prior to connection to driven equipment.
- 40 D. Subbase that supports the equipment base and that is made in the form of a cast iron or steel
41 structure that has supporting beams, legs and cross member that are cast welded or bolted, shall
42 be tested for a natural frequency of vibration after equipment is mounted. Keep the ratio of the
43 natural frequency of the structure to the frequency of the disturbing force out of the range from
44 0.5 to 1.5.

2 **SECTION 11060**
3 **PUMPING EQUIPMENT: BASIC REQUIREMENTS**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:
7 1. Pumping equipment.
- 8 B. Related Sections include but are not necessarily limited to:
9 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
10 2. Division 1 - General Requirements.
11 3. Section 09905 - Painting and Protective Coatings.
12 4. Section 11005 - Equipment: Basic Requirements.
13 5. Section 11065 - Pumping Equipment: Sump.
14 6. Section 11072 - Pumping Equipment: Vertical Turbine.
15 7. Section 11078 - Pumping Equipment: Seal-Less Magnetic Drive.
16 8. Section 11079 - Pumping Equipment: Chemical Metering.
17 9. Division 16 - Electrical.

18 **1.2 QUALITY ASSURANCE**

- 19 A. Referenced Standards:
20 1. Hydraulic Institute (HI):
21 a. Standards for centrifugal, rotary and reciprocating pumps.
- 22 B. Fully coordinate all mechanical seal systems specified to ensure pump and seal compatibility.
- 23 C. For variable speed pumping applications, the pump manufacturer is designated to have single
24 source responsibility for coordination of the pump and variable speed drive system.

25 **1.3 DEFINITIONS**

- 26 A. The abbreviations are defined as follows:
27 1. IPS: Iron Pipe Size.
28 2. NPSHR: Net Positive Suction Head Required.
29 3. TDH: Total Differential Head.
30 4. TEFC: Totally Enclosed Fan Cooled.
- 31 B. Pump Service Category - Pump or pumps having identical names (not tag numbers) used for
32 specific pumping service.

33 **1.4 SUBMITTALS**

- 34 A. Shop Drawings:
35 1. See Section 11005.
36 2. Product technical data including:
37 a. Performance data and curves with flow (gpm), head (FT), horsepower, efficiency,
38 NPSH requirements, submergence requirement.
39 b. Pump accessory data.
40 c. Bearing supports, shafting details and lubrication provisions.
41 d. Solids passage information.
- 42 3. Certifications:
43 a. Certified pump performance curves as described in Article 2.4.
- 44 4. Test reports:
45 a. Factory hydrostatic test.

- 1 B. Operation and Maintenance Manuals:
- 2 1. See Section 01340.
- 3 C. Miscellaneous:
- 4 1. Certifications:
- 5 a. Statement relative to installation and start-up per Paragraph 3.2.

6 **PART 2 - PRODUCTS**

7 **2.1 ACCEPTABLE MANUFACTURERS**

- 8 A. Subject to compliance with the Contract Documents, the following manufacturers are
- 9 acceptable:
- 10 1. Pumps:
- 11 a. See individual pump specification sections.
- 12 2. Mechanical seals:
- 13 a. Chesterton.
- 14 b. Garlock.
- 15 B. Submit requests for substitution in accordance with Specification Section 01640.

16 **2.2 ACCESSORIES**

- 17 A. See Section 11005.
- 18 B. Each Unit:
- 19 1. Lifting eye bolts or lugs.
- 20 2. Plugged gage cock connection at suction and discharge nozzles.
- 21 3. Tapped and plugged openings for casing and bearing housing vents and drains.
- 22 4. Fittings for properly adding flushing lubricant.
- 23 5. Pressure relief fittings for grease lubrication.
- 24 C. Packing Seal:
- 25 1. Provide packing unless mechanical seal is specified in narrow-scope pump sections.
- 26 2. Minimum of five rings graphite impregnated synthetic packing.
- 27 3. Provide minimum 1/4 IN DIA supply tap and 1/2 IN DIA minimum drain tap.
- 28 4. Provide split teflon or bronze water seal ring.
- 29 5. Adjustable split follower cast iron or bronze gland.
- 30 6. Packing to be NSF approved for potable water use.
- 31 D. Mechanical Seals:
- 32 1. Provide as specified in the narrow-scope pump sections.
- 33 2. Provide rotating balanced O-ring type.
- 34 3. Provide water lubrication - cooling.
- 35 4. Materials:
- 36 a. Metal parts except springs: 316 stainless steel.
- 37 b. Springs: Hastelloy C.
- 38 c. Seal faces: Unfilled carbon graphite versus silica-free Grade 99.5 ceramic.
- 39 d. Elastomers: Viton.

40 **2.3 FABRICATION**

- 41 A. Pump Support:
- 42 1. Design base to support weight of drive, shafting and pump.
- 43 2. Comply with HI vibration limitations.
- 44 3. Mount horizontal pump, motor and coupling on single piece drip lip type baseplate.
- 45 4. Mount vertical pumps on single piece pedestal baseplate.
- 46 5. Fabricate to withstand all operating loads transmitted from the pump and drive.

47 **2.4 SOURCE QUALITY CONTROL**

- 1 A. If specifically required in the individual pump specification sections, provide factory tests:
2 1. All units:
3 a. Hydrostatic test at 150 percent of shutoff head for a minimum of 5 minutes.
4 2. Adjustable speed units:
5 a. Head (FT) verses flow (gpm) pump curves:
6 1) Maximum, minimum and two equally spaced intermittent speeds.
7 2) Efficiencies along each curve.
8 3) Brake horsepower along each curve.
9 3. Constant speed units:
10 a. Head (FT) versus flow (gpm) pump curves:
11 1) Efficiencies along curve.
12 2) Brake horsepower along each curve.
13 4. Results certified by a registered professional engineer.
14 B. Statically and dynamically balance each pump per HI standards.

15 **PART 3 - EXECUTION**

16 **3.1 INSTALLATION**

- 17 A. See Section 11005.
18 B. Floor or Pad-Mounted Units (Non-Submersible):
19 1. Align vertically and horizontally level, wedge and plumb units to match piping interfaces.
20 2. Assure no unnecessary stresses are transmitted to equipment flanges.
21 3. Tighten flange bolts at uniform rate and manufacturer's recommended torque for uniform
22 gasket compression.
23 4. Support and match flange faces to uniform contact over entire face area prior to bolting pipe
24 flange and equipment.
25 5. Permit piping connecting to equipment to freely move in directions parallel to longitudinal
26 centerline when and while bolts in connection flange are tightened.
27 6. Grout equipment into place prior to final bolting of piping but not before initial fitting and
28 alignment.
29 7. Assemble connecting piping with gaskets in place and minimum of four bolts per joint
30 installed and tightened. Test alignment by loosening flange bolts to see if there is any
31 change in relationship of piping flange with equipment connecting flange. Realign as
32 necessary, install flange bolts and make equipment connection.
33 8. Field paint units as defined in Section 09905.
34 9. Provide pressure gage on discharge of all pumps and on suction and discharge of all non-
35 submersible units.
36 C. Submersible Units:
37 1. Comply with requirements defined in paragraphs 3.1-B.7, 8, and 9.

38 **3.2 FIELD QUALITY CONTROL**

- 39 A. Provide Manufacturer's Field Services as defined in Section 01650 to provide the following
40 services:
41 1. Assistance during installation to include observation, guidance, instruction of
42 CONTRACTOR's assembly, erection, installation or application procedures.
43 2. Inspection, checking, and adjustment as required for equipment to function as warranted by
44 manufacturer and necessary to provide written approval of installation.
45 3. Revisiting the site as required to correct problems and until installation and operation are
46 acceptable to OWNER.
47 4. Resolution of assembly or installation problems attributable to, or associated with,
48 respective manufacturer's products and systems.
49 5. Assistance during Demonstration Period functional and performance testing, and until
50 product acceptance by the OWNER.

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3

SECTION 11065
PUMPING EQUIPMENT: SUMP

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6 A. Section Includes:

7 1. Submersible sump pumps.

8 B. Related Sections include but are not necessarily limited to:

9 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

10 2. Division 1 - General Requirements.

11 3. Section 11060 - Pumping Equipment: Basic Requirements.

12 **1.2 QUALITY ASSURANCE**

13 A. Referenced Standards:

14 1. American Iron and Steel Institute (AISI):

15 a. Steel Products Manual.

16 2. ASTM International (ASTM):

17 a. A48, Standard Specification for Gray Iron Castings.

18 b. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.

19 c. C1018, Standard Test Method for Flexural Toughness and First-Crack Strength of
20 Fiber-Reinforced Concrete (Using Beam with Third-Point Loading).

21 **1.3 SUBMITTALS**

22 A. Shop Drawings:

23 1. See Section 11060.

24 2. Product technical data including:

25 a. Acknowledgement that products submitted meet requirements of standards referenced.

26 b. Manufacturer's installation instructions.

27 B. Operation and Maintenance Manuals:

28 1. See Section 01340.

29 **PART 2 - PRODUCTS**

30 **2.1 ACCEPTABLE MANUFACTURERS**

31 A. Subject to compliance with the Contract Documents, the following manufacturers are
32 acceptable:

33 1. Submersible sump pumps:

34 a. Hydromatic.

35 b. Aurora.

36 c. Fairbanks - Morse.

37 B. Submit requests for substitution in accordance with Specification Section 01640.

38 **2.2 MATERIALS**

39 A. Sump pump: Tag No's. P-42-A/B/C/D

40 1. Pump casing:

41 a. Cast iron, ASTM A48, Class 35A.

42 b. Bronze, ASTM B62, Class 4A.

- 1 c. Stainless steel, AISI Type 316.
- 2 2. Impeller:
- 3 a. Bronze, ASTM B62.
- 4 b. Cast iron, ASTM A48, Class 35A.
- 5 c. Stainless steel, AISI Type 316.
- 6 d. Engineered Thermoplastic.
- 7 3. Shaft:
- 8 a. Carbon steel.
- 9 b. Stainless steel, AISI Type 316.
- 10 4. Impeller wear rings:
- 11 a. Manufacturers standard.
- 12 5. Mechanical seal:
- 13 a. Seal face: Carbon/ceramic.
- 14 b. Seal body: Brass.
- 15 c. Spring: Stainless steel.
- 16 d. Bellows: Buna-N.
- 17 6. Fasteners:
- 18 a. Stainless steel

19 2.3 EQUIPMENT

- 20 A. Performance and Configuration Requirements:
- 21 1. Continuous duty: Tag No's. P-42-A/B/C/D.
- 22 a. Design condition: 5.0 gpm at 22 FT TDH.
- 23 b. Pump configuration: Vertical.
- 24 c. Maximum pump speed: 1550 rpm.
- 25 d. Nameplate driver horsepower: Maximum 1/3 HP.
- 26 e. Drive type: Constant speed.
- 27 f. Drive configuration: Direct coupled.
- 28 g. Minimum solids passage: 3/4 IN.
- 29 h. Discharge: 1.5 IN NPT.
- 30 i. Electrical: Dielectric oil filled motor, 120V, 1Ø, thermally protected.

31 2.4 ACCESSORIES

- 32 A. See Section 11060.
- 33 B. Controls:
- 34 1. Vertical mechanical float switch mounted on pump. Install in duty/standby configuration by
- 35 staggering the height of the pump float switches. For duty pumps, install float switch to
- 36 start pump once the impeller is submerged. For standby pumps, install float switch 6-IN
- 37 above the duty pump switch.
- 38 2. Provide flexible bellows for gastight seal.
- 39 3. Potting compound to make electrical connections watertight.
- 40 C. Sump cover:
- 41 1. Provide fiberglass grating sump cover, size as shown on the drawings, with embed angles so
- 42 that cover is flush with floor.
- 43 2. Cover to be easily removed.
- 44 3. Cover shall be designed to handle 100 psf live loading.
- 45 4. Cover to be designed to allow for pump discharge to pass through. Provide unions as
- 46 required for easy removal of cover and pumps.

47 2.5 FABRICATION

- 48 A. General:
- 49 1. Pump casing uniform and free from blowholes or other defects and designed to withstand
- 50 150 percent of shutoff head.

- 1 B. Suction and Discharge:
2 1. Threaded NPT connections of the following diameters:
3

SERVICE CATEGORY	DISCHARGE (IN)
Floor Drainage	1.5 IN NPT

- 4
5 2. Provide fitting and hose for discharge from pump to connection at top of sump. Separate
6 discharge hoses for each sump pump to be connected to single pipe near top of sump to
7 allow removal of one sump pump while second pump continues operation. Provide valves
8 and connections to allow isolation of individual discharge lines.
- 9 C. Impeller:
10 1. Enclosed or open.
11 2. Key to pump shafts with same material as shaft.
- 12 D. Bearings:
13 1. Oil lubricated.

14 **PART 3 - EXECUTION**

15 **3.1 INSTALLATION**

- 16 A. Comply with requirements of Section 11060.

17 **3.2 FIELD QUALITY CONTROL**

- 18 A. See Section 11060.

19 **END OF SECTION**

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2

SECTION 11072

3

PUMPING EQUIPMENT: VERTICAL TURBINE (LINE SHAFT)

4

PART 1 - GENERAL

5

1.1 SUMMARY

6

A. Section Includes:

7

1. Vertical turbine pumps.

8

B. Related Sections include but are not necessarily limited to:

9

1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

10

2. Division 1 - General Requirements.

11

3. Section 11005 - Equipment: Basic Requirements.

12

4. Section 11060 - Pump Equipment: Basic Requirements.

13

5. Section 13440 - Instrumentation for Process Control: Basic Requirements.

14

1.2 QUALITY ASSURANCE

15

A. Referenced Standards:

16

1. American Iron and Steel Institute (AISI).

17

2. American National Standard Institute (ANSI):

18

- a. B16.1, Cast-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.

19

3. ASTM International (ASTM):

20

- a. A48, Standard Specification for Gray Iron Castings.

21

- b. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

22

- c. A108, Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality.

23

- d. A120, Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless for Ordinary Uses.

24

- e. A276, Standard Specification for Stainless Steel Bars and Shapes.

25

- f. B505, Standard Specification for Copper-Base Alloy Continuous Castings.

26

- g. B584, Standard Specification for Copper Alloy Sand Castings for General Applications.

27

4. American Water Works Association (AWWA):

28

- a. E101, Deep Well Vertical Turbine Pumps - Line Shaft Type.

29

5. Hydraulic Institute Standards (HI).

30

6. Society of Automotive Engineers (SAE).

31

32

33

1.3 SUBMITTALS

34

A. Shop Drawings:

35

1. See Section 01340.

36

2. Product technical data including:

37

B. Operation and Maintenance Manuals:

38

1. See Section 01340.

38

39

PART 2 - PRODUCTS

40

2.1 ACCEPTABLE MANUFACTURERS

41

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

42

1. Fairbanks Morse.

43

- 1 2. Byron Jackson.
- 2 3. Layne-Bowler.
- 3 4. Goulds.
- 4 5. Floway.
- 5 6. Peerless.
- 6 7. Ingersoll-Dresser.
- 7 B. Submit requests for substitution in accordance with Specification Section 01640.

8 **2.2 PERFORMANCE AND DESIGN REQUIREMENTS**

- 9 A. Performance Parameters:
 - 10 1. Name and tag numbers of pumps: P-1D
 - 11 a. Primary design conditions: 1750 gpm at 73 FT TDH and 81 percent efficiency.
 - 12 b. Secondary design conditions: 1050 gpm at 85 FT TDH and 64 percent efficiency.
 - 13 c. Maximum speed: 1170 rpm.
 - 14 d. Maximum horsepower: 50 HP.
 - 15 e. Minimum shutoff condition: 0 gpm at 104 FT.
 - 16 f. Column size: 10 IN.
 - 17 g. Discharge flange: 10 IN.
 - 18 2. Type of discharge head: above ground.
- 19 B. Provide pumps with increasing head characteristics from secondary design conditions to shutoff
 - 20 condition. Provide pumps with net positive suction head requirements (NPSHR) less than the net
 - 21 positive suction head available (NPSHA) at all operating conditions.

22 **2.3 ACCESSORIES**

- 23 A. See Sections 11005 and 13440.

24 **2.4 COMPONENTS**

- 25 A. General:
 - 26 1. Furnish units consisting of a vertical shaft turbine, direct connected to a vertical hollow
 - 27 shaft motor. Design unit with non-reversing ratchets.
 - 28 2. Weight of revolving parts of pump including unbalanced hydraulic thrust of impeller is
 - 29 carried by thrust bearing in driver.
 - 30 3. Make provision at driver shaft for adjusting impeller with reference to bowls.
- 31 B. Column:
 - 32 1. Construct discharge column pipe of steel and supply with threaded connections.
 - 33 2. Provide top and bottom sections of column pipes to 5 FT lengths.
 - 34 3. Provide intermediate column sections not exceeding 10 FT in length.
 - 35 4. Sandblast column and coat with a minimum 15 mils dry film thickness epoxy system at the
 - 36 factory.
 - 37 5. Provide coating equal to that recommended by Tnemec or Koppers and approved for use
 - 38 with potable water.
- 39 C. Open Line Shaft:
 - 40 1. 416 stainless steel, rolled and ground.
 - 41 2. Maximum length: 10 FT.
 - 42 3. Furnish renewable shaft sleeves constructed from 416 stainless steel at each bearing
 - 43 location.
 - 44 4. Undercutting of shafting at sleeve locations is not permitted.
 - 45 5. Provide rubber bearings at each column connection supported by retainers butted between
 - 46 machined faces of discharge column.
 - 47 6. All shaft coupling locations shall coincide with column connections.
- 48 D. Pump Bowl and Suction Bell:

- 1 1. Provide bowl and suction bell constructed of close grained cast iron, free from
- 2 imperfections and accurately machined and fitted.
- 3 2. Coat pump bowl water passages with an abrasion-resistant baked enamel, phenolic or
- 4 epoxy.
- 5 3. Provide coating suitable for potable water service.
- 6 4. Design to ensure easy removal of bearings and impeller.
- 7 5. Furnish suction bell with flared end to reduce entrance losses and with a sufficient number
- 8 of vanes to support lower guide bearings and weight of impeller and pump shaft when
- 9 dismantling pump.
- 10 E. Bearings:
- 11 1. Provide units with sleeve bearings of SAE 600 bronze in each bowl and in suction bell.
- 12 2. In bowl, provide main bronze bearing immediately above impeller and a lower bronze
- 13 bearing immediately below impeller.
- 14 3. Provide for lubrication of bowl bearings with pumped liquid.
- 15 4. Furnish suction bell bearing having minimum length equal to five shaft diameters.
- 16 5. Ensure bell bearing is permanently packed type with packing to be a nonsoluble grease.
- 17 6. Provide SAE 40 bronze collar for bell bearing to prevent abrasives from entering bearing.
- 18 F. Pump Shaft and Impeller:
- 19 1. Provide pump unit shaft constructed of rolled and ground 416 or 410 stainless steel.
- 20 2. Furnish enclosed type impellers constructed of bronze and securely attached to impeller
- 21 shaft.
- 22 3. Ensure impeller is accurately fitted and statically and dynamically balanced.
- 23 4. Provide bronze replacement wear rings in each bowl to prevent wear on bowls.
- 24 G. Discharge Head Assemblies:
- 25 1. Design discharge head assembly for 150 psi working pressure and 250 psi test pressure.
- 26 2. Provide discharge head for above ground mounting constructed of fabricated steel with
- 27 integral discharge flange.
- 28 3. Construct discharge nozzle with a vertical vane to minimize turbulence.
- 29 4. Furnish ANSI B16.1 125/150 LB flange.
- 30 5. Mount discharge head on fabricated steel base plate which is of sufficient size to span
- 31 opening in support structure.
- 32 6. Supply base plate with lifting lugs capable of supporting weight of entire unit.
- 33 7. Furnish stuffing box constructed of cast iron and containing not less than four rings of
- 34 graphited asbestos packing. Compress packing around shaft with adjustable gland. Furnish
- 35 grease fitting to provide additional lubrication to bronze upper shaft bearing. Provide
- 36 connections for grease inlet and pressure relief. Provide 416 stainless steel shaft at top
- 37 section of line shaft where it passes through stuffing box. Provide bronze upper shaft
- 38 bearing directly below stuffing box, in the head, to eliminate any shaft whip which could
- 39 damage the seal. Hard pipe stuffing box bleedoff to wet pit below pumps.
- 40 H. Suction Strainer:
- 41 1. Supply vortex suppressor type basket strainer constructed of 316 stainless steel with net
- 42 open area of not less than four times the throat area of the suction bell.
- 43 2. Maximum opening shall not be more than 75 percent of the minimum opening of the water
- 44 passage through the bowls and impellers.
- 45 3. Solid bottom.
- 46 4. Wire mesh sides w/ 1/2" square openings (about 65% net open area) w/ sufficient area for
- 47 maximum 3 ft/sec approach velocity at one pump operating flow.
- 48 5. Internal baffle plates.
- 49 6. Attach to bell by bolting. Use of clips prohibited.
- 50 I. Data Plates:
- 51 1. Provide stainless steel data plate securely attached to pump.
- 52 2. Include manufacturer's name, pump size and type, serial number, speed, impeller diameter,
- 53 capacity and head rating, and other pertinent data.

- 1 J. Motors:
2 1. Vertical hollow shaft, squirrel cage, induction type.
3 2. 460 V, 60 HZ, 3 PH.
4 3. WP-I type with 1.15 service factor.
5 4. Size motor to drive pump continuously over the complete head - capacity range without the
6 load exceeding the nameplate rating.
7 5. Design motor for 40 DegC ambient.
8 6. Comply with Section 11005.
9 7. Provide 120V, 1 PH, motor space heater.

10 **2.5 MAINTENANCE MATERIALS**

- 11 A. Extra Materials:
12 1. Furnish the Owner the following extra parts for each pump service category:
13 a. Lower bearing assembly: One set.
14 b. Upper bowl bearing: One set.
15 c. Line shaft bearing assemblies: One set.
16 d. Packing, gland follower, studs and nuts: One set.
17 e. Lantern ring: One.
18 f. Wearing rings: One set.

19 **2.6 SOURCE QUALITY CONTROL**

- 20 A. All pumps:
21 1. Hydrostatic test at 150 percent of shutoff head for a minimum of 5 minutes.
22 2. Factory test each pump.
23 a. Head (FT) versus flow (gpm) pump curves:
24 1) Efficiencies along curve.
25 2) Brake horsepower along each curve.
26 b. Results certified by a registered professional engineer.

27 **PART 3 - EXECUTION**

28 **3.1 INSTALLATION**

- 29 A. Install products in accordance with manufacturer's instructions.

30 **3.2 FIELD QUALITY CONTROL**

- 31 A. See Section 11060.

32 **END OF SECTION**
33

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2 **SECTION 11078**
3 **PUMPING EQUIPMENT: SEAL-LESS MAGNETIC DRIVE CHEMICAL TRANSFER**
4 **PUMPS**

5 **PART 1 - GENERAL**

6 **1.1 SUMMARY**

- 7 A. Section Includes:
8 1. Seal-less magnetic drive chemical transfer pumps.
- 9 B. Related Sections include but are not necessarily limited to:
10 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
11 2. Division 1 - General Requirements.
12 3. Section 11005 - Equipment: Basic Requirements.
13 4. Section 11060 - Pumping Equipment: Basic Requirements.
14 5. Section 13442 - Primary Elements and Transmitters.

15 **1.2 QUALITY ASSURANCE**

- 16 A. Referenced Standards:
17 1. Anti-Friction Bearing Manufacturers Association (AFBMA).
18 2. American Iron and Steel Institute (AISI):
19 a. Steel Products Manual.
20 3. ASTM International (ASTM):
21 a. A48, Standard Specification for Gray Iron Castings.
22 b. B584, Standard Specification for Copper Alloy Sand Castings for General Applications.
23 4. Hydraulic Institute Standards for Centrifugal Rotary and Reciprocating Pumps (HI).

24 **1.3 SUBMITTALS**

- 25 A. Shop Drawings:
26 1. See Section 11060.
- 27 B. Operation and Maintenance Manuals:
28 1. See Section 01340.

29 **PART 2 - PRODUCTS**

30 **2.1 ACCEPTABLE MANUFACTURERS**

- 31 A. Subject to compliance with the Contract Documents, the following manufacturers are
32 acceptable:
33 1. Centrifugal chemical transfer pumps:
34 a. March.
35 b. Pacer.
36 c. Sequence.
37 d. Webster.
38 e. Or approved equal.
- 39 B. Specifications are based on March Manufacturing Company products.
- 40 C. Submit requests for substitution in accordance with Specification Section 01640.

41 **2.2 MATERIALS**

- 1 A. Seal-less magnetic drive chemical transfer pump: Tag No. P-56-T
 2 1. Cover, Pump Housing: Polypropylene.
 3 2. Volute O-ring: Viton.
 4 3. Impeller and magnetic assembly: Polypropylene.
 5 4. Impeller: Hastelloy "C".
 6 5. Spindle shaft: Ceramic.
 7 6. Thrust washer: Ceramic.
 8 7. Pump housing: polypropylene.
 9 8. Motor bracket: polypropylene.
 10 9. Hardware: 18-8 stainless steel or 316 stainless steel.

11 **2.3 EQUIPMENT**

- 12 A. Provide transfer pumps meeting the following parameters listed here:
 13

Pump Design Parameters	Ferric Sulfate (P-56T)
Total discharge head (TDH), FT	5
Maximum pump speed (RPM)	3450
Pump discharge (MPT)	3/4 IN
Pump suction (FPT)	1 IN
Service liquid	Ferric sulfate
pH	1.0 (as is)
% concentration	59% solution
Specific gravity	1.58-1.60
Flow rate (gpm)	30
Motor type: Maximum motor size (Hp) and voltage requirement	TEFC: 0.50 Hp, 120V, 1 Ph

14 **2.4 ACCESSORIES**

- 15 A. See Section 11060.

16 **2.5 FABRICATION**

- 17 A. Fabricate pump case to withstand 50 psig or 200 percent of maximum working pressure
 18 specified by pump performance, whichever is greater.
 19 B. Pump components in contact with the liquid shall be polypropylene or Hastelloy "C".
 20 C. Moving components within the pump shall be the impeller-magnetic assembly.
 21 D. Pump shall be lubricated by pumped liquid.
 22 E. Disassembly of pump shall be accomplished by simply removing 6 to 8 housing screws. Access
 23 to the entire assembly up to the motor will be possible.
 24 F. Statically and dynamically balance impellers per Hydraulic Institute Standards.

25 **PART 3 - EXECUTION**

26 **3.1 INSTALLATION**

- 27 A. See Section 11060.

28 **3.2 FIELD QUALITY CONTROL**

- 29 A. See Section 11060.

30 **END OF SECTION**

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2

SECTION 11079

3

PUMPING EQUIPMENT: CHEMICAL METERING PUMPS

4 PART 1 - GENERAL

5 1.1 SUMMARY

6

A. Section Includes:

7

1. Chemical metering pumps – diaphragm type.

8

B. Related Sections include but are not necessarily limited to:

9

1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

10

2. Division 1 - General Requirements.

11

3. Section 11060 - Pumping Equipment: Basic Requirements.

12

1.2 QUALITY ASSURANCE

13

A. Referenced Standards:

14

1. American National Standard Institute (ANSI).

15

2. Standards of the Hydraulic Institute.

16

3. Standards of the American Water Works Association.

17

4. National Electric Code.

18

5. Standards of National Electrical Manufacturers Association.

19

6. Institute of Electrical and Electronic Engineers.

20

7. American Gear Manufacturers Association.

21

B. Manufacturer's Qualifications: Manufacturer of the Chemical Metering Pumps shall have

22

experience in providing similar type equipment and shall show evidence with his submittal of at

23

least five (5) installations where equipment of the same material, same design and same

24

application of the type specified herein have been in satisfactory operation for at least five (5)

25

years.

26

1.3 SUBMITTALS

27

A. Shop Drawings:

28

1. See Section 11060.

29

B. Operation and Maintenance Manuals:

30

1. See Section 01340.

31

PART 2 - PRODUCTS

32

2.1 ACCEPTABLE MANUFACTURERS

33

A. Subject to compliance with the Contract Documents, the following manufacturers are

34

acceptable:

35

1. LMI.

36

2. Milton Roy.

37

3. Prominent.

38

4. Or ENGINEER approved equal.

39

2.2 MATERIALS

40

A. Ferric Sulfate Metering Pumps: Tag No's. P-56-A/B

41

1. Pump head: Polypropylene.

42

2. Pump diaphragm: Teflon faced composite.

- 1 3. Check valves: Ceramic or Teflon.
- 2 4. O-rings: Viton or EPDM.
- 3 5. Pulsation dampener: PVC body with Viton diaphragm.
- 4 6. Calibration column: Clear PVC.
- 5 7. Backpressure regulator: PVC.
- 6 8. Pressure relief valves: PVC.
- 7 9. Suction/Discharge valves: Polypropylene.
- 8 10. Flow indicators: PVC body, Pyrex inner cylinder, Viton seals.

9 **2.3 PERFORMANCE AND DESIGN REQUIREMENTS**

10 A. Performance Requirements:

- 11 1. Ferric Sulfate Metering Pumps: Tag No's. P556-A/B
- 12 a. Design condition: Minimum 0.48, Maximum 3.19 GPH at 35 psi TDH.
- 13 b. Continuous operation, variable speed.
- 14 c. Repeatability within +/-2% accurate.
- 15 d. Suction/Discharge connectors: 1/2 IN O.D., 3/8 IN I.D.
- 16 e. Redundancy: Provide a system level pump arrangement in Duty/Standby configuration.
- 17 f. Model Numbers:
- 18 1) Prominent: Gamma/5b.
- 19 g. Liquid pumped: 59% Ferric Sulfate.

20 **2.4 DETAILS OF CONSTRUCTION**

- 21 A. Metering Pumps shall be positive displacement, solenoid-driven, mechanically actuated
- 22 diaphragm type pumps. Output volume shall be adjustable while pumps are in operation from
- 23 zero to maximum capacity. Adjustment shall be by dial knobs or electronic keypad, one for
- 24 changing pump speed, the other for changing stroke length. The metering pump shall accept a 4-
- 25 20 mA control signal to adjust pump speed (stroke frequency). The stroke length shall be set
- 26 manually. The metering pumps shall operate using 120 volt, 60 Hz power.
- 27 B. Metering pump housings shall be of chemically resistant glass fiberglass reinforced
- 28 thermoplastic. All exposed fasteners shall be Type 316 Stainless Steel. Metering pump check
- 29 valves shall be ball type with ceramic or teflon balls on combination valve seat and seal ring.
- 30 C. A multi-function valve shall be attached to the discharge of each pump. The discharge valve
- 31 shall provide the following functions: Back pressure control, antisiphon, pressure relief, and
- 32 priming drain. Materials of construction shall be PVC or suitable for liquid being pumped.
- 33 Settings shall be field adjustable.
- 34 D. Metering pumps shall be self-priming and not lose prime as result of intermittent operation.
- 35 E. Non-corrosive tubing (i.e. - polyethylene) shall be provided with pump with compression style
- 36 connections. A foot valve with integral strainer shall be provided for the suction line and an
- 37 injection check/back pressure valve with 1/2 inch connection for the injection point. N.P.T. style
- 38 connections are not permitted on concentrated chemical injection lines. Calibration columns and
- 39 feed isolation valves are required for metering pumps in continuous operation. An on-line spare
- 40 shall be provided for metering pumps in continuous operation. The chemical delivery system
- 41 shall be fabricated from non-corrosive materials. The General Contractor shall be responsible
- 42 for interconnecting tubing.

43 **2.5 FABRICATION**

- 44 A. Factory assemble pump complete with air valve.
- 45 B. Coat all steel materials with a factory-applied epoxy.
- 46 C. Pump to be capable of running dry indefinitely without damage.

47 **2.6 MAINTENANCE MATERIALS**

- 48 A. Maintenance Materials:

1 91C18

2

SECTION 11922

3

POLYETHYLENE CHEMICAL STORAGE TANKS

4

PART 1 - GENERAL

5

1.1 SUMMARY

6

A. Section Includes:

7

1. High density Cross-Linked Polyethylene (XLPE) bulk chemical storage tanks.

8

B. Related Sections include but are not necessarily limited to:

9

1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

10

2. Division 1 - General Requirements.

11

3. Section 10400 - Identification, Stenciling, and Tagging Systems.

12

4. Section 11005 - Equipment: Basic Requirements.

13

5. Section 15060 - Pipe and Pipe Fittings: General Requirements.

14

1.2 QUALITY ASSURANCE

15

A. Referenced Standards:

16

1. American Society for Testing and Materials (ASTM):

17

- a. C582, Reinforced Plastic Laminates for Self-Supporting Structures for Use in a Chemical Environment.

18

- b. D1998-91, Standard Specification for Polyethylene Upright Storage Tanks.

19

2. American National Standards Institute:

20

- a. B16.5, Pipe Flanges and Flanged Fittings.

21

3. National Bureau of Standards (NBS):

22

- a. PS15, Custom Contact Molded Reinforced Polyester Chemical Resistant Process Equipment.

23

24

B. Qualifications:

25

1. Tank manufacturer shall have manufactured at least 100 tanks of similar size and design within five years.

26

27

28

1.3 SUBMITTALS

29

A. Shop Drawings:

30

1. See Section 01340.

31

2. Product technical data including:

32

- a. Acknowledgement that products submitted meet requirements of standards referenced.

33

- b. Tank fabrication drawings for each tank.

34

- c. Structural calculations for the tank assuming full conditions with the specified liquid.

35

3. Certification:

36

- a. Manufacturer's certification that resin used for interior surface veil is suitable for use with the chemicals specified and that exterior resin is resistant to solar UV radiation.

37

- b. Certification must be accompanied by documentation of successful testing performed by the tank or resin manufacturer with XLPE specimens in the specified chemical environments or documentation of a tank in service for at least five years in the specified chemical environment.

38

39

40

41

42

43

4. Manufacturer's warranty conforming to the specification requirements or a statement from manufacturer signed by an officer certifying their acceptance of the specified warranty.

44

1.4 WARRANTY

1 A. Tank manufacturer shall warrant the tank suitable for storage of the specified chemicals without
 2 structural failure or chemical leakage for a period of five years due to design or fabrication
 3 defects, or failure of the resins or reinforcing due to exposure to the specified chemicals or solar
 4 ultraviolet light.

5 **PART 2 - PRODUCTS**

6 **2.1 ACCEPTABLE MANUFACTURERS**

- 7 A. Subject to compliance with these Specifications, the following Manufacturers are acceptable:
 8 1. XLPE Bulk and Day Chemical Storage Tanks:
 9 a. Poly Processing, Inc (Poly Corr).
 10 b. Ryan Herco.
 11 c. Nalgene.
 12 B. Submit requests for substitution in accordance with Specification Section 01640.

13 **2.2 MATERIALS**

- 14 A. XLPE Tanks.
 15 1. Plastic – The molding powder used shall be Marlex CL-100 or Cl-200 as manufactured by
 16 Phillips Petroleum Company, Plastics Division or powders of equal physical and chemical
 17 properties.
 18 2. Fillers and pigments – The plastic shall not contain any fillers. All plastic shall contain a
 19 minimum of .25% u.v. stabilizer and maximum of .50%. Pigments shall be added by the
 20 tank manufacturer to provide the specified color, not to exceed 1% of the weight of the tank.
 21 Color to be selected by Owner.
 22 3. Mechanical Properties – The minimum properties of the raw material shall be as follows
 23 based on molded parts.
 24
 25

PROPERTY	ASTM	VALUE	UNITS
Density	D1505	59 (.938-.941)	#/Ft
ESCR Spec. thickness 125 mils F 50	D1693	1000	Hrs.
Tensil Strength Ultimate 2"/min.	D638 Type IV Spec.	2600	psi.
Elongation at Break 2"/min.	D638 Type IV Spec	450	%
Vicat Softening Temp.	D1525	255	DegF
Brittleness Temp	D746	-180	DegF
Flexural Modulus	D790	100,000	psi.

- 26
 27 B. Connections and openings:
 28 1. Furnish flanged inlet, outlet, vent, and overflow connections sized and oriented as follows:
 29 a. Locate 6-IN chemical inlet on tank roof 6-IN horizontally from sidewall.
 30 b. Locate chemical 2-IN outlet on sidewall 6-IN from bottom of the tank.
 31 c. Locate 6-IN vent/overflow on tank roof 6 IN horizontally from sidewall.
 32 2. Interior chemical fill pipe:
 33 a. Schedule 80 PVC or FRP pipe extending from inlet connection to 9 IN above tank
 34 bottom. Material compatible with stored chemical.
 35 b. Interior flanged connection to tank nozzle at top and base support for 90 degree elbow
 36 at bottom.
 37 c. Pipe size to match exterior fill pipe.
 38 d. Pipe supports at 8 FT maximum, designed for easy pipe removal and replacement.
 39 e. 3/4 IN DIA by 6 IN long horizontal FRP vacuum breaking pipe from interior tank
 40 nozzle at top of tank, and pointed toward tank center.
 41 3. Manways and ventilation openings for bulk chemical storage tanks:

- 1 a. 1 - 24 IN diameter top access manway.
- 2 b. Furnish flanged ventilation opening. Install with flange and 6 IN goose neck vent with
- 3 corrosion resistant bug screen
- 4 4. Furnish drain connection as follows:
- 5 a. Furnish 4-IN drain at bottom of tank sidewall.
- 6 5. Washout/inspection openings:
- 7 a. Furnish a minimum 12-IN flanged washout/inspection opening oriented 12 IN
- 8 horizontally from sidewall. Install with blind flange.
- 9 6. Level sensor connection (connection is for future level sensor):
- 10 a. Furnish 2-IN NPT female connection for level sensor on tank roof 6 IN horizontally
- 11 from sidewall. Provide plug in connection (level sensor not included not included in
- 12 this contract).
- 13 7. Provide flanges for manways, openings, and connections with 40 to 50 Durometer 1/8-IN
- 14 thick full-face gaskets suitable for use in the stated chemical environment. Flanges to be
- 15 ANSI B16.5, 150 lb. Nozzles to be conically gusseted, capable of resisting, 1,300 ft-lbs
- 16 bending and 2,000 ft-lbs torque.
- 17 8. Provide external FRP ladders for bulk storage tank. The ladder shall be supported on and
- 18 anchored to the concrete base and bracketed to the tank shell as required. The ladder shall
- 19 include safety rails across the top of the tank to the access manhole, attached to the ladder
- 20 siderails, and anchored to the tank head as required. No carbon steel parts or fasteners will
- 21 be permitted. Provide anchors and fasteners compatible with solution stored. The ladder
- 22 shall have a clear width of at least 16-IN, shall have rungs at least 3/4-IN in diameter and
- 23 spaced not more than 12-IN apart, and shall have a minimum clearance of at least 7-IN
- 24 between the back of the ladder and the tank well.

25 C. Accessories

- 26 1. Furnish tank with the following accessories:
- 27 a. Lifting lugs - three-spaced 90 degrees apart at top portion of straight shell and one lug
- 28 below top center lug.
- 29 b. Noncorrosive hold down lugs.
- 30 c. Pipe support-mounting lugs suitable for supporting brackets which carry the external
- 31 pipes as shown on the plans.
- 32 d. Certification label stating:
- 33 1) Corrosion resistant liner resin.
- 34 2) Type of liner reinforcement.
- 35 3) Chemical to be stored including specific gravity.
- 36 4) Exterior resin.
- 37 5) Tank capacity.
- 38 6) Date of manufacture.
- 39 7) Manufacturer.

40 **2.3 DESIGN REQUIREMENTS**

- 41 A. Ferric sulfate bulk storage tank: Tag No. TK-56:
- 42 1. Materials: XLPE
- 43 2. Nominal capacity: 2,500 gallons.
- 44 3. Diameter: 8-FT, 0-IN.
- 45 4. Sidewall height: 8-FT, 2-IN.
- 46 5. Chemical compatibility: Suitable for storage of ferric sulfate solution, trade concentration
- 47 59%, pH 1.0, 120 DegF ambient fluid temperature.
- 48 6. Structural design requirements:
- 49 a. Fluid specific gravity of 1.58 to 1.60.
- 50 b. Seismic zone 0.
- 51 c. 100 MPH basic wind speed.

1 **PART 3 - EXECUTION**

2 **3.1 TANK INSTALLATION**

- 3 A. Upon delivery, check tanks closely for damage. If damaged, the tanks will not be accepted
4 unless repairs are made in accordance with the manufacturer's recommendations and the
5 manufacturer certifies in writing that the repairs were made in accordance with their
6 recommendations and the tank is completely sound and suitable for service. Handle the tanks
7 with care to prevent inadvertent damage during installation.
- 8 B. Install the tanks in complete accordance with the manufacturer's installation instructions.
- 9 C. The tank foundation must provide smooth continuous full bottom support (maximum deviation
10 1/8-IN per 10 feet in any direction).
- 11 D. Tanks must not be grouted.
- 12 E. Secure tanks to pads with 3/4 or 1 IN diameter stainless steel bolts set in the pads.
- 13 F. For identification and warning signs, comply with Section 10400.

14 **3.2 FIELD QUALITY CONTROL**

- 15 A. Provide the services of the manufacturer's representative as required to assure proper installation
16 of the tanks. Manufacturer shall certify in writing that the tanks are correctly installed before
17 initial filling.
- 18 B. After the tanks are installed and before piping connections are made and equipment attached,
19 block outlets and fill tank with clear water for a period of at least four (4) hours.
- 20 C. Repair any leaks in tanks which are disclosed and retest until all leaks have been detected and
21 repaired to the satisfaction of the Engineer.
22

23

END OF SECTION

1 2002/01/14

2 **SECTION 11947**
3 **IN-LINE STATIC MIXER**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6 A. Section Includes:

- 7 1. In-line static mixers.

8 B. Related Sections include but are not necessarily limited to:

- 9 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
10 2. Division 1 - General Requirements.
11 3. Section 11005 - Equipment: Basic Requirements.

12 **1.2 QUALITY ASSURANCE**

- 13 A. See Section 11005.

14 **1.3 SUBMITTALS**

15 A. Shop Drawings:

- 16 1. See Section 01340 and 11005.
17 2. Product technical data including:
18 a. Materials of construction.
19 b. Dimensions and weights.
20 c. Performance specifications.
21 d. List of installations.

22 **PART 2 - PRODUCTS**

23 **2.1 ACCEPTABLE MANUFACTURERS**

24 A. Subject to compliance with the Contract Documents, the following manufacturers are
25 acceptable:

- 26 1. Komax Systems.
27 2. Koflo.
28 3. Chemineer.
29 4. Statiflo.
30 5. Floway.
31 6. Lightnin.
32 7. Or approved equal.

- 33 B. Submit requests for substitution in accordance with Specification Section 01640.

34 **2.2 MATERIALS**

35 A. Elements, housing, and flanges:

- 36 1. Body: 316 stainless steel or Filament Wound Reinforced Plastic (FRP)
37 2. Elements: Same material as Body.
38 3. Flanges: Same material as Body or carbon steel.
39 4. Injection Ports: Same material as Body.

40 **2.3 PERFORMANCE REQUIREMENTS**

41 A. Performance:

08340-9336

- 1 1. Tag No. MXS-76-1
2 a. Minimum Flow: 2,250 GPM
3 b. Maximum Flow: 3,475 GPM
4 c. Maximum coefficient of variation: 0.05
5 d. Maximum pressure drop: 1.6 PSI
6 e. Design pressure: 100 PSI
7 f. Test Pressure: See Section 15060.
8 2. Tag No. MXS-76-2
9 a. Minimum Flow: 750 GPM
10 b. Maximum Flow: 1,250 GPM
11 c. Maximum coefficient of variation: 0.05
12 d. Maximum pressure drop: 1.6 PSI
13 e. Design pressure: 100 PSI
14 f. Test Pressure: See Section 15060.
- 15 B. Design:
16 1. Tag No. MXS-76-1
17 a. Diameter: 14 IN.
18 b. Length: 45 IN.
19 c. End connections: Flanged, flat face, same material as body.
20 d. Housing: filament wound FRP. 316 Stainless steel may be substituted for the FRP.
21 e. Elements: Two (2) flash mixing elements per mixer.
22 f. Injection Ports: 3 EA. – 2 IN diameter, flanged connections (ANSI 125 LB Drilling.)
23 Spaced at 60° prior to start of the mixing elements. Provide blind flanges for 2 of the
24 injection ports.
25 2. Tag No. MXS-76-2
26 a. Diameter: 10 IN.
27 b. Length: 37 IN.
28 c. End connections: Flanged, flat face, same material as body.
29 d. Housing: filament wound FRP. 316 Stainless steel may be substituted for the FRP.
30 e. Elements: Two (2) flash mixing elements per mixer.
31 f. Injection Ports: 3 EA. – 2 IN diameter, flanged connections (ANSI 125 LB Drilling.)
32 Spaced at 60° prior to start of the mixing elements. Provide blind flanges for 2 of the
33 injection ports.

34 PART 3 - EXECUTION

35 3.1 INSTALLATION

- 36 A. Install products in accordance with manufacturer's instructions.

37 3.2 FIELD QUALITY CONTROL

- 38 A. See Section 11060.
- 39 B. Provide services of equipment manufacturer's field service representative(s) to:
40 1. Inspect equipment covered by these Specifications.
41 2. Provide a written statement that manufacture's equipment has been installed properly, and is
42 ready for operation by Owners personnel. Provide test report verifying that maximum
43 coefficient of variation required is achieved.

44

END OF SECTION

2 **SECTION 11949**
3 **MIXERS: FLOCCULATOR**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:
7 1. Flocculation basin mixer.
- 8 B. Related Sections include but are not necessarily limited to:
9 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
10 2. Division 1 - General Requirements.
11 3. Section 11005 - Equipment: Basic Requirements.
- 12 C. Referenced Standards:
13 1. American Bearing Manufacturers Association (ABMA):
14 a. L-10 Standards--Standards 9 and 11, Method for Evaluating and Load Rating of
15 Bearings.
16 2. American National Standards Institute/American Gear Manufacturers Association
17 (ANSI/AGMA):
18 a. 211.02, Standard for Surface Durability of Helical and Herringbone Gear Teeth.
19 b. 221.02, Standard for Rating the Strength of Helical and Herringbone Gear Teeth.
20 c. 390.03a, Gear Handbook, Gear Classification, Materials and Measuring Methods for
21 Bevel, Hypoid, Fine Pitch Wormgearing and Racks Only as Unassembled Gears.
22 d. 2000-A88, Gear Classification and Inspection Handbook, Tolerances and Measuring
23 Methods for Unassembled Spur and Helical Gears.
24 e. 6001-C88, Design and Selection of Components for Enclosed Gear Drives.
25 f. 6025-C90, Sound for Enclosed Helical, Herringbone, and Spiral Bevel Gear Drives.
26 3. American Iron and Steel Institute (AISI).
27 4. ASTM International (ASTM):
28 a. A36, Standard Specification for Carbon Structural Steel.
29 b. A48, Standard Specification for Gray Iron Castings.
30 c. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
31 d. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile
32 Strength.
33 5. American Welding Society Publication (AWS):
34 a. D1.0, Code for Welding in Building Construction.
35 6. Institute of Electrical and Electronics Engineers (IEEE).
36 7. National Electrical Manufacturers Association Standards (NEMA):
37 a. MG-1, Motors and Generators.
38 8. Occupational Safety and Health Act (OSHA).

39 **1.2 SUBMITTALS**

- 40 A. Shop Drawings:
41 1. See Section 11005.
42 2. Product technical data:
43 a. Provide calculations supporting all shaft and impeller design criteria (stresses and
44 critical speed).
45 b. Submit all loadings, torques and forces imposed by operating equipment.
46 c. Pumping capacity and water horsepower at delivered power.
- 47 B. Operation and Maintenance Manuals:
48 1. See Section 01340.

1 **PART 2 - PRODUCTS**

2 **2.1 ACCEPTABLE MANUFACTURERS**

3 A. Subject to compliance with the Contract Documents, the following manufacturers are
4 acceptable:

5 1. Mixers:

- 6 a. Lightnin Mixing Equipment Company.
- 7 b. Philadelphia Mixer Corporation.
- 8 c. Hayward Gordon.

9 B. Submit requests for substitution in accordance with Specification Section 01640.

10 **2.2 MATERIALS**

11 A. Mixer Housings: Fabricated steel or cast iron.

12 B. Impeller Shaft: Stainless steel, AISI Type 316.

13 C. Impeller: Stainless steel, AISI Type 316.

14 **2.3 PERFORMANCE AND DESIGN REQUIREMENTS**

15 A. Performance and Design Requirements:

16 1. Flocculation Tank Mixer: Tag No. MX-70-1

- 17 a. Velocity gradient (G): 100-150 Seconds⁻¹.
- 18 b. Design speed: 30-45 rpm.
- 19 c. Number of impellers per mixer: 1.
- 20 d. Motor size: 1 HP.
- 21 e. Drive type: Variable speed.
- 22 f. Flow: 750 to 1,250 GPM.
- 23 g. Flocculation Basin Dimensions: 159-IN L x 104-IN W x 135-IN H.
- 24 h. Flocculation Basin Water Depth:
 - 25 1) Minimum: 106-IN
 - 26 2) Maximum: 118-IN
- 27 i. Minimum water temperature: 40 degF.

28 **2.4 FABRICATION**

29 A. Speed Reducer:

- 30 1. Designed and rated per AGMA standards with AGMA nameplate.
- 31 2. Type:
 - 32 a. Right angle gear drive.
 - 33 b. Hollow quill-type output shaft, independent bearing support with flexible coupling
 - 34 connection of output shaft to agitator shaft above the reducer.
 - 35 c. Separate agitator shaft bearings located above and below the main drive bearings.
 - 36 d. Combination helical, spiral bevel, and pinion drive gears.
 - 37 e. Totally enclosed.
 - 38 f. Worm gears not acceptable.
- 39 3. Service factor: 2.0 of nameplate on motor.
- 40 4. Gearing: AGMA quality number 10 or better ANSI/AGMA 2000-A88.
- 41 5. Bearing design:
 - 42 a. Antifriction type, ball or roller, oil or grease lubricated.
 - 43 b. All shaft bearings located outside of tankage.
 - 44 c. All bearings minimum ABMA L-10 life of 100,000 HRS at full motor nameplate HP at
 - 45 design speed.
- 46 6. Lifting lugs.
- 47 7. Lubrication:
 - 48 a. Oil or grease lubricated.

- 1 b. Positive lubrication of all gears and bearings.
- 2 c. Maintain recommended thermal rating of reducer. Provide cooling system, and oil
- 3 pumps if required.
- 4 d. Dipstick oil level indicators.
- 5 e. Adequate separation between oil and grease lubricated parts.
- 6 f. Oil breather located above possible oil foam level.
- 7 8. Lubricating provisions:
- 8 a. Oil drain.
- 9 b. Grease fittings protected by removable neoprene cover and easily accessible.
- 10 c. Greased bearings with seal to retain grease.
- 11 9. Reducer agitator and output shaft and impeller shaft.
- 12 a. Agitator shaft oversized for direct, rigid coupling to impeller shaft below reducer.
- 13 b. Maximum indicated runout at lower end of impeller shaft not to exceed 1/8 IN for
- 14 every 10 FT of overhang, as measured when turning by hand.
- 15 c. Maximum stress: 8,000 psi at maximum load.
- 16 d. Independent bearing support of agitator shaft and hollow quill output shaft provides
- 17 isolation of speed reducer from shock loads, impeller bending loads, and the weight of
- 18 impeller shaft.
- 19 e. Torsionally resilient, flexible coupling connects hollow quill output shaft and agitator
- 20 shaft above the reducer.
- 21 f. Full load noise level not to exceed 85 dBA at 3 FT from any part of the drive assembly.
- 22 B. Impeller:
- 23 1. Axial flow basic design.
- 24 2. Dynamically and hydraulically stable.
- 25 3. Blades bolted to hub, impeller hook keyed to impeller shaft.
- 26 4. Maximum stress on impeller component not to exceed 11,000 psi under maximum operation
- 27 load.
- 28 5. Use of stabilizing rings or fins will not influence stress limitations specified.
- 29 6. Shaft impeller system design; operating speed does not exceed 70 percent of its first critical
- 30 speed.
- 31 C. Shaft Coupling:
- 32 1. Rigid flange on agitator shaft located for ease of access.
- 33 2. Designed to transmit 200 percent of full torque and 150 percent of axial load.
- 34 3. Located outside tankage.
- 35 4. Faces provided with rabbeted male and female piloted connection.
- 36 5. No match marks required for alignment.
- 37 D. Motor:
- 38 1. See Section 11005.

39 PART 3 - EXECUTION

40 3.1 INSTALLATION

- 41 A. Install units in accordance with manufacturer's recommendations.
- 42 B. Comply with Section 11005.

43 3.2 FIELD QUALITY CONTROL

- 44 A. Provide Manufacturer's Field Services as defined in Section 01650 to provide the following
- 45 services:
- 46 1. Inspect equipment to be installed under these Specifications.
- 47 2. Supervise any adjustments and perform modifications as necessary.
- 48 3. Conduct start-up of equipment.
- 49 4. See Section 01650 for duration and scheduling of training sessions required.

END OF SECTION