**Design Envelope 4302 & 4382**

File No: 100.193EU

Date: August 30, 2017

Supersedes: 100.193EU

Date: October 07, 2015

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

A. This Section specifies single stage, [single] [double] suction type, [split coupled] [close coupled] 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. 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. ASTM International (ASTM).
			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. DIN EN 61800-3-[2004], Adjustable Speed Electrical Power Drive Systems - Part 3: EMC Requirements and Specific Test Methods.
			2. IEEE 519-[1992], Recommended Practices and Requirements for Harmonic Control In Electrical Power Systems.
		7. International Electro-technical 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.
			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 and control enclosure dimensions on shop drawings.
			2. Include control system wiring diagrams.
		3. Test Reports: Submit test reports showing compliance with specified performance characteristics and physical properties including structural performance (hydrostatic test).
		4. Field Reports: Submit manufacturer’s field reports within 3 days of each manufacturer representative’s site visit and inspection.
	2. 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.
	3. 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 material and components in manufacturer’s original packaging with identification labels intact and in sizes and packaging to suit project.
			2. 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.
			3. Do not place cable slings around pump shaft or integrated control enclosure and avoid contact with flush lines and any optional filters. IOM manual instructions to be followed.
		3. 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 and motor getting overheated, the ambient temperature is not to exceed 45°C when installed at sea level. Operating in higher ambient temperatures will require de-rating of the controls unit and motor. Verify maximum temperatures with manufacturer for elevations other than sea level.

* + 1. Ambient Temperature: 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.

* + 1. Warranty period for DE pumps: 3 years EXW
1. **PRODUCTS**

ARMSTRONG GUIDE NOTE: Included in this section are specification items for [2] similar pump types in that they are both dualARM units, which allows [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 4302 series describes a split-coupled shaft design which allows mechanical seals to be removed without disturbing the pump, motor or controls. (Recommended for above 5.5kW motors) The 4382 series contain close-coupled pumps where the mechanical seal can be serviced without disturbing the in-line casing (Recommended for 5.5kW and smaller 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, dualARM 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 be one size larger than the single size pump size, so that both units may operate in parallel for double single pump flow rate with no loss of single pump efficiency
			2. Each ¼ inch 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] [close-coupled] serviceable without disturbing [motor, controls or piping connections] [piping connections].
			4. Include ¼ inch casing drain plug at the lowest point in the casing
		2. Acceptable Material: ARMSTRONG, [Design Envelope 4302] [Design Envelope 4382]
	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 (Note that constant flow applications can also be served by the intelligent control (Sensorless) or IPS control panel / BMS control.

* + - 1. Select hydraulic design conditions and minimum maintained 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] [proportional pressure] [not enabled to allow BMS or IPS control panel operation].
		1. Pump Operating Conditions:
			1. Pump head: [\_\_\_\_\_\_] minimum [\_\_\_\_\_\_] maximum.
			2. Pump capacity (flow): [\_\_\_\_\_\_] minimum [\_\_\_\_\_\_] maximum.

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

ARMSTRONG GUIDE NOTE: Use 25 bar at ≤37°C and 19 bar at 148°C for DIN PN25 flanged piping systems. 25 Bar at 37°C for lower temperatures and 19 Bar at 148°C maximum for fluid temperatures higher than 37°C

* 1. Materials

ARMSTRONG GUIDE NOTE: Use Cast iron casing for PN160 flanged piping systems and ductile iron casing for PN25 flanged piping systems.

* + 1. Casing: Cast iron to ASTM A48 equivalent to BS1452 Grade 220 or ductile iron ASTM A536 equivalent to BS 2789400/17.
			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.
		2. Impellers: To ASTM B584 (equivalent to BS1400 LG2C), bronze, fully enclosed and dynamically balanced to standard ISO 1940-1and fitted to shafts with keys. Use two-plane balancing when installed impeller diameter is less than 6 times impeller width.
		3. Pump Shafts:
			1. [4302] Split-coupled: Stainless steel to ASTM A582/A582M, Grade 416 (equivalent to BS970 416).
			2. [4382] Close-coupled: Steel motor shaft with Shaft Sleeve: Stainless steel to ASTM A276, Type 316 (equivalent to BS970 316).

ARMSTRONG GUIDE NOTE: Use the following paragraph for DE 4302 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 4302 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; DIN PN25 is suitable to 25 bar.

* + 1. Flanges: To ANSI/ASME B16.5, Class [125] [250].
		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 4302 and close coupled seal options for DE 4382.

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®]

ARMSTRONG GUIDE NOTE: For close coupled pumps specify Type 2A single spring inside seals with Sintered Silicon Carbide stationary seats

ARMSTRONG GUIDE NOTE: Specify 2A type seal with resin bonded carbon rotating face for potable and general non-potable water systems up to 93°C. Specify 2A type seal with Antimony loaded carbon rotating face for non-potable systems with a temperature >93°C to 121°C. For low or high temperature applications for all glycols above 30% concentration by weight and / or abrasives above 2000ppm specify 2A type seal with Sintered Silicon Carbide rotating face

* + 1. Mechanical Seal: [Potable] [Non-potable], Type 2A inside single spring seal design and rated to [93°C] [121°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: EPDM
	1. Motor
		1. IE3 Motor: To IEC/ IEC 60034-30-1
			1. Power: [\_\_\_\_\_\_] KW.
			2. Enclosure: TEFC.
			3. Efficiency: IE3 efficiency To IEC/ IEC 60034-30-1, MEPS levels table.
			4. Power supply: [380 -480] V, [50] 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. Specify ‘less weather shield’ if appropriate for locations outdoor though installed under cover

* + 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 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 (non‑linear) 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

For pumps power range up to 7.5kW the standard drive integrated is the FCM300. This drive is compact and doesn’t require any particular orientation.

For pumps power range above 7.5kW or requiring a different BMS communication than MODBUS RTU, the IVS102 drives are integrated. The default for orientation is typically L1 with controls mounted NE at discharge flange on plan view. If not convenient for other equipment, motor and controls may be rotated and mounted at 90-degree increments CW for L2, L3 and L4 being NW of discharge on plan view.

* + - 1. Orientation: [L1] [L2] [L3] [L4].

For Armstrong pumps up to 7.5kW the standard controls support Modbus RTU, for Armstrong pumps above 7.5kW A pump controls support Modbus RTU, BACnet™ MS/TP, Johnson® Metasys N2, and Siemens® FLN P1 as standard protocols. LonWorks® protocol and Modbus TCP are available as an option. Contact Armstrong Fluid Technology at for further information.

* + - 1. Protocol: [Modbus RTU] [BACnet™ MS/TP] [Johnson® N2] [Siemens® FLN] [LonWorks®]
			2. Sensorless override for BAS/BMS control signal.
			3. [Manual pump control] [Closed loop PID control]
			4. Enclosure: IP66
			5. EMI/RFI Control: Integrated filter designed to DIN EN61800-3.

ARMSTRONG GUIDE NOTE: The IVS 102 intelligent variable speed drive has built-in DC line reactors. This does not guarantee performance to any system wide harmonic specification or the costs to meet a system wide specification.

* + - 1. Harmonic mitigation: Dual DC-link reactors (Equivalent: 5% impedance AC line reactor) to mitigate harmonics to support IEEE 519-2014 system requirements.
				1. Programmable skip frequencies (bypass) and adjustable switching frequency for reduction of audible noise and vibration control.
				2. Cooling: For FCM 300 drives the heat is dissipated through in-built heat sink, for IVS102 drive it is fan cooled through back panel.
				3. Ambient working conditions: [-10°C to +45°C], up to 1000m above sea level.
			2. Drives I/O and serial ports
				1. FCM 300

One analogue input current, one analogue input voltage

Three digital input (one selectable as pulse input)

One 24V DC supply for DI and one 10V DC supply for potentiometer

One analogue output current (selectable as digital output)

One relay output

One communication port 1- RS485

* + - * 1. IVS102

Analog I/O: 2 Current or voltage inputs, 1 current output minimum

Digital I/O: 6 programmable inputs minimum with 2 minimum programmable as outputs and 2 minimum programmable as Pulse inputs.

Relay outputs: 2 programmable minimum.

Communications ports: one- RS485, one- USB minimum.

One 10V supply output.

Two 24V Supply output.

* + 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 setpoints 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 & head values.
		2. 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. Note that DE 4302 & DE 4382 double pump units may be operated in 100% duty / standby or 2\*50% or 60% parallel operation

* + 1. Parallel pump staging will be provided without the use of BAS / BMS. Min / max speed / frequency based staging shall not be acceptable and a locally mounted logic controller shall be used for best efficiency staging
		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 Controller will have in-built redundancy features including:
			1. ‘Daisy-chained’ control card power connection to each pump controller.
			2. Controller ‘offline’ operational protection preventing loss of system flow
	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 (AMA) automatic motor adaptation for superior motor protection and control.
	2. Fabrication

ARMSTRONG GUIDE NOTE: Split-coupled [DE 4302] and close-coupled [DE 4382] are supplied with flush lines. DE 4302 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. Close-coupled [DE 4382] seal flush line evacuates air from the seal area automatically, by being piped to the (Lower pressure) suction area

* + 1. Pre-program integrated intelligent controls for each pump before pump leaves factory.
			1. Install flush / vent line in factory.
			2. Ensure flush / vent line runs from seal chamber to [pump discharge] [pump suction].
			3. Mark pumps and controls with co-ordinated identification.
	1. Accessories
		1. Pipe Flanges: To DIN EN 1092-1, PN16 and PN25
		2. Hangers and Supports: 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. Vibration isolators, neoprene isolation pads.
		2. 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: Armstrong recommends using FTV combination / triple duty valves for variable flow applications. There are instances where the pump may operate off-the- curve. Varying the speed does not bring the duty point back on the pump curve. In these cases, throttling is required. Use the Flo-Trex valve generally only with constant speed pump applications. Specify cast iron for DIN PN16 pipe flanges and ductile iron for DIN PN25 pipe flanges.

* + 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: Four ½ inch diameter sized to meet system pressure requirements.
	1. Product substitutions
		1. Substitutions: 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. Preparation
		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 4302 & DE 4382 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. Where pumps are supported entirely by piping system ensure hangers are sized for extra load of pump weight.
		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 for HVAC Piping and Equipment.
			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 labour 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 according to authority having jurisdiction in the country.

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 with client personnel.

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 for Quality Control.
				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.
	2. **Cleaning**

ARMSTRONG GUIDE NOTE: For smaller projects that do not have a separate Section for cleaning, delete the reference to Cleaning in the following two Paragraphs.

* + 1. Progress Cleaning: Perform cleanup as work progresses.
			1. Leave work area clean end of each day.
		2. Final cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment.
		3. Waste Management:
			1. Co-ordinate recycling of waste materials with Construction Waste Management and Disposal.
			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.
	1. Protection
		1. Protect installed products and components from damage during construction.
		2. Repair damage to adjacent materials caused by hydronic pump installation.

END OF SECTION 23 21 23 – Hydronic pumps