SECTION 232123 - HYDRONIC PUMPS

Revise this Section by deleting and inserting text to meet Project-specific requirements.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

1. GENERAL
	* + 1. RELATED DOCUMENTS

Retain or delete this article in all Sections of Project Manual.

* + - * 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
			1. SUMMARY
				1. Section Includes:

Close-coupled, in-line centrifugal pumps.

Close-coupled, end-suction centrifugal pumps.

Separately coupled, horizontally mounted, in-line centrifugal pumps.

Separately coupled, vertically mounted, in-line centrifugal pumps.

Separately coupled, base-mounted, end-suction centrifugal pumps.

Separately coupled, base-mounted, double-suction centrifugal pumps.

Separately coupled, vertically mounted, double-suction centrifugal pumps.

Separately coupled, vertically mounted, turbine centrifugal pumps.

Wet-rotor pumps.

Automatic condensate pump units.

* + - 1. DEFINITIONS

Retain terms that remain after this Section has been edited for a project.

* + - * 1. ECM: Electronically commutated motor.
				2. EPDM: Ethylene propylene diene monomer.
				3. EPR: Ethylene propylene rubber.
				4. FKM: Fluoroelastomer polymer.
				5. HI: Hydraulic Institute.
				6. NBR: Nitrile rubber or Buna-N.
			1. SUBMITTALS
				1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
				2. Manufacturer’s installation instructions shall be provided along with product data.
				3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
				4. Product Data: For each type of pump.

Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated.

Indicate pump's operating point on curves.

* + - * 1. Shop Drawings: For each pump.

Show pump layout and connections.

Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.

Include diagrams for power, signal, and control wiring.

Retain "Coordination Drawings" paragraph below for situations where limited space necessitates maximum utilization for efficient installation of different components or if coordination is required for installation of products and materials by separate installers. Coordinate paragraph with other Sections specifying products listed below. Preparation of coordination drawings requires the participation of each trade involved in installations within the limited space.

* + - * 1. Coordination Drawings: Plans, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

Retain "Seismic Qualification Data" paragraph below if required by seismic criteria applicable to Project. Coordinate with Section 230548 "Vibration and Seismic Controls for HVAC." See ASCE/SEI 7 for certification requirements for equipment and components.

* + - * 1. Seismic Qualification Data: Certificates for pumps, accessories, and components, from manufacturer.

Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

Retain "Field quality-control reports" paragraph below if Contractor is responsible for field quality-control testing and inspecting.

* + - * 1. Field quality-control reports.
			1. CLOSEOUT SUBMITTALS
				1. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.
			2. MAINTENANCE MATERIAL SUBMITTALS
				1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Revise "Mechanical Seals" subparagraph below to suit Project.

Mechanical Seals: [**One] <Insert number**> mechanical seal(s) for each pump.

1. PRODUCTS

Manufacturers and products listed in SpecAgent and MasterWorks Paragraph Builder are neither recommended nor endorsed by the AIA or Deltek. Before inserting names, verify that manufacturers and products listed there comply with requirements retained or revised in descriptions and are both available and suitable for the intended applications.

* + - 1. PERFORMANCE REQUIREMENTS
				1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

Retain "Delegated Design" paragraph below if Contractor is required to assume responsibility for design.

* + - * 1. Delegated Design: Engage a qualified professional Director’s Representative, to design vibration isolation[ **and seismic restraints**].

Retain "Seismic Performance" paragraph below with "Seismic Qualification Data" paragraph in "Informational Submittals" Article for projects requiring seismic design. Delete paragraph if performance requirements are indicated on Drawings. Model building codes and ASCE/SEI 7 establish criteria for buildings subject to earthquake motions. Coordinate requirements with Structural Engineer.

* + - * 1. Seismic Performance: Pumps shall withstand the effects of earthquake motions determined in accordance with [**ASCE/SEI 7] <Insert requirement**>.

Retain first subparagraph below to define the term "withstand" as it applies to this Project. Definition varies with type of building and occupancy and is critical to valid certification. Option is used for essential facilities where equipment must operate immediately after an earthquake.

The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified[ **and the unit will be fully operational after the seismic event**]."

For life-safety components required to function after an earthquake (such as fire-sprinkler systems, components that contain hazardous content, and storage racks in structures open to the public), the Component Importance Factor is 1.5. For other components, the Component Importance Factor is 1.0 unless the structure is in Seismic Use Group III and component is necessary for continued operation of facility or failure of component could impair continued operation of facility, in which case the Component Importance Factor is 1.5.

Component Importance Factor: [**1.5] [1.0**].

See ASCE/SEI 7, Coefficients for Architectural Component Table and Seismic Coefficients for Mechanical and Electrical Components Table for requirements to be inserted in subparagraph below.

<**Insert requirements for Component Amplification Factor and Component Response Modification Factor**>.

* + - 1. CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS
				1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Armstrong Pumps, Inc.

ITT Corporation.

Taco Comfort Solutions.

Approved equivalent.

* + - * 1. Source Limitations: Obtain pumps from single source from single manufacturer.
				2. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically.
				3. Pump Construction:

Casing: Radially split, cast iron, with threaded gauge tappings at inlet and outlet[, **replaceable bronze wear rings**,] and threaded [**companion-flange] [union-end**] connections.

Impeller: ASTM B584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.

Retain "Pump Shaft Sleeve" or "Pump Stub Shaft" subparagraph below. Some larger in-line close-coupled pumps have a stub shaft rigidly attached to the motor shaft without a bearing or flexible connector to make disassembly easier. Consult manufacturers.

Pump Shaft Sleeve: [**Bronze] [Type 304 stainless steel**].

Pump Stub Shaft: [**Type 304] [Type 316] stainless steel**.

In "Seal" subparagraph below, verify suitable bellows and gasket materials if pumped fluids operate above 200 deg F (93 deg C) or contain glycol. If fluid pH is maintained above 9.0 or if fluid contains more than 400 ppm of dissolved solids or 20 ppm of undissolved solids, consider using silicon carbide stationary and rotating rings.

Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless steel spring, and [**NBR] [EPDM] [FKM] <Insert material**> rubber bellows and gasket. Include water slinger on shaft between motor and seal.

Seal Flushing: Flush, cool, and lubricate pump seal by directing pump discharge water to flow over the seal.

Delete "Shaft Coupling" subparagraph if rigid, axially-split spacer coupling is not used and impeller is mounted directly onto motor shaft.

* + - * 1. Shaft Coupling: Rigid, axially-split spacer coupling to allow service of pump seal without disturbing pump or motor.

Default motor characteristics are specified in Section 230513 "Common Motor Requirements for HVAC Equipment." If different characteristics are required, insert paragraphs to suit Project.

* + - * 1. Motor: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

In "Enclosure" subparagraph below, coordinate type availability with equipment manufacturers.

Enclosure: **[Totally enclosed, fan cooled] <Insert enclosure type**>.

Retain first subparagraph below for premium efficiency.

NEMA Premium Efficient motors as defined in NEMA MG 1.

Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

[**Single] [Variable**]-speed motor.

Delete first subparagraph below if pump is single speed or if variable-frequency motor controller is to be provided under Section 262923 "Variable-Frequency Motor Controllers."

Provide integral pump motor variable-speed controller.

If unique characteristics are required for motors in this Section, insert subparagraphs below.

<**Insert unique motor characteristics**>.

If Project has more than one type or configuration of close-coupled, in-line centrifugal pump, delete "Capacities and Characteristics" paragraph below and schedule pumps on Drawings.

* + - * 1. Capacities and Characteristics:

Capacity: <**Insert gpm**>.

Total Dynamic Head: <**Insert feet**>.

Maximum Operating Pressure: [**175 psig] [250 psig] <Insert value**>.

Maximum Continuous Operating Temperature: [**225 deg F] [250 deg F] <Insert temperature**>.

Inlet and Outlet Size: <**Insert NPS**>.

Impeller Size: <**Insert inches**>.

Motor Speed: <**Insert rpm**>.

Motor Horsepower: <**Insert value**>.

Electrical Characteristics:

Volts: [**120] [240] [208] [460] <Insert value**> V.

Phase: [**Single] [Three**].

Hertz: 60 Hz.

Full-Load Amperes: <**Insert value**> A.

Minimum Circuit Ampacity: <**Insert value**> A.

Maximum Overcurrent Protection: <**Insert value**> A.

* + - 1. CLOSE-COUPLED, END-SUCTION CENTRIFUGAL PUMPS
				1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Armstrong Pumps, Inc.

ITT Corporation.

Taco Comfort Solutions.

Approved equivalent.

* + - * 1. Source Limitations: Obtain pumps from single source from single manufacturer.
				2. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally.
				3. Pump Construction:

Casing: Radially split, cast iron, with[ **replaceable bronze wear rings**,] drain plug at bottom and air vent at top of volute, threaded gauge tappings at inlet and outlet, and [**threaded companion-flange] [flanged**] connections.

Impeller: ASTM B584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.

Retain "Pump Shaft Sleeve" or "Pump Stub Shaft" subparagraph below. Some larger in-line close-coupled pumps have a stub shaft rigidly attached to the motor shaft without a bearing or flexible connector to make disassembly easier. Consult manufacturers.

Pump Shaft Sleeve: [**Bronze] [Type 304 stainless steel**].

Pump Stub Shaft: [**Type 304] [Type 316**] stainless steel.

In "Seal" subparagraph below, verify suitable bellows and gasket materials if pumped fluids operate above 225 deg F (107 deg C) or contain glycol.

Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless steel spring, and [**NBR] [EPDM] [FKM**] bellows and gasket. Include water slinger on shaft between motor and seal.

Default motor characteristics are specified in Section 230513 "Common Motor Requirements for HVAC Equipment." If different characteristics are required, insert paragraphs to suit Project.

* + - * 1. Motor: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

In "Enclosure" subparagraph below, coordinate type availability with equipment manufacturers.

Enclosure: [**Totally enclosed, fan cooled] <Insert enclosure type**>.

Retain first subparagraph below for premium efficiency.

NEMA Premium Efficient motors as defined in NEMA MG 1.

Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

[**Single] [Variable**]-speed motor.

Delete first subparagraph below if pump is single speed or if variable-frequency motor controller is to be provided under Section 262923 "Variable-Frequency Motor Controllers."

Provide integral pump motor variable-speed controller.

If unique characteristics are required for motors in this Section, insert subparagraphs below.

<**Insert unique motor characteristics**>.

If Project has more than one type or configuration of close-coupled, end-suction centrifugal pump, delete "Capacities and Characteristics" paragraph below and schedule pumps on Drawings.

* + - * 1. Capacities and Characteristics:

Capacity: <**Insert gpm**>.

Total Dynamic Head: <**Insert feet**>.

Maximum Operating Pressure: [**175 psig] <Insert value**>.

Maximum Continuous Operating Temperature: [**225 deg F] [250 deg F] <Insert temperature**>.

Inlet and Outlet Size: <**Insert NPS**>.

Impeller Size: <**Insert inches**>.

Motor Speed: <**Insert rpm**>.

Motor Horsepower: <**Insert value**>.

Electrical Characteristics:

Volts: [**120] [240] [208] [460] <Insert value**> V.

Phase: [**Single] [Three**].

Hertz: 60 Hz.

Full-Load Amperes: <**Insert value**> A.

Minimum Circuit Ampacity: <**Insert value**> A.

Maximum Overcurrent Protection: <**Insert value**> A.

* + - 1. SEPARATELY COUPLED, HORIZONTALLY MOUNTED, IN-LINE CENTRIFUGAL PUMPS
				1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Armstrong Pumps, Inc.

ITT Corporation.

Taco Comfort Solutions.

Approved equivalent.

* + - * 1. Source Limitations: Obtain pumps from single source from single manufacturer.
				2. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally.
				3. Pump Construction:

Casing: Radially split, cast iron, with threaded gauge tappings at inlet and outlet, and threaded [**companion-flange] [union-end**] connections.

Impeller: ASTM B584, cast bronze; statically and dynamically balanced, and keyed to shaft. For pumps that are not frequency-drive controlled, trim impeller to match specified performance.

Pump Shaft: [**Carbon steel, with copper-alloy shaft sleeve] [Type 304 stainless steel] [Type 316 stainless ste**el].

In "Seal" subparagraph below, verify suitable bellows and gasket materials if pumped fluids operate above 225 deg F (107 deg C) or contain glycol.

Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless steel spring, and [**NBR] [EPDM] [FKM] <Insert material**> bellows and gasket.

Pump Bearings: [**Permanently lubricated ball bearings] [Grease lubricated ball bearings**].

* + - * 1. Shaft Coupling: [**Molded-rubber insert with interlocking spider] [Interlocking frame with interconnecting springs**] capable of absorbing vibration.

Default motor characteristics are specified in Section 230513 "Common Motor Requirements for HVAC Equipment." If different characteristics are required, insert paragraphs to suit Project.

* + - * 1. Motor: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

In "Enclosure" subparagraph below, coordinate type availability with equipment manufacturers.

Enclosure Type: [**Totally enclosed, fan cooled] <Insert enclosure type**>.

Retain first subparagraph below for premium efficiency.

NEMA Premium Efficient motors as defined in NEMA MG 1.

Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

[**Single] [Variable**]-speed motor.

Delete first subparagraph below if pump is single speed or if variable-frequency motor controller is to be provided under Section 262923 "Variable-Frequency Motor Controllers."

Provide integral pump motor variable-speed controller.

If unique characteristics are required for motors in this Section, insert subparagraphs below.

<**Insert unique motor characteristics**>.

If Project has more than one type or configuration of separately coupled, horizontally mounted, in-line centrifugal pump, delete "Capacities and Characteristics" paragraph below and schedule pumps on Drawings.

* + - * 1. Capacities and Characteristics:

Capacity: <**Insert gpm**>.

Total Dynamic Head: <**Insert feet**>.

Maximum Operating Pressure: [**175 psig] <Insert value**>.

Maximum Continuous Operating Temperature: [**225 deg F] [250 deg F] <Insert temperature**>.

Inlet and Outlet Size: <**Insert NPS**>.

Impeller Size: <**Insert inches**>.

Motor Speed: <**Insert rpm**>.

Motor Horsepower: <**Insert value**>.

Electrical Characteristics:

Volts: [**120] [240] [208] [460] <Insert value**> V.

Phase: [**Single] [Three**].

Hertz: 60 Hz.

Full-Load Amperes: <**Insert value**> A.

Minimum Circuit Ampacity: <**Insert value**> A.

Maximum Overcurrent Protection: <**Insert value**> A.

* + - 1. SEPARATELY COUPLED, VERTICALLY MOUNTED, IN-LINE CENTRIFUGAL PUMPS
				1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Armstrong Pumps, Inc.

ITT Corporation.

Taco Comfort Solutions.

Approved equivalental.

* + - * 1. Source Limitations: Obtain pumps from single source from single manufacturer.
				2. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted vertically.
				3. Pump Construction:

Casing: Radially split, cast iron, with threaded gauge tappings at inlet and outlet[, **replaceable bronze wear rings**,] and threaded [**companion-flange] [union-end**] connections.

Impeller: ASTM B584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For pumps that are not frequency-drive controlled, trim impeller to match specified performance.

Pump Shaft: [**Carbon steel, with copper-alloy shaft sleeve] [Type 304 stainless steel] [Type 316 stainless steel**].

In "Seal" subparagraph below, verify suitable bellows and gasket materials if pumped fluids operate above 225 deg F (107 deg C) or contain glycol.

Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless steel spring, and [**NBR] [EPDM] [FKM] <Insert material**> bellows and gasket.

* + - * 1. Shaft Coupling: [**Molded-rubber insert with interlocking spider] [Interlocking frame with interconnecting springs**] capable of absorbing vibration.

Default motor characteristics are specified in Section 230513 "Common Motor Requirements for HVAC Equipment." If different characteristics are required, insert paragraphs to suit Project.

* + - * 1. Motor: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

In "Enclosure" subparagraph below, coordinate type availability with equipment manufacturers.

Enclosure: [**Totally enclosed, fan cooled] <Insert enclosure type**>.

Retain first subparagraph below for premium efficiency.

NEMA Premium Efficient motors as defined in NEMA MG 1.

Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

[**Single] [Variable**]-speed motor.

Delete first subparagraph below if pump is single speed or if variable-frequency motor controller is to be provided under Section 262923 "Variable-Frequency Motor Controllers."

Provide integral pump motor variable-speed controller.

If unique characteristics are required for motors in this Section, insert subparagraphs below.

<**Insert unique motor characteristics**>.

If Project has more than one type or configuration of separately coupled, vertically mounted, in-line centrifugal pump, delete "Capacities and Characteristics" paragraph below and schedule pumps on Drawings.

* + - * 1. Capacities and Characteristics:

Capacity: <**Insert gpm**>.

Total Dynamic Head: <**Insert feet**>.

Maximum Operating Pressure: [**175 psig] [250 psig] <Insert value**>.

Maximum Continuous Operating Temperature: [**225 deg F] [250 deg F] <Insert temperature**>.

Inlet and Outlet Size: <**Insert NPS**>.

Impeller Size: <**Insert inches**>.

Motor Speed: <**Insert rpm**>.

Motor Horsepower: <**Insert value**>.

Electrical Characteristics:

Volts: [**120] [240] [208] [460] <Insert value**> V.

Phase: [**Single] [Three**].

Hertz: 60 Hz.

Full-Load Amperes: <**Insert value**> A.

Minimum Circuit Ampacity: <**Insert value**> A.

Maximum Overcurrent Protection: <**Insert value**> A.

* + - 1. SEPARATELY COUPLED, BASE-MOUNTED, END-SUCTION CENTRIFUGAL PUMPS
				1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Armstrong Pumps, Inc.

ITT Corporation.

Taco Comfort Solutions.

Approved equivalent.

* + - * 1. Source Limitations: Obtain pumps from single source from single manufacturer.
				2. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, end-suction pump with flexible shaft coupling as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal.
				3. Pump Construction:

Not all manufacturers provide volute supports that allow removal and replacement of impeller without disconnecting piping.

Casing: Radially split, cast iron, with[ **replaceable bronze wear rings**,] threaded gauge tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and [**threaded companion-flange] [flanged**] connections.[ **Provide integral mount on volute to support the casing, and provide attached piping to allow removal and replacement of impeller without disconnecting piping or requiring realignment of pump and motor shaft**.]

Impeller: ASTM B584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For pumps that are not frequency-drive controlled, trim impeller to match specified performance.

Pump Shaft: [**Carbon steel, with copper-alloy shaft sleeve] [Type 304 stainless steel] [Type 316 stainless steel**].

Retain "Seal, Mechanical Type" or "Seal, Packing Type" subparagraph below. If retaining first subparagraph, verify suitable bellows and gasket materials if pumped fluids above 225 deg F (107 deg C) or containing glycol.

Seal, Mechanical Type: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless steel spring, and [**NBR] [EPDM] [FKM] <Insert material**> bellows and gasket.

Seal, Packing Type: Packing seal consisting of stuffing box with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.

Pump Bearings: Grease-lubricated ball bearings in cast-iron housing with grease fittings.

Not all manufacturers provide drop-out coupling that allows removal and replacement of impeller without disconnecting piping. This device is required with volute support described in "Casing" subparagraph.

* + - * 1. Shaft Coupling: Molded-rubber insert and interlocking spider capable of absorbing vibration. [**Couplings shall be drop-out type to allow disassembly and removal without removing pump shaft or motor] [EPDM coupling sleeve for variable-speed applications**].
				2. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.
				3. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A36/A36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.

Default motor characteristics are specified in Section 230513 "Common Motor Requirements for HVAC Equipment." If different characteristics are required, insert paragraphs to suit Project.

* + - * 1. Motor: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

In "Enclosure" subparagraph below, coordinate type availability with equipment manufacturers.

Enclosure: [**Totally enclosed, fan cooled] <Insert enclosure type**>.

Retain first subparagraph below for premium efficiency.

NEMA Premium Efficient motors as defined in NEMA MG 1.

Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

[**Single] [Variable**]-speed motor.

Delete first subparagraph below if pump is single speed or if variable-frequency motor controller is to be provided under Section 262923 "Variable-Frequency Motor Controllers."

Provide integral pump motor variable-speed controller.

If unique characteristics are required for motors in this Section, insert subparagraphs below.

<**Insert unique motor characteristics**>.

If Project has more than one type or configuration of separately coupled, base-mounted, end-suction centrifugal pump, delete "Capacities and Characteristics" paragraph below and schedule pumps on Drawings.

* + - * 1. Capacities and Characteristics:

Capacity: <**Insert gpm**>.

Total Dynamic Head: <**Insert fee**t>.

Maximum Operating Pressure: [**175 psig] [250 psig] <Insert value**>.

Maximum Continuous Operating Temperature: [**225 deg F] [250 deg F] <Insert temperature**>.

Inlet and Outlet Size: <**Insert NPS**>.

Impeller Size: <**Insert inches**>.

Motor Speed: <**Insert rpm**>.

Motor Horsepower: <**Insert value**>.

Electrical Characteristics:

Volts: [**120] [240] [208] [460] <Insert value**> V.

Phase: [**Single] [Three**].

Hertz: 60 Hz.

Full-Load Amperes: <**Insert value**> A.

Minimum Circuit Ampacity: <**Insert value**> A.

Maximum Overcurrent Protection: <**Insert value**> A.

* + - 1. SEPARATELY COUPLED, BASE-MOUNTED, DOUBLE-SUCTION CENTRIFUGAL PUMPS
				1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Armstrong Pumps, Inc.

ITT Corporation.

Taco Comfort Solutions.

Approved equivalent.

* + - * 1. Source Limitations: Obtain pumps from single source from single manufacturer.
				2. Description: Factory-assembled and -tested, centrifugal, impeller-between-bearings, separately coupled, double-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal.
				3. Pump Construction:

Not all manufacturers provide casing supports that allow removal and replacement of impeller without disconnecting piping. If retaining this option, also retain drop-out coupling described in "Shaft Coupling" paragraph below.

Casing: [**Radially] [Horizontally**] split, cast iron, with[ **replaceable bronze wear rings**,] threaded gauge tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and ASME B16.1, [**Class 125] [Class 250] flanges.[ Casing supports shall allow removal and replacement of impeller without disconnecting piping**.]

Impeller: ASTM B584, cast bronze; statically and dynamically balanced, and keyed to shaft. For pumps that are not frequency-drive controlled, trim impeller to match specified performance.

Pump Shaft: [**Type 304] [Type 316**] stainless steel.

Retain "Seal, Mechanical Type" or "Seal, Packing Type" subparagraph below. If retaining first subparagraph, verify suitable bellows and gasket materials if pumped fluids operate above 225 deg F (107 deg C) or contain glycol.

Seal, Mechanical Type: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless steel spring, and [**NBR] [EPDM] [FKM] <Insert material**> bellows and gasket.

Seal, Packing Type: Packing seal consisting of stuffing box with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.

Pump Bearings: Grease-lubricated ball bearings in cast-iron housing with grease fittings.

Not all manufacturers provide drop-out coupling that allows removal and replacement of impeller without disconnecting piping. This device is required with casing support described in "Casing" subparagraph.

* + - * 1. Shaft Coupling: Molded-rubber insert and interlocking spider capable of absorbing vibration. [**Couplings shall be drop-out type to allow disassembly and removal without removing pump shaft or motor] [EPDM coupling sleeve for variable-speed applications**].
				2. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.
				3. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A36 channels and angles. Fabricate to mount pump casing, coupling guard, and motor.

Default motor characteristics are specified in Section 230513 "Common Motor Requirements for HVAC Equipment." If different characteristics are required, insert paragraphs to suit Project.

* + - * 1. Motor: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

In "Enclosure" subparagraph below, coordinate type availability with equipment manufacturers.

Enclosure: [**Totally enclosed, fan cooled] <Insert enclosure type**>.

Retain first subparagraph below for premium efficiency.

NEMA Premium Efficient motors as defined in NEMA MG 1.

Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

[**Single] [Variable**]-speed motor.

Delete first subparagraph below if pump is single speed or if variable-frequency motor controller is to be provided under Section 262923 "Variable-Frequency Motor Controllers."

Provide integral pump motor variable-speed controller.

If unique characteristics are required for motors in this Section, insert subparagraphs below.

<**Insert unique motor characteristics**>.

If Project has more than one type or configuration of separately coupled, base-mounted, double-suction centrifugal pump, delete "Capacities and Characteristics" paragraph below and schedule pumps on Drawings.

* + - * 1. Capacities and Characteristics:

Capacity: <**Insert gpm**>.

Total Dynamic Head: <**Insert feet**>.

Maximum Operating Pressure: [**175 psig] [250 psig] <Insert value**>.

Maximum Continuous Operating Temperature: [**225 deg F] [250 deg F] <Insert temperature**>.

Inlet and Outlet Size: <**Insert NPS**>.

Impeller Size: <**Insert inches**>.

Motor Speed: <**Insert rpm**>.

Motor Horsepower: <**Insert value>.**

Electrical Characteristics:

Volts: [**120] [240] [208] [460] <Insert value**> V.

Phase: [**Single] [Three**].

Hertz: 60 Hz.

Full-Load Amperes: <**Insert value**> A.

Minimum Circuit Ampacity: <**Insert value**> A.

Maximum Overcurrent Protection: <**Insert value**> A.

* + - 1. SEPARATELY COUPLED, VERTICALLY MOUNTED, DOUBLE-SUCTION CENTRIFUGAL PUMPS
				1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Armstrong Pumps, Inc.

ITT Corporation.

Taco Comfort Solutions.

Approved equivalent.

* + - * 1. Source Limitations: Obtain pumps from single source from single manufacturer.
				2. Description: Factory-assembled and -tested, centrifugal, impeller-between-bearings, separately coupled, double-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted vertically.
				3. Pump Construction:

Casing: Radially split, cast iron, with[ **replaceable bronze wear rings**,] threaded gauge tappings at inlet and outlet, drain plug at bottom of volute, mounting support, and ASME B16.1, [**Class 125] [Class 250**] flanges.

Impeller: ASTM B584, cast bronze; statically and dynamically balanced, and keyed to shaft. For pumps that are not frequency-drive controlled, trim impeller to match specified performance.

Pump Shaft: [**Type 304 stainless steel] [Type 316 stainless steel] <Insert material**>.

Retain "Seal, Mechanical Type" or "Seal, Packing Type" subparagraph below. If retaining first subparagraph, verify suitable bellows and gasket materials if pumped fluids operate above 225 deg F (107 deg C) or contain glycol.

Seal, Mechanical Type: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless steel spring, and [**NBR] [EPDM] [FKM] <Insert material**> bellows and gasket.

Seal, Packing Type: Packing seal consisting of stuffing box with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.

Pump Bearings: Grease-lubricated ball bearings in cast-iron housing with grease fittings.

* + - * 1. Shaft Coupling: Molded-rubber insert and interlocking spider capable of absorbing vibration.

Default motor characteristics are specified in Section 230513 "Common Motor Requirements for HVAC Equipment." If different characteristics are required, insert paragraphs to suit Project.

* + - * 1. Motor: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

In "Enclosure" subparagraph below, coordinate type availability with equipment manufacturers.

Enclosure: [**Totally enclosed, fan cooled] <Insert enclosure type**>.

Retain first subparagraph below for premium efficiency.

NEMA Premium Efficient motors as defined in NEMA MG 1.

Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

[**Single] [Variable**]-speed motor.

Delete first subparagraph below if pump is single speed or if variable-frequency motor controller is to be provided under Section 262923 "Variable-Frequency Motor Controllers."

Provide integral pump motor variable-speed controller.

If unique characteristics are required for motors in this Section, insert subparagraphs below.

<**Insert unique motor characteristics**>.

If Project has more than one type or configuration of separately coupled, vertically mounted, double-suction centrifugal pump, delete "Capacities and Characteristics" paragraph below and schedule pumps on Drawings.

* + - * 1. Capacities and Characteristics:

Capacity: <**Insert gpm**>.

Total Dynamic Head: <**Insert feet**>.

Maximum Operating Pressure: [**175 psig] [250 psig] <Insert value**>.

Maximum Continuous Operating Temperature: [**225 deg F] [250 deg F] <Insert temperature**>.

Inlet and Outlet Size: <**Insert NPS**>.

Impeller Size: <**Insert inches**>.

Motor Speed: <**Insert rpm**>.

Motor Horsepower: <**Insert value>.**

Electrical Characteristics:

Volts: [**120**] [**240**] [**208**] [**460**] <**Insert value**> V.

Phase: [**Single**] [**Three**].

Hertz: 60 Hz.

Full-Load Amperes: <**Insert value**> A.

Minimum Circuit Ampacity: <**Insert value**> A.

Maximum Overcurrent Protection: <**Insert value**> A.

* + - 1. SEPARATELY COUPLED, VERTICALLY MOUNTED, TURBINE CENTRIFUGAL PUMPS
				1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

American-Marsh Pumps.

Flowserve Corporation.

Peerless Pump Company.

Approved equivalent.

* + - * 1. Source Limitations: Obtain pumps from single source from single manufacturer.
				2. Description: Factory-assembled and -tested, [**single-stage] [multistage**], centrifugal, impeller-between-bearings, end-suction pump as defined in HI 2.1-2.2 and HI 2.3; designed for installation with pump and motor shafts mounted vertically and projecting into a sump.
				3. Pump Construction:

Pump Bowl: Cast iron, with [**cone] [basket**] strainer[, **replaceable bronze wear ring**,] and suction bell.[ **Water passages of intermediate bowls shall be coated with porcelain enamel**.]

Impeller: ASTM B584, cast bronze; statically and dynamically balanced and keyed to shaft. For pumps that are not frequency-drive controlled, trim impeller to match specified performance.

Pump Shaft: [**Carbon] [Type 304 stainless] [Type 316 stainless**] steel sized in accordance with manufacturer's written instructions.

Pump Bearings: Water-lubricated bronze and rubber sleeve bearings in cast-iron housing.

Pump Column: ASTM A53, Grade B steel pipe.

Retain "Seal, Mechanical Type" or "Seal, Packing Type" subparagraph below. If retaining first subparagraph, verify suitable bellows and gasket materials if pumped fluids operate above 225 deg F (107 deg C) or contain glycol.

Seal, Mechanical Type: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless steel spring, and [**NBR] [EPDM] [FKM**] bellows and gasket. Include water slinger on shaft between motor and seal.

Seal, Packing Type: Packing seal consisting of stuffing box with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.

* + - * 1. Shaft Coupling: Keyed with locking collets.
				2. Discharge Head: ASME B16.1, [**Class 125] [Class 250**] discharge flange with threaded gauge tapping. Top of discharge head shall have a registered fit to accurately locate the driver.

Default motor characteristics are specified in Section 230513 "Common Motor Requirements for HVAC Equipment." If different characteristics are required, insert paragraphs to suit Project.

* + - * 1. Motor: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

In "Enclosure" subparagraph below, coordinate type availability with equipment manufacturers.

Enclosure: **[Totally enclosed, fan cooled] <Insert enclosure type**>.

Retain first subparagraph below for premium efficiency.

NEMA Premium Efficient motors as defined in NEMA MG 1.

Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

[**Single] [Variable**]-speed motor.

Delete first subparagraph below if pump is single speed or if variable-frequency motor controller is to be provided under Section 262923 "Variable-Frequency Motor Controllers."

Provide integral pump motor variable-speed controller.

If unique characteristics are required for motors in this Section, insert subparagraphs below.

<**Insert unique motor characteristics**>.

If Project has more than one type or configuration of separately coupled, vertically mounted, turbine centrifugal pump, delete "Capacities and Characteristics" paragraph below and schedule pumps on Drawings.

* + - * 1. Capacities and Characteristics:

Capacity: <**Insert gpm**>.

Total Dynamic Head: <**Insert feet**>.

Minimum Static Head: <**Insert feet**>.

Maximum Operating Pressure: [**175 psig] <Insert value**>.

Maximum Continuous Operating Temperature: [**200 deg F] <Insert temperature**>.

Outlet Size: <**Insert NPS**>.

Impeller Size: <**Insert inches**>.

Motor Speed: <**Insert rpm**>.

Motor Horsepower: <**Insert value**>.

Electrical Characteristics:

Volts: [**120] [240] [208] [460] <Insert value**> V.

Phase: [**Single] [Three**].

Hertz: 60 Hz.

Full-Load Amperes: <**Insert value**> A.

Minimum Circuit Ampacity: <**Insert value**> A.

Maximum Overcurrent Protection: <**Insert value**> A.

* + - 1. WET-ROTOR PUMPS
				1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Armstrong Pumps, Inc.

ITT Corporation.

Taco Comfort Solutions.

Approved equivalent.

* + - * 1. Source Limitations: Obtain pumps from single source from single manufacturer.
				2. Description: Factory-assembled and -tested, wet-rotor pump. Pump and motor to form an integral unit with bearings lubricated by the pumped liquid.
				3. Pump Construction:

Body: [**100 percent lead-free bronze] [Type 304 stainless steel] [Cast iron**].

Impeller: [**Polypropylene] [Noryl] [Type 304 stainless steel**].

Pump Shaft: [**Ceramic] [Type 304 stainless steel] [Type 316 stainless steel**].

Bearings. Double-sintered carbon.

* + - * 1. Motor: [**Single] [Three] [Variable**] speed.

Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.

Default motor characteristics are specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

Efficiency: Premium Efficiency.

NEMA Design: <**Insert designation**>.

Service Factor: <**Insert value**>.

Delete first subparagraph below if electronic motor speed control is not required.

Integral pump motor variable-speed control.

Delete subparagraph below if ECM is not required.

ECM.

If Project has more than one type or configuration of wet-rotor pump, delete "Capacities and Characteristics" paragraph below and schedule pumps on Drawings.

* + - * 1. Capacities and Characteristics:

Capacity: <**Insert gpm**>.

Total Dynamic Head: <**Insert feet**>.

Maximum Operating Pressure: [**150 psig] <Insert value**>.

Maximum Continuous Operating Temperature: [**225 deg F] [230 deg F] <Insert temperature**>.

Inlet and Outlet Size: <**Insert NPS**>.

Impeller Size: <**Insert inches**>.

Motor Speed: <**Insert rpm**>.

Motor Horsepower: <**Insert value**>.

Electrical Characteristics:

Volts: [**120] <Insert value**> V.

Phase: [**Single] [Three**].

Hertz: 60 Hz.

Full-Load Amperes: <**Insert value**> A.

Minimum Circuit Ampacity: <**Insert value**> A.

Maximum Overcurrent Protection: <**Insert value**> A.

* + - 1. AUTOMATIC CONDENSATE PUMP UNITS

Units in this article are complete with pump, basin, and controls and have limited applications and small capacity.

* + - * 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Beckett Corporation.

Grundfos Pumps Corporation.

Little Giant Pump Co.

Approved equivalent.

* + - * 1. Source Limitations: Obtain pump units from single source from single manufacturer.
				2. Description: Packaged units with corrosion-resistant pump, [**aluminum] [plastic**] tank with cover, and automatic controls. Collects and removes condensate from fan coil units, air handling units, condensing boilers, and similar components. Include factory- or field-installed check valve and 72-inch- minimum, electrical power cord with plug.

If Project has more than one type or configuration of automatic condensate pump unit, delete "Capacities and Characteristics" paragraph below and schedule pumps on Drawings.

* + - * 1. Capacities and Characteristics:

Tank Capacity: <**Insert gal**>.

Pump Capacity: <**Insert gpm**>.

Maximum Lift: <**Insert feet**>.

Motor Horsepower: <**Insert value**>.

Electrical Characteristics:

Volts: [**120] <Insert value**> V.

Phase: Single.

Hertz: 60 Hz.

Full-Load Amperes: <**Insert value**> A.

Minimum Circuit Ampacity: <**Insert value**> A.

Maximum Overcurrent Protection: <**Insert value**> A.

* + - 1. PUMP SPECIALTY FITTINGS

See the Evaluations for cautions about pump specialty fittings. In this article, retain ductile-iron body for 300-psig (2060-kPa) pressure rating; retain stainless steel strainer for condenser water usage.

* + - * 1. Suction Diffuser:

Angle pattern.

[**175-psig] [300-psig**] pressure rating, [**cast] [ductile**]-iron body and end cap, pump-inlet fitting.

Bronze 16-mesh wire startup and [**bronze] [Type 304 stainless steel**] permanent strainers with 3/16-inch.

[**Bronze] [Carbon steel] [Type 304 stainless steel**] straightening vanes.

Drain plug.

Factory-fabricated support.

* + - * 1. Triple-Duty Valve:

Angle or straight pattern.

[**175-psig] [300-psig**] pressure rating, [**cast] [ductile**]-iron body, pump-discharge fitting.

Valve with multi-turn stem and memory stop to allow valve to be returned to its original position after shutoff.

Brass valve disc with EPDM rubber seat.

Type 304 stainless steel valve stem.

Drain plug and bronze-fitted shutoff, balancing, and check valve features.

Brass gauge ports with integral check valve and orifice for flow measurement.

* + - 1. INTEGRAL PUMP MOTOR VARIABLE-SPEED CONTROLLERS
				1. Where specified or scheduled, provide pumps with an integral pump motor speed controller.

Motor: Operates as constant- or variable-speed pump with speed regulated by an integrated variable-speed drive.

Integrated Pump Controller: Supports direct communication with the building management system (BMS) with built-in support for the following protocols: [**Modbus RTU] [BACnet? MS/TP] [Metasys N2**].

Commissioning and pump set up access to pump controls via the following:

A web interface (data exchange).

A user interface located on the face of speed controller to adjust modes and mode values.

An electronic display that reads real-time mode set values, flow, head, speed, and power and that locks out unauthorized adjustment of pump.

Provide electronics with "Auto" as factory default but slope of the proportional curve will automatically match the required system curve, constant pressure control (delta-p/c), variable differential pressure control (delta-p/v), constant curve duty (uncontrolled pump), and rpm regulation. RPM (speed) regulation can be accomplished by the following:

Manual (via user interface or HTML).

Remote via 0 to 10 V dc.

Data protocol communications with the BMS.

Pump Electronics: Standard with multiple digital inputs and one external digital output to be available for additional mechanical room control and pump status monitoring.

Controller: Mounted on or adjacent to the motor. Provide enclosure rated to UL Type 12.

Electronically Protected Pumps: Rated for continuous duty and with built-in startup circuit. Provide overcurrent, line surge and current limit protection, thermal monitoring, heat sink status and over temperature protection.

Pump capable of being monitored continuously via integrated Internet link.

Integrated pump controller system to have the following features:

Controller software shall be capable of sensorless control in variable-volume systems without need for pump-mounted (internal/external) or remotely mounted differential pressure sensor.

Integrated Pump Controller Sensorless Control: Operates under Quadratic Pressure Control (QPC) to ensure that head reduction with reducing flow conforms to quadratic control curve.

Controller:

Minimum head of 40 percent of design duty head.

User-adjustable control mode settings and minimum/maximum head set points using built-in programming interface.

Controller Integrated Control Software:

Capable of controlling pump performance for non-overloading power at every point of operation.

Capable of maintaining flow rate data.

* + - 1. ELECTRONICALLY COMMUTATED MOTOR (ECM)
				1. Provide pumps so they are specified or scheduled with ECM.

Synchronous, constant torque, ECM with permanent magnet rotor. Rotor magnets to be time-stable, nontoxic ceramic magnets (Sr-Fe).

Driven by a frequency converter with an integrated power factor correction filter. Conventional induction motors will not be acceptable.

Each motor with an integrated variable-frequency drive, tested as one unit by manufacturer.

Motor speed adjustable over full range from 0 rpm to maximum scheduled speed.

Variable motor speed to be controlled by a 0- to 10 V-dc or 4- to 20-mA input.

Integrated motor protection verified by UL to protect the pump against over-/undervoltage, overtemperature of motor and/or electronics, overcurrent, locked rotor, and dry run (no-load condition).

1. EXECUTION
	* + 1. EXAMINATION
				1. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

Retain first two paragraphs below if required.

* + - * 1. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
				2. Examine foundations and inertia bases for suitable conditions where pumps will be installed.
				3. Proceed with installation only after unsatisfactory conditions have been corrected.
			1. PUMP INSTALLATION

In first paragraph below, retain "HI 1.4" option for centrifugal pumps and "HI 2.4" option for vertically mounted, turbine centrifugal pumps.

* + - * 1. Comply with ANSI/HI Standard [**1.4] [and] [2.4**].
				2. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.
				3. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
				4. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.
				5. Equipment Mounting:

Retain first subparagraph below to require equipment to be installed on cast-in-place concrete equipment bases.

Install base-mounted pumps on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."

Retain one of two subparagraphs below if vibration isolation is required. Retain first for projects in seismic areas; retain second for projects not in seismic areas. Indicate vibration isolation and seismic-control device type and minimum deflection in supported equipment schedule on Drawings.

Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

Retain "Equipment Mounting" paragraph below for in-line pumps suspended from structure.

* + - * 1. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and [**elastomeric hangers] [spring hangers] [spring hangers with vertical-limit stop**] of size required to support weight of in-line pumps.

Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

* + - 1. ALIGNMENT

Retain this article only for separately coupled, end- and double-suction centrifugal pumps.

Retain one of first two paragraphs below.

* + - * 1. Engage a Company Service Advisor to perform alignment service.
				2. Perform alignment service. When required by manufacturer to maintain warranty coverage, engage a Company Service Advisor to perform it.
				3. Comply with requirements in HI standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.
				4. Comply with pump and coupling manufacturers' written instructions.
				5. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.
			1. PIPING CONNECTIONS

Coordinate piping installations and specialty arrangements with Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.

* + - * 1. Comply with requirements for piping specified in Section 232213 "Steam and Condensate Heating Piping" and Section 232216 "Steam and Condensate Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
				2. Where installing piping adjacent to pump, allow space for service and maintenance.
				3. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
				4. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
				5. Install [**check, shutoff, and throttling valves] [check valve and throttling valve with memory stop] [triple-duty valve**] on discharge side of pumps.
				6. Install [**Y-type strainer] [suction diffuser**] and shutoff valve on suction side of pumps.

Use startup strainer for initial system startup. Install permanent strainer element before turnover of system to Director’s Representative.

* + - * 1. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.
				2. Install pressure gauges on pump suction and discharge or at integral pressure-gauge tapping, or install single gauge with multiple-input selector valve.

Retain paragraph below for automatic condensate pump units.

Provide detail of condensate pump piping inlet and drain on Drawings. Coordinate with plumbing design.

* + - * 1. Install check valve on each condensate pump unit discharge unless unit has a factory-installed check valve.
			1. ELECTRICAL CONNECTIONS
				1. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
				2. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
				3. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
				4. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

Retain one of two subparagraphs below. First subparagraph cross-references Section 260553 "Identification for Electrical Systems" and should be retained for consistent electrical identification. Second subparagraph is an abbreviated version of product specified in Section 260553 "Identification for Electrical Systems."

Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

* + - 1. CONTROL CONNECTIONS
				1. Install control and electrical power wiring to field-mounted control devices.
				2. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."
			2. STARTUP SERVICE
				1. [**Engage a Company Service Advisor to perform] [Perform**] startup service.

Complete installation and startup checks in accordance with manufacturer's written instructions.

Check piping connections for tightness.

Clean strainers on suction piping. Use startup strainer for initial startup.

Perform the following startup checks for each pump before starting:

Verify bearing lubrication.

Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.

Verify that pump is rotating in correct direction.

Prime pump by opening suction valves and closing drains, and prepare pump for operation.

Start motor.

Open discharge valve slowly.

* + - 1. FIELD QUALITY CONTROL

Retain "Testing Agency," "Manufacturer's Field Service," or "Perform tests and inspections" paragraph below. Retain first option in first paragraph if Owner will hire an independent testing agency.

Retain "Manufacturer's Field Service" paragraph below to require a factory-authorized service representative to perform tests and inspections.

* + - * 1. Manufacturer's Field Service: Engage a Company Service Advisor to test and inspect components, assemblies, and equipment installations, including connections.

Retain "Perform tests and inspections" paragraph below to require Contractor to perform tests and inspections and retain option to require Contractor to arrange for the assistance of a factory-authorized service agent.

* + - * 1. Perform tests and inspections[ **with the assistance of a Company Service Advisor**].
				2. Hydronic pumps will be considered defective if they do not pass tests and inspections.
				3. Prepare test and inspection reports.
			1. DEMONSTRATION
				1. [**Engage a Company Service Advisor to train] [Train**] Director’s Representative's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION 232123