SECTION 11219 - CUSTOM ENGINEERED VERTICAL VARIABLE SPEED NON-CLOG PUMPS

City of San Diego, CWP Guidelines

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NTS: The custom engineered pumps specified in Sections 11219 through 11222 are to be used for the main sewage pump stations as well as the influent pump stations in treatment plants. Sections 11198 and 11212 cover all intermediate (lighter duty) solids handling pumps in treatment plants.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

A. **General:** The WORK of this Section includes providing custom engineered vertical variable-speed non-clog centrifugal pumps for pumping fluids containing [unscreened] sewage solids. Each pumping unit shall consist of a pump, [flywheel,] intermediate shafting and couplings, electric motor, motor support, variable-frequency drive, and all appurtenances to provide a complete pumping system. Equipment furnished under this Section shall conform to the requirements of this Section and the Related Sections.

B. **Type:** Each pump shall be of the vertical dry pit bottom-suction volute-casing type. Impellers shall be enclosed non-clog Francis or mixed-flow configuration with two or more vanes designed specifically to pump unscreened wastewater with stringy organic solids and grit. The pumps shall be designed so that the impeller, back head, frame, and pump shaft can be removed as a complete unit without disturbing the connecting piping, casing, or motor. The pump and motor shall each be supported on separate cast iron or fabricated steel bases.

C. **Unit Responsibility:** The CONTRACTOR shall cause the equipment specified under this Section, including the variable speed drives specified under Section 11033 and the motors, to be furnished by the pump manufacturer, as provided in Section 11000. The CONTRACTOR shall furnish a Certificate of Unit Responsibility Assignment as provided in Section 11175.

1.2 RELATED SECTIONS

A. The WORK of the following Sections applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.

1. Section 11000 Equipment, General Requirements
2. Section 11002 Equipment Supports, Grouting and Installation
3. Section 11030 Variable Speed Drives, General
4. Section 11033 Variable Frequency Drives
5. Section 11175 Pumps, General

1.3 SPECIFICATIONS AND STANDARDS

A. Specifications and standards shall comply with Sections 11000 and 11175. Where this Section is silent on any subject, item or equipment, the requirements of Section 11175 shall govern.

1.4 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted in compliance with Section 01300, in addition to the provisions of Sections 11000 and 11175:

1. Data on temperature and vibration monitoring systems.

1.5 OWNER'S MANUAL

A. OWNER'S MANUAL requirements shall be as set forth in Sections 11000 and 11175.

1.6 SERVICES OF MANUFACTURER

A. Services of the manufacturer shall be provided in accordance with Section 11175 and as follows:

1. **Inspection, Startup and Field Adjustment:** An authorized service representative of the manufacturer shall visit the site for not less than [ ] days to check the installation, supervise start-up, and supervise testing and adjustment of pumps.

2. **Instruction of OWNER'S Personnel:** The authorized service representative shall instruct the OWNER'S personnel in the skills required for each Trade Group indicated and the duration indicated. This includes all aspects of pump operation and maintenance, including step-by-step troubleshooting procedures with necessary test equipment. Instruction shall include, but not be limited to, review of operation and maintenance manual; installation and removal of pumps, motors [, flywheels] and shafts; service and replacement of bearings; service and flushing of seal water system; replacement and service of seals; daily maintenance requirements; and long-term maintenance provisions. Instruction of the OWNER'S personnel shall be conducted separate from the start-up and testing activities. Each of the OWNER'S Trade Groups will be instructed individually, and no more than six hours will be scheduled in one day. Durations of instruction are:

Trade Group	Class Hours	Field Hours
Electricians	[3]	[3]
Electronics Technicians	[3]	[3]
Operations	[3]	[3]
Plant Maint. Technicians	[3]	[3]

1.7 FACTORY TESTS:

A. Each pump shall be factory tested in accordance with the requirements established in Section 11175 and shall be a witnessed test.

1.8 FLUID TO BE PUMPED:

A. The fluid to be pumped is municipal wastewater from a sanitary wastewater collection system. The fluid is anticipated to range between 64 degrees F and 78 degrees F and contain up to 300 mg/L of solids consisting of grit and organic material with small quantities of petroleum products and animal fats and greases. Owing to the presence of grit, the fluid is expected to be somewhat abrasive.

1.9 SYSTEM CONFIGURATION AND OPERATION:

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NTS: The CITY desires that the pump suction/inlet piping practices recommended in ANSI/HI 9.8, a nationally recognized consensus standard, be incorporated in the design of its projects. Exceptions to this requirement must be submitted in writing to the CITY's project manager, and must be approved in writing by the CITY's project manager in advance of incorporating any exceptions into the design. The performance characteristics of installations that do not conform to the standard are to be confirmed by physical modeling as established in the standard. Physical modeling is expensive and requires months to complete.

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A. The pumps will be installed in a dry pit and obtain the fluid to be pumped via the indicated piping connected to a [trench type wet well] [ ] designed in accordance with the requirements of ANSI/HI 9.8. [It is expected this equipment will be used for cleaning the wet well using the method described in ANSI/HI 9.8 on a weekly cycle.]

B. The pumps will be operated at variable speed in response to the control system specified in Section [13300]. Generally, the pumps will be controlled to match pumping rate to the rate of flow entering the pumping station, by controlling the wet well liquid surface elevation to mimic the normal depth vs flow curve in the influent sewer. The number of pumps in service will be altered as required to achieve this objective and control liquid levels. As pumps are placed in service or taken out of service, all pumps will operate at the same speed, following the fluctuations in signal strength from the wet well level control system.

1.10 PERFORMANCE CRITERIA:

A. Performance of pumps furnished under this Section shall be guaranteed under the terms of paragraph 11175-1.7C. Field vibration shall be measured in accordance with requirements specified in Section 11175. Non-conforming pumps will be rejected.

PART 2 -- PRODUCTS

2.1 PUMP NAME: [ ] (P-[ ] through P-[ ])

A. **General:** Each custom engineered vertical non-clog pump will be driven at variable speed using the output from a single variable frequency drive. [Each individual pump/motor will include a flywheel assembly directly connected to the motor's shaft and, in turn, connected to the pump shaft.] The pumps will discharge through conventional spring-loaded check valves to a common manifold which will connect to the station force main.

Custom engineered vertical variable-speed non-clog pumps shall conform to the following requirements:

1.	Number of pumping units	-	[ ]
2.	Location	-	[ ]
3.	Service	-	[ ]
4.	Operation	-	continuous
5.	Drive	-	variable speed

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NTS: For pumps discharging to long new pipelines (over 1,000 feet in length), two system curves shall be developed by the DESIGN CONSULTANT, as recommended in ANSI/HI 9.6.1.5.5.2: one for the system as it will be installed; and a second to represent the condition of the system after some increase in pipe roughness has occurred. Pump design operating condition points shall be specified for the entire range of new and aged pipe conditions, since the pumps will be required to perform satisfactorily for both conditions.

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B. **Operating Conditions:** Pumping equipment furnished under this Section shall be required to produce the specified flows and discharge heads under the conditions set forth as follows:

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NTS: For the FULL SPEED operating conditions, ***do not state the speed***. Condition A flow should be the result of the targeted maximum flow for the installation divided by the number of pumps in service. Condition A head is the system head at the worst (lowest) assumed 'C' value plus the value of the individual pump losses ('pump correction loss') at the rated flow.

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1. Condition A: Full Speed - Maximum Head Operation (See Notes a and f):

Capacity, gpm	-	[ ]
Total head, feet	-	[ ]
NPSHA, feet	-	[ ]

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NTS: Condition B is the so-called 'runout condition'. Condition B head is the system head at the best (highest) assumed 'C' value plus the value of the individual pump losses ('pump correction loss') at the flow indicated. The flow at condition B head is unique to the individual pump selection and occurs at full pump speed so do not list a flow except as provided in Note b.

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2. Condition B: Full Speed - Minimum Head Operation (See Notes b and f):

Capacity, gpm	-	from pump H/Q curve
Total head, feet	-	[ ]
NPSHA, feet	-	[ ]

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NTS: ***Never insert a speed in the reduced speed portion of the table.*** The speeds necessary to achieve the required operation are unique to each individual pump vendor's product.

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3. Condition C: Reduced Speed - Maximum Head Operation (See Notes c and f):

Capacity, gpm	-	[ ]
Total head, feet	-	[ ]
NPSHA, feet	-	[ ]
Pump speed	-	Reduced

4. Condition D: Reduced Speed - Minimum Head Operation (See Notes d and f):

Capacity, gpm	-	[ ]
Total head, feet	-	[ ]
NPSHA, feet	-	[ ]
Pump speed	-	Reduced

5. Condition E: Reduced Speed - Startup/Shutdown (See Notes e and f):

Capacity, gpm	-	0
Total head, feet	-	[ ]
NPSHA, feet	-	[ ]
Pump speed	-	Minimum

NOTES:

*a. Condition A shall be taken as the rated, continuous-duty operating condition with the pump operating **at maximum speed against maximum anticipated system head.** Performance at the rated condition shall be guaranteed in accordance with Section 11175. Condition A has been*

selected to obtain the rated pumping capacity for the installation. It is not intended that the pumps be selected for maximum efficiency at Condition A. Pumps furnished under this Section should be selected to achieve Condition A performance, but also operate continuously without objectionable vibration or cavitation at the head specified under Condition B. Condition A may be located in the Allowable Operating Region as established by the pump manufacturer in accordance with ANSI/HI 9.6.3 and listed in the manufacturer's published application data for the specific model proposed for this application.

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NTS: While the flow used to establish Condition B should not be listed in the Operating Conditions table, it should be inserted into the blank in Note b to indicate the basis for the NPSHA information.

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b. Condition B is presented to indicate operating conditions when the pump is operating at ***maximum speed against minimum anticipated system head,*** *assuming a hypothetical head-capacity curve. Pumps with head-capacity curves steeper than that assumed will produce less flow at lower head. The reverse will occur with pumps having a shallower head-capacity curve.* ***Proposed pump selections meeting this discharge head requirement by operating the equipment at less than full speed will be rejected. Condition B shall be used for pump selection. Condition B shall be located within the Preferred Operating Region as established by the pump manufacturer in accordance with ANSI/HI 9.6.3 and listed in the manufacturer's published application data for the specific model proposed for this application.*** *NPSHA, as listed for Condition B is calculated on a pumped flow of [ ] mgd.*

c. Condition C is the anticipated continuous duty minimum speed condition when the pump is operating ***against maximum anticipated system head.*** *Pumps furnished under this specification shall be capable of sustained (24 hours per day) operation at this condition within the requirements set forth in Section 11175. Condition C shall be located within the Preferred Operating Region as established by the pump manufacturer in accordance with ANSI/HI 9.6.3 and listed in the manufacturer's published application data for the specific model proposed for this application.*

d. Condition D is the anticipated continuous duty minimum speed condition when the pump is operating ***against minimum anticipated system head.*** *Pumps furnished under this specification shall be capable of sustained (24 hours per day) operation at this condition within the requirements set forth in Section 11175. Condition D shall be located within the Preferred Operating Region as established by the pump manufacturer in accordance with ANSI/HI 9.6.3 and listed in the manufacturer's published application data for the specific model proposed for this application.*

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NTS: Condition E is intended to inform the manufacturer of the conditions imposed upon startup and shutdown. If the pumps are to be started and stopped against a closed valve, then so state.

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e. Condition E represents the expected momentary (startup/shutdown) condition. Pumps furnished under this Specification will operate for no more than 30 seconds at this condition when initiating or terminating a service cycle. The maximum anticipated number of service cycles is 12 per day.

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NTS: NPSHA data is dominated by considerations associated with the pump setting (elevation). Therefore, it is imperative that the drawings show the elevation of

the pump inlet piping (not the centerline of the pump inlet flange) for use by the pump manufacturer in responding to NPSH margin requirements. To avoid the potential for conflict, do not list the centerline elevation in the Specifications. Section 11175 places restrictions on NPSH margin (NPSHA/NPSHR). The design engineer, specifier and submittal reviewer should become completely familiar with these requirements and the procedures established in ANSI/HI 9.6.1 to make certain that the design incorporates a setting that will allow all reasonable candidate pump designs to comply with these restrictions and rule out those designs that do not. ***Bear in mind: NPSHA must exceed NPSHR by a wide margin at all specified operating conditions and that this margin requirement will vary depending on several considerations. The bottom line with respect to installation costs is that the greater the NPSHR for a given pump, the lower a pump must be below the inlet hydraulic gradient.*** The specifications, under Section 11175, require the pump manufacturer to demonstrate by calculation and supporting documentation that the proposed pump meets the NPSHA/NPSHR margin limitations established in the specification and in ANSI/HI 9.6.1.

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f. Total head in the above tabulation is the algebraic difference between the discharge head and suction head as defined in ANSI/HI 1.1 – 1.6. Net positive suction head available (NPSHA) in the above tabulation is referred to the pump inlet piping at centerline elevation (project datum) as shown and is calculated in accordance ANSI/HI 1.3 for average barometric pressure and maximum temperature conditions. NPSHA at the pump impeller eye can be determined by adjusting the given value by proposed pump dimensions and the indicated requirements for pump installation details. An allowance of five feet has been included for the presence of volatile constituents in the pumped fluid. Required NPSHA margin shall be as specified in Section 11175.

g. The pumps will be operated at variable speed in response to the control system specified in Section [ ]. To permit the pump to operate at or near best efficiency during reduced-speed operation, it is preferred that the rated condition lie to the right of the best efficiency point on the pump's head capacity curve.

h. Maximum expected surge pressure is [ ] psig.

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NTS: Note that all specified operating conditions require net positive suction head (NPSH) information. Provide NPSHA information for any added operating conditions.

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C. **Design Requirements**:

1. General: The pumps shall be specifically designed to pump the fluid described in paragraph 11219-1.8, and shall comply with the requirements specified in Section 11175.

   Variable-speed drives furnished for this application shall be specifically designed to start and accelerate motors, [flywheels,] shafting, pumps and entrained water when operating against the conditions specified in paragraph 11219-2.1B.

The rotor and critical speed analysis requirements specified in paragraph 11175-1.10, Rotor and Critical Speed Analysis and System Design, apply to the driven and drive equipment, including supports and appurtenances, furnished under this Section.

The pumps shall be provided with suitable lifting hooks and a hoist sling, if required, so that each pump can be removed in one piece. [It shall be the manufacturer's responsibility to ensure that each pump can be lifted to the ground floor using the hoist equipment included in the design.]

2. Minimum solid sphere capable of passing through pump (in. dia.) - [ ]

3. Max pump speed (rpm) - [ ]

4. Max pump efficiency at max speed, minimum (percent) - [ ]

[5. Rotating moment of inertia (WK^2) ($lb\text{-}ft^2$) - [ ]]

[The rotating moment of inertia requirement applies to the sum of the moments of inertia of the motor rotor, flywheel, shafting, couplings, pump rotor, and water entrained in the pump rotor.]

6. Max motor size (hp) - [ ]

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NTS: Depending on the method of driving the pump, another line may be needed to indicate motor speed or other considerations.

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[7. Max motor speed (rpm) - [ ]]

D. **Pump Dimensions:**

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NTS: Avoid velocities at pump inlet connections greater than about 14 ft/sec if possible. ***Note: ANSI/HI 9.8, at paragraph 9.8.4, limits velocities in the piping approaching the pump to 8 ft/sec.*** In addition, the standard also dictates a straight section of not less than five nominal pipe diameters downstream from any valve or fitting and upstream from any size reduction for the pump inlet connection.

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1. Min size of suction flange (in) - [ ]

2. Min size of discharge. flange (in) - [ ]

3. Flange rating (psig) - [ ]

2.2 PUMP REQUIREMENTS

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NTS: Pump construction is covered in Section 11175, which relies upon API 610 for basic requirements for materials and features. The DESIGN CONSULTANT should verify that the referenced API 610 requirements are suitable for the specific application, and list exceptions in the following paragraphs.

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A. **General**: Construction of custom engineered vertical variable-speed non-clog pumps shall conform to the requirements set forth in Section 11175, except as described in the following paragraphs.

B. **Materials:**

1.	Seal	-	split mechanical seal per Section 11175
2.	Motor support shapes	-	Rolled steel, ASTM A283
3.	Motor support plates	-	Steel, ASTM A36
[4.	Flywheel	-	Cast steel, ASTM A216]
[5.	Flywheel support frame	-	Steel, ASTM A36]
[6.	Flywheel shaft	-	Steel, ASTM A322 Grade 4140 or ASTM A576 Grade 1045]

C. **Pump Shafts**: The pump shaft shall be designed for the stresses and deflection limitations set forth in paragraph 11175-1.10.

D. **Impeller and Casing**: The impeller and casing shall be a non-clog design. The impeller shall be an enclosed Francis or mixed-flow configuration with two or more vanes and front and rear shrouds. Semi-open impellers will not be allowed. The leading edges of the impeller vanes and casing cutwater shall be smooth and rounded and configured to avoid accumulation of stringy materials and to pass solids. Impeller passages shall be designed specifically to pass solids found in unscreened municipal wastewater and to avoid cavitation. Vane overlap shall be minimized to permit efficient release of solids to the volute passages. All water passages shall be smooth and free from hollows, cracks, pin holes and projections. The impeller shall be firmly keyed to the shaft and held firmly in place by a threaded, cast stainless steel locknut designed to prevent stringy material from catching on it. The arrangement shall be such that the impeller cannot unscrew or loosen by torque from either forward or reverse rotation. The finished impeller with its wearing ring attached shall be statically and dynamically balanced.

The casing nozzle shall be fitted with a handhole not less than four inches in diameter. The handhole cover shall have surfaces which exactly match the inner contours of the casing waterway. The casing shall be foot-mounted for installation on the support base. The mounting foot shall have provisions for bolting and doweling to the base. A tapped, valved and plugged connection shall be provided at the nozzle for a pressure gage.

E. **Inlet Nozzle**: Pumps with inlet diameters 18 inches and less shall be fitted with inlet elbows designed to efficiently conduct the liquid into the impeller entrance. The elbow shall be fitted with a handhole not less than 6 inches in diameter. Pumps with inlet diameters 20 inches and greater shall have an inlet nozzle suitable for connection to the inlet draft tube indicated. The nozzle shall be fitted with a handhole not less than 8 inches in diameter. Handhole covers shall have surfaces which exactly match the inner contours of the elbow or nozzle waterway.

F. **Frame**: The frame shall be designed to carry both radial and thrust bearings. Openings shall be provided adjacent to the stuffing box. The connection between the backhead and frame shall have self-registering and centering fits. The frame shall be drilled and tapped for a 1-inch seal water drain to an external drain system.

G. **Supports**: Equipment supports shall be as specified in Sections 11175 and 11002.

H. **Drive and Motor:** Variable speed drive with [vertical] [horizontal], heavy-duty, electric motor suitable for [460]-volt, [3]-phase, 60-Hz ac power supply, in accordance with Sections 11033 and 16040. The [motor] [gear] shall be supported independently on structural members with maintenance access to the upper intermediate coupling. As indicated in Section 11033, the motor shall be equipped with a winding temperature protection system and elements for monitoring bearing temperature or vibration. [The gear reducer shall be designed in accordance with AGMA 6010-E for an application factor of 1.25 and a life factor of 1.0. The gearset shall be evaluated in accordance with Miner's rule (Appendix F, AGMA 6010) using the beat frequencies established by the impeller vanes passing the volute cutwater at any speed required to achieve the indicated performance. The gears shall be AGMA Quality 12 or better and a non reverse mechanism of the sprag type shall be provided.] For variable speed drive see Sections 11030 to [11033]. The variable speed drive shall be as described in Section 11033.

I. **Balancing**: The rotating assembly, including coupling, shaft, impeller with wearing rings and impeller nut, shall be dynamically balanced prior to final assembly. Balancing shall conform to the requirements specified in Section 11175.

Maximum Speed, rpm	Maximum Amplitude peak to peak, mils
600	3.5
720	3.0
900	2.5
1200	2.0

The CONTRACTOR shall furnish certified copies of all logs to demonstrate that all rotating elements have been balanced in accordance with these Specifications.

J. **Intermediate Shaft and Couplings**: Each pump shall be provided with a single section of tubular shafting and two flexible couplings for connection to the motor driver or flywheel. The shafting and couplings shall be designed with an application factor of 1.5 based upon the manufacturer's standard application criteria. Shaft offset shall be between ½ and 1½ degrees. Shafting shall be composite carbon fiber reinforced synthetic resin type as manufactured by ABB or equal. Shafting

shall be complete, with a shaft guard which shall extend 3 feet above the pump frame and elsewhere as specified. Guards shall conform to paragraph 11000-2.13.

K. **Suction and Discharge Connections**: Suction and discharge connections shall be flanged, ANSI B16.1, Class [250]. Flanges shall be flat faced. Bolt holes shall straddle the horizontal and vertical center lines. Provide 90-degree suction elbow for pumps with inlet connections 18 inches in diameter and smaller. Provide gasket between elbow and pump inlet. Cap screws or bolts connecting the suction elbow to the casing shall be Type 316 stainless steel, ASTM A 276.

[L. **Motor Maintenance Platform**: The CONTRACTOR shall provide a motor maintenance platform. The platform, when deployed, shall form a continuous working surface three feet wide around each motor at the base level of the motor (at the top level of the flywheel). There shall be access to the platform from the surrounding floor by means of a stairway attached to the platform, and the stairway and the working area of the platform shall be railed with a railing 42 inches high all around. The platform shall disassemble easily into two halves, each of which shall be equipped with retractable wheeled rollers so that it can be moved along the floor to an adjacent motor. Upon assembly at the new motor, the two halves of the platform shall be easily reassembled and the wheels easily retractable to form a stable work platform. The platform shall be sufficiently sturdy that no noticeable deformation, displacement, or warping shall occur when a lateral force of 500 pounds is applied to any part of the platform, including the rails.]

M. **Temperature and Vibration Monitoring System**: Temperature and vibration monitoring system shall consist of primary elements, indicators, alarm switches and shutdown switches for each pump and motor. System shall monitor pump bearing housing radial vibration and temperature and shall monitor motor upper and lower bearing temperatures or vibration as indicated.

[2.3 FLYWHEEL

A. The flywheel shall consist of a dynamically balanced, cast weight of sufficient dimensions to produce the overall rotating moment of inertia (WK^2) specified for the pump rotating system under paragraph 11219-2.1C, and shall be keyed and locked on a shaft supported by bottom thrust and top radial bearings. Bearings shall be of the grease-lubricated, high-precision, anti-friction type designed for quiet operation and shall be selected in accordance with ABMA 9 or 11 for an L-10 life of not less than 100,000 hours. Input and output bearings shall be held in place in a fabricated steel enclosure designed to carry the weight of the motor, flywheel, and associated shafting, and designed for seismic overturning moments in accordance with the UBC. The flywheel enclosure shall be finished in a manner consistent with the appearance of the motor and shall conform to all requirements for personnel protection. The motor shall be bolted to the flywheel frame, and provisions shall be made in the flywheel frame to permit doweling the motor to the frame after field alignment. The flywheel frame shall provide for access to the top and bottom shaft couplings without disturbing the motor or flywheel. The flywheel frame shall be bolted to the support plate described in paragraph 11219-2.4, and shall be equipped with at least three lifting eyes. The flywheel frame shall be of sufficient dimension to permit doweling to the support plate after field alignment. The flywheel shaft shall be ground and polished and shall be keyed for direct connection to the motor output shaft by means of a flexible coupling, and the output shaft shall be designed to accommodate the flexible coupling specified in paragraph 11219-2.2J.

B. Sufficient access shall be provided to permit removal of the motor from the flywheel housing without disturbing the flywheel. Realignment registers shall be provided.]

2.4 MOTOR [AND FLYWHEEL] SUPPORTS

A. Each motor [and flywheel] shall be supported by a heavy, rigid fabricated steel base plate bolted to a fabricated steel frame designed to span the opening specified in the motor room floor over the pump. The base plate design shall conform in all respects to the criteria established in the AISC Manual. Welding shall be performed by welders certified in accordance with AWS B-3.0 and shall conform to AWS B-3.0 and AWS D-1.1. All welds shall be ground smooth and shall be free from skips, laps, blowholes and gas pockets. The base plate shall be finished flat and shall be suitable for bolting and doweling the [motor] [flywheel frame] in position after field alignment. The drive unit support shall be designed to safely carry the drive unit weight and the weight of the [flywheel and] vertical shafting plus the dynamic loads associated with the operation and code requirements specified herein. The base plate shall be suitable for doweling to the fabricated steel frame after field alignment. The final design shall conform to the concepts indicated and be subject to review and acceptance by the engineer responsible for the dynamic analyses specified under paragraph 11175-1.10. The fabricated steel frame shall be welded into an assembly that supports the base plate under all sides, and cast into the reinforced concrete around the opening in the motor room floor to form a curb. The frame shall be stress relieved after fabrication and all support surfaces intended for connection to the base plate shall be finished flat and parallel to the base plate.

B. The supports shall be designed for seismic loadings in accordance with the UBC for seismic zone 4 by a registered structural engineer licensed to practice in the State of California. Calculations and supporting data shall be provided with the OWNER'S Manual.

C. The pumping unit manufacturer shall be completely responsible for the adequacy of the motor [and flywheel] supports, including coordination with the dynamic analyses required under this Section. This requirement, however, is not to be construed as relieving the CONTRACTOR of his responsibility for this portion of the work.

2.5 PAINTING

A. All external surfaces of the pump, [flywheel] and motor shall be coated as specified in Section 09800. All interior wetted surfaces of the pump shall be coated as specified in Section 09800.

2.6 NAMEPLATES, TOOLS AND SPARE PARTS

A. **Nameplates and Tools**: The WORK includes providing nameplates and tools in accordance with Section 11175.

B. **Spare Parts**: The WORK includes the following spare parts per pump:

1. 1 - Impeller, complete with wearing ring

2. 1 - set all bearings

3. 3 - replacements, packing

4. 1 - set, wearing rings

5. 1 - set, packing gland and lantern ring

6. 1 - shaft sleeve

2.7 MANUFACTURERS

A. Pursuant to the limitations described in paragraph 11000-2.1D, candidate pump manufacturers include, [Ebara, Fairbanks Morse, Ingersoll Dresser, Morris, and Patterson], or equal.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Pumping equipment shall be installed in accordance with approved procedures submitted with the shop drawings and as indicated.

B. General installation requirements shall be as indicated in Section 11175.

** END OF SECTION **