**Design Envelope 4332 Tango**

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Typical Specifications

ARMSTRONG GUIDE NOTE: This master specification section includes ARMSTRONG GUIDE NOTEs identified as “ARMSTRONG GUIDE NOTE” for information purposes and to assist the specification writer in making appropriate decisions. The ARMSTRONG GUIDE NOTE always immediately precedes the text to which it is referring. The section serves as a guideline only and should be edited with deletions and additions to meet specific project requirements.

ARMSTRONG GUIDE NOTE: This specification section follows the recommendations of the Guideline on the application of Commission Regulation 641/2009/EC and the amendment 622/2012/EC with regard to eco-design requirements. Optional text is indicated by square brackets [ ]; delete the optional text including the brackets in the final copy of the specification. Delete the ARMSTRONG GUIDE NOTEs in the final copy of the specification. Trade/brand names with appropriate product model numbers, styles and types are used in ARMSTRONG GUIDE NOTEs and in the specification text Article or Paragraph titled “Acceptable Material”.

1. GENERAL
	1. SUMMARY OF WORK
2. This Section specifies single stage, single suction type, vertical inline design pumps with integrated intelligent controls.
	1. RELATED REQUIREMENTS

ARMSTRONG GUIDE NOTE: Include in this Paragraph only those sections and documents that directly affect the work of this section. If a reader of this section could reasonably expect to find a product or component specified in this section, but it is actually specified elsewhere, then the related section number(s) should be listed in the Paragraph below. Do not include Division 00 Documents or Division 01 Sections since it is assumed that all technical sections are related to all project Division 00 Documents and Division 01 Sections to some degree. Refer to other documents with caution since referencing them may cause them to be considered a legal part of the Contract. Edit the following paragraphs to suit specific project conditions.

* + 1. Section [23 05 48 – Vibration and Seismic Controls for HVAC: vibration isolation and seismic restraints].
		2. Electrical connections: IEC 61984, Connectors - Safety requirements and tests are used in the EU and BS 7671 "Requirements for Electrical Installations for the U.K.

ARMSTRONG GUIDE NOTE: In the following Article, include only those reference standards which appear in the finished version of the project specification.

* 1. REFERENCE STANDARDS
		1. British standard institute and European DIN standards organization (BSI/DIN).
			1. EN1092-1:2007: pipe and flanges fittings ½ “BSPT and PN16 Standard.
		2. International Electrical Commission (IEC).
			1. IEC 60529-[2004], Degrees of Protection Provided By Enclosures (IP Code).
		3. American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE).
			1. ASTM A48/A48M-[2003 (2008)], Standard Specification for Gray Iron Castings. (Equivalent to BSI: BS1452 Grade 220)
			2. ASTM A536-[1984 (2009)], Standard Specification for Ductile Iron Castings (BS 2789400/17).
			3. ASTM A582/A582M-[2005], Standard Specification for Free-Machining Stainless Steel Bars (Equivalent to BSI: BS970 416).
			4. ASTM B584-[2011], Standard Specification for Copper Alloy Sand Castings for General Applications (Equivalent to BSI: BS1400 LG2C).
		4. European commission (COMMISSION REGULATION (EU) No 547/2012, implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to eco-design).
			1. Electrical motor: Regulation 640/2009/EC on Electric Motor Efficiency.
			2. Low voltage - Switchgear and Control assemblies BS EN 60439-1 and Low voltage directive (2006/95/EC).
			3. EMC-Directive for Electromagnetic Compatibility 2004/108/EC.
			4. Minimum efficiency index (MEI) for clean water pumps from the Commission directive no. 547/2012.
			5. The machinery directive for Safety of Machinery - Electrical equipment of machines 2006/42/EC.
		5. German Institute for Standardization (DIN).
			1. DIN EN 61800-3-[2004], Adjustable Speed Electrical Power Drive Systems - Part 3: EMC Requirements and Specific Test Methods.
		6. Institute of Electrical and Electronics Engineers (IEEE).
			1. IEEE 519-[1992], Recommended Practices and Requirements for Harmonic Control In Electrical Power Systems.
		7. International Electrotechnical Commission (IEC).
			1. Council Directive 2006/95/EC- low voltage Directive, IEC 60034-1: 2010 rotating electrical machines Part1: Rating and performances.
		8. European commission (EC).
			1. Council Directive 2006/42/EC- Machine Directive, IEC 60204-SER: 2013
	2. ADMINISTRATIVE REQUIREMENTS
		1. Co-ordination: Co-ordinate work of this Section with work of other trades for proper time and sequence to avoid construction delays.
		2. Pre-installation Meeting: Convene pre-installation meeting after Award of Contract and one week prior to commencing work of this Section to verify project requirements, substrate conditions and coordination with other building sub-trades, and to review manufacturer’s written installation instructions.
			1. Notify attendees 2 weeks prior to meeting and ensure meeting attendees include as minimum:
				1. Owner;
				2. Consultant;
				3. Mechanical Subcontractor;
				4. Electrical and control Subcontractor;
				5. Manufacturer’s Technical Representative.
			2. Ensure meeting agenda includes review of methods and procedures related to hydronic pump installation including co-ordination with related work.
			3. Record meeting proceedings including corrective measures and other actions required to ensure successful completion of work and distribute to each attendee within 1 week of meeting.

ARMSTRONG GUIDE NOTE: Article below includes submittals of relevant data to be furnished by Contractor.

* 1. ACTION AND INFORMATIONAL SUBMITTALS
		1. Product Data: Submit product data including manufacturer’s literature for hydronic pump, controls, components and accessories, indicating compliance with specified requirements and material characteristics.
			1. Submit list on pump manufacturer’s letterhead of materials, components and accessories to be incorporated into Work.
			2. Include pump performance curves indication where project pumps appear in curve range with pre-defined performance envelope showing optimum efficiency region.
			3. Include product names, types and series numbers.
			4. Include contact information for manufacturer and their representative for this Project.
				1. Include information on costs for wiring of drive to motor, and wiring pump mounted (internal/external) or remotely mounted differential pressure sensor(s). Also include costs for piping and commissioning of differential pressure sensor(s).
		2. Shop Drawings: Submit shop drawings indicating dimensions and materials for pump components and controls.
			1. Show pump, motor and control enclosure dimensions on shop drawings.
			2. Include controls wiring diagrams.
		3. Test Reports:

Submit test reports showing compliance with specified performance characteristics and physical properties including structural performance (hydrostatic test).

* + 1. Field Reports:

Submit manufacturer’s field reports within 3 days of each manufacturer service engineer or subcontractor’s site visit and inspection.

* 1. CLOSEOUT SUBMITTALS
		1. Operation and Maintenance Data: Supply maintenance data including marked performance curves for each hydronic pump for incorporation into site IOM manual specified.
		2. Record Documentation: Closeout Submittals.
			1. List materials used in hydronic pump work. Include marked up performance curves for each pump.
			2. Warranty: Submit warranty documents specified.
	2. QUALITY ASSURANCE
		1. The pump and controls shall be integrated by the manufacturer in the factory, including assembly, wiring, programming and testing. Sensorless data shall be mapped in the integrated controls using tested performance measurements for each specific pump which are DE Sensorless. The use of catalog data for Sensorless data mapping will not be acceptable.
		2. The complete pump and control package shall be compliant with the Directive 2006/42/EC- Machine Directive, IEC 60204-SER: 2013, Eco-design Directive 2009/125/EC, the EC-Directive "Electromagnetic Compatibility" 89/336/EEC of the European Parliament and of the Council.

ARMSTRONG GUIDE NOTE: The following Article although not part of Quality Assurance, can be used to enhance the quality of materials by ensuring that they are delivered and handled properly at the work site.

* 1. DELIVERY STORAGE AND HANDLING
		1. Delivery and Requirements:
			1. Deliver materials and components in manufacturer’s original packaging with identification labels intact and in sizes to suit project.
				1. Include manufacturer's name, job number, pump location, and pump model and series numbers on identification labels.
		2. Storage and Handling Requirements: Store materials off ground and protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
			1. Exercise care to avoid damage during unloading and storing. IOM manual instructions to be followed.
			2. Leave pump port protection plates in place until pumps are ready to connect to piping.

ARMSTRONG GUIDE NOTE: DEPM IVS Vertical Inline units include a lifting lug capable of supporting complete pump and control to facilitate handling.

* + - 1. Complete pump and control package shall be lifted by overhead lifting lug(s). Do not place cable slings around pump shaft or integrated control enclosure.
		1. Packaging Waste Management:

ARMSTRONG GUIDE NOTE: For smaller projects that do not have a separate Section for waste management and disposal, delete the following paragraph.

* + - 1. Remove waste packaging materials from site and dispose of packaging materials at appropriate recycling facilities.

ARMSTRONG GUIDE NOTE: For smaller projects that do not have a Waste Management Plan, delete the option referring to a Waste Management Plan.

* + - 1. Collect and separate for disposal paper and plastic material in appropriate on-site storage containers for recycling [in accordance with Waste Management Plan].
	1. FIELD CONDITIONS

ARMSTRONG GUIDE NOTE: To avoid the controls unit getting overheated, the ambient temperature is not to exceed 113°F / 45°C when installed at sea level. Operating in higher ambient temperatures will require de-rating of the controls unit. Verify maximum temperatures with manufacturer for elevations other than sea level.

* + 1. Ambient Temperature: [113] °F] [45°C] maximum at [sea level] [up to [3,300 feet] [1,000m] above sea level].
		2. Relative Humidity: [95] % maximum.
	1. WARRANTY
		1. Project Warranty: Refer to Contract Conditions for project warranty provisions.
		2. Manufacturer’s warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty document executed by authorized company official. Manufacturer’s warranty is in addition to and not intended to limit other rights Owner may have under Contract Conditions.

ARMSTRONG GUIDE NOTE: Coordinate article below with manufacturer’s warranty requirements. Note that Armstrong’s Design Envelope units carry an 18 months warranty from date of shipment, or 12 months from date of installation, whichever comes first. To receive an additional 6 months of standard coverage, Owner may register the pump unit at www.armstrongfluidtechnology.com/warrantyregistration

* + 1. Warranty period: [18] months from date of shipment, or [12] months from date of installation, whichever comes first. To receive an additional [6] months of standard coverage, Owner may register the pump unit at http://armstrongfluidtechnology.com/registration
1. PRODUCTS

ARMSTRONG GUIDE NOTE: Tango units allow [2] pumps in a common casing to be operated for duty / standby or parallel operation applications, with a single pipe connection; where one unit can be isolated for service with the second unit still in operation. The 4332 series describes a split-coupled shaft design which allows mechanical seals to be removed without disturbing the pump, motor or controls. (Recommended for above 7.5kW motors).

* 1. MANUFACTURER
		1. Armstrong Fluid Technology, Wolverton Street, Manchester, M11 2ET United Kingdom, Phone: +44 (0)8444 145 145, FAX: +44 (0)8444 145 146, e-mail: info@armstrongfluidtechnology.com. URL: [www.armstrongfluidtechnology.com](http://www.armstrongfluidtechnology.com).
		2. Armstrong Fluid Technology, Heywood Wharf, Mucklow Hill, Halesowen West Midlands, B62 8DJ, United Kingdom, Phone: +44 (0)8444 145 145, FAX: +44 (0)8444 145 146, e-mail: info@armstrongfluidtechnology.com. URL: [www.armstrongfluidtechnology.com](http://www.armstrongfluidtechnology.com).
	2. DESCRIPTION
		1. Single stage, single suction type, Tango vertical inline design pump with integrated intelligent controls. The cast casing with equal size suction and discharge flanges, each having separate tapped flush line and pressure gauge connections, shall incorporate two radially split, single stage centrifugal pumps.
			1. The inlet and outlet ports on the casing shall sized such that both units may operate in parallel for double single pump flow rate with no loss of single pump efficiency
			2. Each port shall be fitted with an isolation valve that allow the units to operate in parallel or duty / standby, and may also be used to isolate one pumping unit for servicing / removal with the other pump still operating
			3. Mechanical Seals: [Split-coupled] serviceable without disturbing [motor, controls or piping connections].
			4. Include casing drain plug and ¼ inch suction and discharge gauge ports.
		2. Acceptable Material: ARMSTRONG, [Design Envelope 4332].
	3. DESIGN CRITERIA
		1. Design pump for variable flow applications and selected for hydraulic design conditions and minimum system pressure with [sensorless load Demand Based control] [pressure sensor across most remote load] [IPS control panel / BMS control].

ARMSTRONG GUIDE NOTE: Use the following paragraph for variable flow applications Sensorless or IPS control panel / BMS control. (Note that constant flow applications can also be served by intelligent controls operating at reduced speed to match actual system head)

Pump head can be specified at design conditions and maximum head capability at design flow for the specific pump selected. The maximum head is displayed on the selection software pump curve and it could be specified that the data be detailed on submittals.

* + - 1. Select hydraulic design conditions and minimum pressure with [sensorless load control] [pressure sensor across most remote load].
			2. For Sensorless control the operating control curve shall be [quadratic with adjustable minimum head setting] [constant pressure] [not operative to allow BMS or IPS control panel operation]
		1. Pump Operating Conditions:
			1. Pump head: [\_\_\_\_\_\_] minimum [\_\_\_\_\_\_] maximum capability.
			2. Pump capacity: [\_\_\_\_\_\_] minimum [\_\_\_\_\_\_] maximum capability.

ARMSTRONG GUIDE NOTE: Use 16 bar at ≤ 45°C and 10 bar at 148°C for DIN PN16 flanged piping systems [16 bar at 45°C for lower temperatures] and [10 bar at 148°C maximum] for fluid temperatures higher than 60°C

* 1. MATERIALS

ARMSTRONG GUIDE NOTE: Use Cast iron casing for PN16 flanged piping systems.

* + 1. Casing: [E-coated cast iron equivalent to BS1452 Grade 220].
			1. Test casing to 150 % maximum working pressure.
			2. Ensure casing is radially split to allow for removal of rotating element without disturbing pipe connections.
			3. Drill and tap casing for gauge ports on both suction and discharge connections.
			4. Drill and tap casing at lowest point for drain port.

ARMSTRONG GUIDE NOTE: Use 316 stainless steel impeller for HVAC hydronic applications, duplex stainless steel for higher abrasion and corrosive resistance service i.e. brine applications.

* + 1. Impeller: To [ASTM A743/743M 316 stainless steel] [ASTM 890/A890M duplex CD4MCuN stainless steel], fully enclosed and dynamically balanced to standard ISO 1940-1and fitted to shaft with key. Use two-plane balancing when installed impeller diameter is less than 6 times impeller width.
		2. Pump Shafts:
			1. [4332] Split-coupled: Stainless steel to ASTM A479/A479M, Type 316.

ARMSTRONG GUIDE NOTE: Use the following paragraph for DE 4332 split coupled pumps only. Note that rigid couplings allow simple and quick seal replacements and maintain permanent shaft alignment. NO FIELD SHAFT ALIGNMENT IS NECESSARY ON ARMSTRONG DE 4332 pumping units

* + 1. Coupling: Rigid spacer type, high tensile aluminum.
			1. Design coupling for easy removal on site to reveal space between pump and motor shaft.
				1. Ensure revealed space is sufficient for removal of mechanical seal components without disturbing pump, controls or motor.
				2. Include coupling guard.
				3. Include lower seal chamber throttle bushing to ensure seals maintain positive cooling and lubrication.

ARMSTRONG GUIDE NOTE: Use the following paragraph where extra seal chamber cleanliness is required.

* + - * 1. Include sight flow indicator in flush line to mechanical seal and [50-micron cartridge filter to suit system working pressure] [maintenance- free sediment separator for pump differential pressures greater than 30 psig].

ARMSTRONG GUIDE NOTE: Flanges are suitable for the following system pressures with ambient temperature fluid: DIN PN16 is suitable to 12 bar

* + 1. Flanges: To DIN standard, Pressure class PN16.
		2. Flush Line: 3/8 inch braided stainless steel complete with vent.
		3. Gasket: Synthetic fiber.

ARMSTRONG GUIDE NOTE: Select split-coupled seal options for DE 4332.

ARMSTRONG GUIDE NOTE: For split-coupled pumps in most HVAC applications specify Type AB2, outside balanced seals visit

ARMSTRONG GUIDE NOTE: Specify AB2 type seal with resin bonded carbon rotating face for potable and general non-potable water systems up to 93°C fluid temperature. Specify AT-70 type seal with Antimony loaded carbon rotating face for non-potable systems with a temperature > 93°C to 148°C. For low or high temperature applications for all glycols above 30% concentration by weight and / or abrasives above 2000ppm specify AT-70 type seal with Sintered Silicon Carbide rotating face

ARMSTRONG GUIDE NOTE: Specify Viton® secondary seal for AB2 potable and general non-potable water systems to 93°C. For non-potable higher temperature to 148°C specify AT-70 with Aflas® secondary seal elastomer

* + 1. Mechanical Seal: [Potable] [Non-potable], Type [AB2] [AT-70] outside balanced seal design and rated to [93°C] [148°C] maximum
			1. Rotating face: [Resin bonded carbon] [Antimony loaded carbon] [Sintered Silicon Carbide]
			2. Stationary face: Sintered Silicon Carbide
			3. Seal rotating hardware: Stainless Steel
			4. Secondary / shaft seal elastomer: [Viton®] [Aflas®]
	1. MOTOR
		1. Design Envelope Permanent Magnet High-Power (DEPMH) Motor to IEC/ IEC 60034-30-1
			1. Horsepower: [11-37] kW.
			2. Enclosure: [TEFC].
			3. Efficiency: IE5 to IEC/ IEC 60034-30-1, MEPS levels table
			4. Power supply: 380 -480, [50/60] Hertz, 3 phase
	2. PUMP CONTROLS

ARMSTRONG GUIDE NOTE: All integrated controls need a minimum of IEC 60509:1989 standard IP55 enclosure as water splashes may occur. For outdoor or sprinklered space service IEC 60509:1989 standard IP66 enclosure is available (motor is available in IP56 for outdoor). IP66 enclosure is normally supplied with a weather shield to protect keypad from UV rays and fans from freezing rain or snow. The DEPC and integrated controls shall be kept out of sunlight to avoid heat gain from solar loading. Ensure overhead sun shading is provided.

* + 1. Control: Integrated with IEC 60509:1989 standard IP55 minimum enclosure rating, [sensorless] controls complete with [fused disconnect switch] and/or with [BMS special communication option card] and menu-driven graphical keypad interface.
			1. Provide near unity displacement power factor (cos Ø) without need for external power factor correction capacitors at all loads and speeds using VVC-PWM type integrated controls
				1. Incorporate DC link reactors for reduction of mains borne harmonic currents and DC link ripple current to increase DC link capacitor lifetime.
				2. Fit RFI filters as standard to ensure integrated controls meets low emission and immunity requirements.

ARMSTRONG GUIDE NOTE: Controls with saturating (non-linear) DC link reactors shall require an additional 3% AC line reactor to provide acceptable harmonic performance at full load, where harmonic performance is most critical.

* + - * 1. Ensure additional 3 % AC line reactor is available for controls with saturating (nonlinear) DC link reactors.

ARMSTRONG GUIDE NOTE: Minimum maintained pressure for speed control from a remote sensor placement would be the value of the sensor setting. Sensorless control would use that same setting value for the control curve pressure at zero flow. If minimum maintained system pressure is not known, default to 40% of design head.

* + - 1. Minimum system pressure to be maintained: [\_\_\_\_\_\_] [mWg] [Bar] [kPa] head

ARMSTRONG GUIDE NOTE: Armstrong pump controls support BACnet™ MS/TP, BACnet™ TCP/IP, and Modbus RTU as standard protocols.

* + - 1. Protocol: [BACnet™ MS/TP] [BACnet™ TCP/IP] [Modbus RTU]
			2. Sensorless override for BAS/BMS control signal.
			3. [Manual pump control] [Closed loop PID control]
			4. Enclosure: [IP 55] [IP 66]
			5. EMI/RFI Control: Integrated filter designed to DIN EN61800-3.

ARMSTRONG GUIDE NOTE: The IVS intelligent variable speed drive is a low harmonic drive via built-in DC line reactors. This does not guaranty performance to any system wide harmonic specification or the costs to meet a system wide specification. If supplied with the system electrical details, Armstrong will run a computer simulation of the system wide harmonics. If system harmonic levels are exceeded Armstrong can also recommend additional harmonic mitigation and the costs for such mitigation.

* + - 1. Harmonic suppression: Dual DC-link reactors (Equivalent: 5% impedance AC line reactor) to mitigate harmonics to support IEEE 519 system requirements.
			2. Programmable skip Frequencies and adjustable switching frequency for noise and vibration control.
			3. Cooling: Fan cooled through back panel.
			4. Ambient working conditions: [[-10°C to +45°C], up to 1000m above sea level.
			5. Analog I/O: 2 Current or voltage inputs minimum, 1 speed output.
			6. Digital I/O: 2 inputs programmable, 2 programmable outputs.
			7. Pulse inputs: 2 programmable minimum.
			8. Relay outputs: 2 programmable minimum.
			9. Communications ports: 1- RS485.
			10. One volt free contact.
			11. Auto alarm reset.
		1. Software: Ensure software for sensorless control includes automatic speed control in variable volume systems without need for pump mounted (internal/external) or remotely mounted differential pressure sensor.
			1. Operating mode under sensorless control: Quadratic Pressure Control (QPC).
				1. Ensure head reduction with reducing flow conforms to quadratic control curve.
				2. Head at zero flow: [40] % minimum of design duty head.
			2. Linear or Proportional Pressure Control without sensor is unacceptable.
			3. Ensure control mode setting and minimum/maximum head set points are user adjustable using built-in programming interface.
			4. Ensure integrated control software is capable of controlling pump performance for non-overloading power at every point of operation.
			5. Ensure integrated control software is capable of flow rate display and data output of ±5% accuracy to BAS/BMS.
			6. Ensure the controls can displayed and digitally transmit real-time flow & values
		2. Include energy monitoring log function.
		3. For multiple pump configuration ensure [duty/standby] [parallel Sensorless pump control with best efficiency staging] is applied

ARMSTRONG GUIDE NOTE: The following refers to Parallel Sensorless Pump Control and should be deleted if not applicable

* + 1. Parallel pump staging will be provided without the use of BAS / BMS and speed / frequency based staging shall not be acceptable and a locally mounted logic controller shall be used for best efficiency staging of up to 4 parallel pumps.
		2. Parallel pump speed control shall be achieved without the need for differential pressure sensors either in the mechanical room or remotely installed in the system.
		3. The Parallel Sensorless Pump Control will have in-built redundancy features including:
			1. ‘Daisy-chained’ power connection to each pump controller
			2. Controller ‘offline’ operational protection preventing loss of system flow

ARMSTRONG GUIDE NOTE: The following refers to optional Energy Performance Bundle and should be deleted if not applicable. Provides energy savings on oversized systems by adjusting pump parameters to on-site conditions. Includes Auto-Flow Balancing and Maximum Flow Control functions. Open all valves and use the Auto-Flow Balancing function to tune the pump to on-site system conditions. Only available if sensorless control is enabled.

* + 1. Energy Performance Bundle: [Yes] [No]
			1. Auto-flow balancing - Automatically determines control curve between design flow at on-site system head, and minimum (zero-head) flow for energy savings
			2. Maximum flow control – Limits flow rate to pre-set maximum for potential energy savings

Maximum flow rate: [\_\_\_\_\_\_] [m3/h] [L/s]

ARMSTRONG GUIDE NOTE: The following refers to optional Protection Bundle and should be deleted if not applicable. Protects other flow sensitive equipment by setting limits of pump operation.

* + 1. Protection Bundle: [Yes] [No]
			1. Minimum flow control – Attempts to maintain flow rate to pre-set minimum to protect equipment in system

Minimum flow rate: [\_\_\_\_\_\_] [m3/h] [L/s]

* + - 1. Bypass valve control – Actuates a bypass valve to protect flow sensitive equipment if pre-set minimum flow rate is reached

ARMSTRONG GUIDE NOTE: The following refers to optional Zone Optimization Bundle and should be deleted if not applicable. Controls pumps to ensure multiple zones are satisfied for heating or cooling.

* + 1. Zone Optimization Bundle: [Yes] [No]
			1. 2 Sensor Control – Controls pumps in a 2-zone application to ensure both zones are always satisfied for heating or cooling

ARMSTRONG GUIDE NOTE: The following refers to optional Dual Season Setup and should be deleted if not applicable. Pre-sets heating and cooling parameters for pumps in 2-pipe systems.

* + 1. Dual Season Setup [Yes] [No]
			1. Cooling Design Flow: [\_\_\_\_\_\_] [m3/h] [L/s]
			2. Cooling Design Head: [\_\_\_\_\_\_] [m] [kPa] [bar] head
			3. Cooling minimum system pressure to be maintained: [\_\_\_\_\_\_] [m] [kPa] [bar] head
			4. Heating Design Flow: [\_\_\_\_\_\_] [m3/h] [L/s]
			5. Heating Design Head: [\_\_\_\_\_\_] [m] [kPa] [bar] head
			6. Heating minimum system pressure to be maintained: [\_\_\_\_\_\_] [m] [kPa] [bar] head
	1. PUMP MOTOR AND CONTROLS PROTECTION
		1. Include protection as follows:
			1. Motor phase to phase fault.
			2. Motor phase to ground fault.
			3. Loss of supply phase.
			4. Over voltage.
			5. Under voltage.
			6. Motor over temperature.
			7. Inverter overload.
			8. Over current
		2. Ensure controls run automatic motor adaptation (AMA) for superior motor protection and control.
		3. Ensure controls have automatic energy optimization (AEO) to maximize energy consumption reduction at part load operation
	2. FABRICATION
		1. Install integrated controls on each pump for use with BAS/BMS for energy logging.

ARMSTRONG GUIDE NOTE: Split-coupled [DE 4332] are supplied with flush lines. Split-coupled [DE 4332] seals are installed in isolated seal chambers and lubricated and cooled by a flush line piped in from the pump discharge. This allows for a clean-up of the flush fluid (See item 2.4.4.4). A vent is necessary on this design to eliminate air blockage of the flush line.

* + 1. Pre-program integrated intelligent controls for each pump before pump leaves factory.
			1. Install flush / vent line in factory.
				1. Ensure flush / vent line runs from seal chamber to [pump discharge].
			2. Mark pumps and controls with coordinated identification.
	1. ACCESSORIES
		1. Pipe Flanges: To DIN EN 1092-1, PN16.
		2. Hangers and Supports: in accordance with Section [23 05 29 – Hangers and Supports for HVAC Piping and Equipment].

ARMSTRONG GUIDE NOTE: Use the following paragraph only when vibration isolators or isolation pads are deemed absolutely necessary to meet unique project requirements. Armstrong Fluid Technology recommends piping system designs that do not require vibration or isolation pads for inline pumps.

* + 1. Suction Diffuser: For [DIN EN 1092-1, PN16 pipe flange and DIN EN 1092-1, PN16 pump flange] [grooved pipe and DIN EN 1092-1, PN16 pump flange] [DIN EN 1092-1, PN25 pipe flange and DIN EN 1092-1, PN25pump flange].

ARMSTRONG GUIDE NOTE: Specify SG for DIN PN16 Flange, SGG for Grooved Pipe and SGHH for DIN PN25 flange.

* + - 1. Acceptable Material: ARMSTRONG, [SG] [SGG] [SGHH].

ARMSTRONG GUIDE NOTE: For Tango pumps in variable flow applications, an external FTV combination / triple duty valve is not required. The Tango discharge valve has built-in isolation and check functionality; and the throttling function is not required when variable speed controls are available - except to keep pump on curve if oversized.

* + 1. Triple Duty Valve: [Cast iron] [Ductile iron] valve body, tight shut-off, spring -closure type silent non-slam check valve with effective throttling design capability.
			1. Valve stem: Stainless steel with flat surfaces for adjustment with open-end wrench.
			2. Acceptable Material: ARMSTRONG, Model FTV Flo-Trex Combination Valve.
		2. Pressure Gauges: 4½ inch diameter sized to meet system pressure requirements.
	1. PRODUCT SUBSTITUTIONS
		1. Substitutions: [In accordance with Section 01 23 13 - Product Substitution Procedures] [No substitutions permitted].
			1. Ensure materials and installation costs are supplied by single manufacturer.
1. EXECUTION
	1. INSTALLERS
		1. Use only installers with 2 years minimum experience in work similar to work of this Section.
	2. EXAMINATION
		1. Verification of Conditions: Verify that conditions of piping previously installed under other Sections or Contracts are acceptable for pump installation in accordance with manufacturer’s written recommendations.
			1. Visually inspect piping, piping configuration and piping location in presence of Consultant.
			2. Inform Consultant of unacceptable conditions immediately upon discovery.
			3. Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.
	3. **P**REPARATION
		1. Weld pipe flanges to piping system for installation of pump.
			1. Ensure suction and discharge pipe flanges are aligned and square to pipe.
	4. INSTALLATION

ARMSTRONG GUIDE NOTE: View DE 4332 installation and operating instructions (I&O) at:

http://armstrongfluidtechnology.com/en/resources-and-tools/installation-and-maintenance-and-parts/installation-and-operating-instructions

* + 1. Install pumps level in accordance with pump manufacturer’s written recommendations
		2. Ensure that pump is pipe-mounted and free to float with any movement, expansion and contraction of piping system.
			1. Support pump using floor mounted saddle as required.
			2. For vertical in-line pumps supported from structure, ensure no pipe strain is imposed on pump flanges.
		3. Install Flo-Trex valve [At [90Deg – Discharge up only] [180Deg - Straight] after recommended length (2D min) of spool piece on discharge connection from pump] [vertically-up after long radius elbow off pump discharge valve]
		4. Install suction guides on pump suction connection.
		5. Install pressure gauges on suction and discharge pump connections.
		6. Install hangers and supports.
			1. Adjust hangers and supports after pump is installed to ensure proper support.
		7. Align pipe flanges with pump flanges and bolt together in accordance with pump manufacturer’s written recommendations.

ARMSTRONG GUIDE NOTE: A sensor is not acceptable in the mechanical room. The costs and labor for wiring to the most remote load and the sensor itself should be incorporated. If the controls are not integrated to the pumping unit, additional wiring material and wiring installation will be required.

* + 1. Connect pumps and integrated control system to electrical distribution system to IEEE regulations and with authority having jurisdiction.

ARMSTRONG GUIDE NOTE: Use the following paragraph when a sensor at the most remote load condition is to be used.

* + - 1. Include wiring to most remote sensor in system where applicable.
				1. Do not run pumps dry to check rotation.
	1. FIELD QUALITY CONTROL
		1. Field Inspection: Coordinate field inspection.

ARMSTRONG GUIDE NOTE: Specify requirements if manufacturers are to provide field quality control with onsite personnel for instruction or supervision of product installation, application, erection or construction. Manufacturer field reports are included under PART 1, Action and Informational Submittals.

* + 1. Manufacturer’s Services:

ARMSTRONG GUIDE NOTE: Use the following Paragraphs only when manufacturer’s field services are provided and are required to verify the quality of the installed components. Establish the number and duration of periodic site visits required by manufacturer and specify below. Consult manufacturer for services required. Delete if field services are not required.

* + - 1. Coordinate manufacturer’s services.
				1. Have manufacturer review work involved in handling, installation, protection, and cleaning of hydronic pumps and components, and submit written reports in acceptable format to verify compliance of Work with Contract conditions.
			2. Manufacturer’s Field Services: Provide manufacturer’s field services consisting of product use recommendations and periodic site visits for product installation review in accordance with manufacturer’s instructions.
				1. Report any inconsistencies from manufacturer’s recommendations immediately to Consultant.
			3. Schedule site visits to review work at stages listed:
				1. After delivery and storage of pumps, controls and components, and when preparatory work on which Work of this Section depends is complete, but before installation begins.
				2. Upon completion of Work, after cleaning is carried out.
				3. Obtain reports within three days of review and submit immediately to Consultant.
	1. COMMISSIONING
		1. Validate alignment, rotation, motor current draw, flows and pressures.

ARMSTRONG GUIDE NOTE: The following refers to optional On-site commissioning and should be deleted if not applicable. An Armstrong Representative shall assist in setting up pump communication to the BAS (does not include physical wiring), adjust the pump parameters to on-site conditions, and perform warranty registration of pumps. The Armstrong Representative shall set up the router and connection of multiple pumps to the network and internet.

* + 1. On-site commissioning of Design Envelope Pumps and Pump Manager [Yes] [No]
	1. CLEANING
		1. Progress Cleaning: Perform cleanup as work progresses.
			1. Leave work area clean end of each day.
		2. Final leaning: Upon completion, remove surplus materials, rubbish, tools, and equipment.
		3. Waste Management:
			1. Co-ordinate recycling of waste materials.
			2. Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section.
			3. Remove recycling containers and bins from site and dispose of materials at appropriate facility.
	2. PROTECTION
		1. Protect installed products and components from damage during construction.
		2. Repair damage to adjacent materials caused by hydronic pump installation.

ARMSTRONG GUIDE NOTE: The following refers to Pump Manager. A performance management service (under the industry category of automated fault detection and diagnostics) to remotely and automatically track and help manage pump performance with analytic and diagnostic Alerts, web assessible trends and automated reports available to the building end user/owner. Pump Manager helps sustain optimal performance and efficiency, minimize unexpected failures and provide predictable maintenance costs. An option for a discount on Extended Warranty for the corresponding pumps is available with a Pump Manager subscription.

* + 1. Pump Manager [building owners are to go to
		<http://armstrongfluidtechnology.com/registration> to activate].

**END OF SECTION – HYDRONIC PUMPS**