

Watson-Marlow 730 Series Variable Speed Peristaltic Pump

Part 1 - General

1.01 Description

- A. Pumps shall be positive displacement peristaltic type complete with spring-loaded pumphead, self-contained variable speed drive, and flexible extruded tube element, and fittings as specified.
- B. Peristaltic pumping action is created by the compression of the flexible tube between the pumphead rollers and track, induced forward fluid displacement within the tube by the rotation of the pump rotor, and subsequent vacuum-creating restitution of the tube.
- C. Pumps shall be dry self-priming, capable of being run dry without damaging effects to pump or tube, and shall have a maximum suction lift capability of up to 30' vertical water column. Maximum pressure rating: 30 psi.
- D. Pump shall not use check valves or diaphragms and shall not require dynamic seals in contact with the pumped fluid. Process fluid shall be contained within pump tubing and shall not directly contact any rotary or metallic components.
- E. Flow shall be in the direction of the rotor rotation, which can be reversed and shall be proportional to rotor speed.

1.02 Quality Assurance

- A. This specification is the basis for design of peristaltic metering pumps. All pumps, whether named as an acceptable supplier, or submitted as an equal must, at a minimum, meet the following critical design requirements.
 - 1. Maximum four compressing rollers for four compressions per revolution.
 - 2. Tube wall thickness of 4.8 mm and material specified
 - 3. Large diameter roller set for 4.8 mm wall thickness tubing with sprung track assembly
 - 4. Max base drive speed of 360 RPM for 4.8mm wall thickness tubing.
 - 5. Track geometry providing a straight through flow-path and rotor geometry with rollers 90 degrees apart.
 - 6. For quality assurance, all pump tubing must be manufactured by the pump manufacturer in accordance with their specifications. Tubing not manufactured by the pump manufacturer will not be acceptable.
 - 7. For chemical compatibility with a broad spectrum of chemicals, the pump housing shall have powder coating per 2.03.C.5.
 - 8. Pumps to be manufacturer's standard product. Manufacturer of tubing pumps must have at least 20 operating installations in domestic water or wastewater treatment plants located in the United States over a period of at least five years in the same service and size as specified.
 - 9. Drive and pump heads shall be 24 hr continuous duty rated and have a five-year manufacturer's warranty from date of shipment.
 - 10. Pumps must be manufactured under ISO 9001-2015.
 - 11. Pumps shall meet all applicable CE and C ETL US standards per UL61010-1:2010 and the tubing must be NSF61 approved for the chemicals being pumped.
 - 12. Pumps shall be 100 % integral in design with the pumphead, motor, controls, and pump case being manufactured by the pump manufacturer themselves. All controls, motors, and gear reduction shall be housed in a single chemically resistant pump case. Pumps that require separate base plates, external gear reducers and /or gear motors, and separate controls— even if mounted on a base plate and pre-wired to the motor—are not acceptable.

1.03 Submittals

A. Submit the following

1. Certified shop drawings.
2. Characteristic performance curve showing flow rate as a function of RPM and pressure.
3. Dimensional drawings.
4. Operating, maintenance, programming, and wiring instructions

1.04 Delivery, Storage, & Handling

A. Shipping

1. Ship pump and drive assembled complete. Ship tubing separately for field installation and process line connection by contractor.
2. Pack all additional spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.
3. Deliver spare parts at the same time as pertaining equipment. Deliver to Owner after completion of work.

B. Receiving

1. Contractor to inspect and inventory items upon delivery to site.
2. Contractor to store and safeguard equipment, material, instructions, and spare parts in accordance with manufacturer's written instructions.

Part 2 - Pump Design

2.01 Manufacturers

A. Watson-Marlow, Inc.

2.02 Pump Process Schedule

Quantity	*(Engineer to specify)*			
Tag Number(s)	*(Engineer to specify)*			
Fluid	*(Engineer to specify)*			
Viscosity				
Specific Gravity				
Fluid Temperature				
Tubing Material	Marpren II *(Alternate material available upon request)*			
Max – Min Capacity (GPM)	*(Engineer to specify)*			
Max Pump RPM for Application	*(Engineer to specify)*			
Tubing ID *(Engineer to specify)*	12.7mm	15.9mm	19.0mm	25.4mm
Displacement/Revolution (Gallons)	0.009	0.013	0.018	0.024
Min Flow Rate (GPM)	0.0009	0.0013	0.0018	0.0024
Max Flow Rate (GPM)	3.4	4.8	6.6	8.8
Fittings	Integral 3/4" Male Cam & Groove Fittings, polypropylene (1" on the 25.4mm Element)			
Max Discharge Pressure (PSI)	*(Engineer to specify)*			
Suction Head	*(Engineer to specify)*			
Power (VAC, Frequency, Phase)	115VAC, 60 Hz, 1 Phase			

2.03 Pump Construction

A. Pumphead

1. Pumphead shall consist of a spring-loaded track/pumphead cover with cover switch, element type tube retainer mechanism, and gear driven roller rotor assembly. The magnetic cover switch shall render the drive inoperable when the pump cover is open. For operator safety, pumpheads without a cover switch and/or non-spring loaded track assemblies will not be acceptable.
2. Rotor assembly shall be equipped with four geared self lubricating compression rollers driven by a 4:1 reduction planetary gear reducer. Compression rollers shall be located 90° apart for compression of the tube against the track four times per revolution. One roller shall at all times be fully engaged with the tubing providing complete compression to prevent backflow or siphoning. Hose occlusion shall be adjustable by the adjustment of two hex head nuts with springs to set the force with which the cover compresses the tubing. Hex nuts shall be fitted with setscrews to limit compression and shall come factory set to accommodate 4.8mm wall thickness tubing. To maximize pump efficiency, pumpheads without geared rollers and/or driven by non-planetary gearing will not be acceptable.
3. The rotor assembly shall be mounted on roller bearings to a drive shaft supported between roller bearings mounted in the pump housing. The assembly will engage the drive shaft by means of gear, which shall directly drive each roller independently.
4. Material of Construction
 - a. Track: Aluminum coated with Alocrom pre-treatment and exterior grade polyester powder coat
 - b. Rotor: Aluminum coated with Alocrom pre-treatment and exterior grade polyester powder coat with Nylatron Rollers
 - c. Springs, Spindles & Hardware: Stainless Steel
 - d. Bearings: Stainless Steel

B. Tubing

1. Pumps shall be supplied with a LoadSure tubing element with molded fittings, which shall be self-locating when fitted into the pumphead. Tube element shall be in contact with the inside diameter of the track (housing) through an angle of 90 degrees and be held in place on the suction and discharge by the element fittings. The tubing elements shall be replaceable with no disassembly of the pumphead and without the use of tools.
2. Pump tubing shall be constructed of Marprene II, a thermoplastic elastomer with a 64 Shore A durometer and 4.8mm wall thickness. Pump manufacturer must manufacture Marprene tubing in-house. Pump manufacturers who purchase third party tubing are not acceptable.
3. Tubing must meet NSF61 for the chemical being pumped.
4. Pump shall readily accept tubing elements with ID's of 12.7mm, 15.9mm, 19.0mm, or 25.4mm without pump adjustment or replacement. Tubing with a wall thickness less than 4.8mm is not acceptable. See 1.02.
5. Molded Fittings: Polypropylene, 3/4" (1" on the 25.4mm element) male cam & groove
6. Supply One (1) tube element of the specified size per pump.
7. Supply Two (2) one-meter long flexible reinforced PVC hoses for connection of pump to suction and discharge process lines. Flexible hose shall have a Polypropylene female cam & groove fitting for mounting to pump and male cam and groove fitting for mounting to process

8. Supply Two (2) female cam & groove to male NPT adaptors.

C. Drive

1. Rating: Continuous 24 hour operation, 40° C ambient.
2. Supply: 110-120V 50/60 Hz and 220-240V 50/60 Hz, 1-Phase field switch able.
Supply nine-foot length mains power cord with standard 115V three-prong plug.
3. Max drive power consumption: 350VA.
4. Enclosure: NEMA 4X
5. Housing: Pressure cast aluminum with Alocrom pre-treatment and exterior grade corrosion resistant polyester powder coat. By nature of the environmental conditions, unpainted housings, including 316SS, are not acceptable.
6. Drive motor- brushless DC motor with integral gearbox and tachometer feedback.
 - a. Speed Control Range of 3600:1 from 0.1 to 360 rpm +/- 0.1 rpm throughout the range.
 - b. Closed loop microprocessor controlled drive with pulse width modulation at speeds above 50 rpm and synchronous mode with magnetic field rotation control below 50 rpm
7. Leak Detector: Pump manufacturer shall supply optical-style leak sensor for leak detection and pump shut down in the event of a tubing failure
8. Mounting: Drive shall be self-supporting and shall not require anchoring.
9. Chemical Resistant Metering Pump Shelf (Optional)
 - a. Material of Construction: HDPE.
 - b. Mounting Hardware & Installation to be supplied by the Contractor

D. Manual Interface & Control

For Applications requiring Analog Process Control Engineer to specify per below:

1. Pumps must meet the following minimum requirements for operator interface functionality. Pumps not meeting this minimum functionality will not be accepted.
 - a. Display: Backlit graphical TFT Display capable of up to 8 lines of text with up to 26 characters per line to display flow rate and programming instructions. Display shall also provide visual indication of running status via screen color: Grey = Running, White = Stopped and Red = Warning.
 - b. Keypad for start, stop, speed increment, speed decrement, forward/reverse direction, rapid prime, and programming.
 - c. Flow units: Programmable in following units: µl/min, ml/min, ml/hr, l/min, l/hr, l/day, gallons/hr, gallons/day, g/min, kg/hr, or lb/day.
 - d. Security: Programmable keypad lock and PIN security for optional lockout of all keys except emergency stop.
 - e. Auto Restart: feature to resume pump status in the event of power outage interruption.
 - f. Multilingual menu: include programming menus in eleven languages, including at a minimum English, Spanish, and French.
 - g. Programmable "Maximum Speed" to allow operator to set the maximum speed of the pump within 0.1-360 rpm
2. Supply auto control features to meet the following minimum functionality requirements. Pumps not meeting this minimum functionality will not be accepted.
 - a. Remote Control Inputs
 1. Speed Control:
 - a) Primary Analog 4-20mA or 0-10VDC speed input, with input signal trim able and speed scaleable over any part of the drive speed range.

- b) Provisions for alternative remote accessory potentiometer (if supplied by others)
- 2. Start/Stop Control: via 5V TTL, 24V industrial logic, dry contact, or powered 110VAC contact as required per the process and instrumentation drawings- Configurable command sense allowing open to equal run or open to equal stopped.
- 3. Forward/Reverse Control: via 5V TTL, 24V industrial logic, dry contact, or powered 110VAC contact as required per the process and instrumentation drawings.
- 4. Auto/Man Mode Control: via 5V TTL, 24V industrial logic, dry contact, or powered 110VAC contact as required per the process and instrumentation drawings.
- 5. Leak Detector Run/Stop Control
- b. Status Outputs
 - 1. Four relay contacts rated for 30 VDC with a maximum load of 30W, NO or NC or four relay contacts rated for 130VAC as required by the process and instrumentation drawings software configurable to indicate the following:
 - a) Running/Stopped status
 - b) Forward/Reverse status
 - c) Auto/Manual status
 - d) General Alarm status
 - e) Leak Detected status
 - 2. Speed output –
 - a. Analog 4-20mA or 0-10 VDC
- c. Termination: supply screw down terminals suitable for up to 18 AWG field wire and accessible through four glanded cable entry points on the pump

For Applications requiring Profibus Process Control Engineer to specify per below:

- 1. Pumps must meet the following minimum requirements for operator interface functionality. Pumps not meeting this minimum functionality will not be accepted.
 - a. Display: Backlit graphical TFT Display capable of up to 8 lines of text with up to 26 characters per line to display flow rate and programming instructions. Display shall also provide visual indication of running status via screen color: Grey = Running, White = Stopped and Red = Warning.
 - b. Keypad: Keypad for start, stop, speed increment, speed decrement, forward/reverse direction, rapid prime, and programming.
 - c. Flow units: Programmable in following units: $\mu\text{l}/\text{min}$, ml/min , ml/hr , l/min , l/hr , l/day , $\text{gallons}/\text{hr}$, $\text{gallons}/\text{day}$, g/min , kg/hr , or lb/day .
 - d. Security: Programmable keypad lock and PIN security for optional lockout of all keys except emergency stop.
 - e. Auto Restart: feature to resume pump status in the event of power outage interruption.
 - f. Multilingual menu: include programming menus in eleven languages, including at a minimum English, Spanish, and French.
 - g. Programmable “Maximum Speed” to allow operator to set the maximum speed of the pump within 0.1-360 rpm

2. Pumps must be capable of two-way digital communication over a PROFIBUS DP network with bus communication speeds from 9.6 to 12,000 kbits/s and meet the following minimum functionality requirements. All control signal features must be located internally to the pump. Pumps not meeting this minimum functionality or that require additional external control boxes with gateways are not acceptable.
 - a. Control Inputs
 1. Speed Control, Start/Stop, Direction of Rotation and Flow Calibration all configurable via digital command
 2. Leak Detector Run/Stop Control: via dry contact from float style leak detector
 - b. Control Feedback
 1. Measured Speed, Running Status, PROFIBUS Control Enabled status, Leak Detected Status, and Current Calibration Information being utilized by the pump
 - c. Extended Diagnostic Feedback
 1. Continuous monitoring and feedback of the following:
 - a) General Error
 - b) Motor Stalled
 - c) Over Current
 - d) Under Voltage
 - e) Over Voltage
 - f) Overload
 - g) Over Temperature
 - h) Speed Error
 - i) Signal Out of Range
 - j) Over Signal
 - k) Tacho Fault
 - l) Leak Detect

For Applications requiring Ethernet Control, Engineer to specify per below:

1. Pumps must meet the following minimum requirements for operator interface functionality. Pumps not meeting this minimum functionality will not be accepted.
 - a. Display: Backlit graphical TFT Display capable of up to 8 lines of text with up to 26 characters per line to display flow rate and programming instructions. Display shall also provide visual indication of running status via screen color: Grey = Running, White = Stopped and Red = Warning.
 - b. Keypad: Keypad for start, stop, speed increment, speed decrement, forward/reverse direction, rapid prime, and programming.
 - c. Flow units: Programmable in following units: $\mu\text{l}/\text{min}$, ml/min , ml/hr , l/min , l/hr , l/day , gallons/hr, gallons/day, g/min , kg/hr , or lb/day .
 - d. Security: Programmable keypad lock and PIN security for optional lockout of all keys except emergency stop.
 - e. Auto Restart: feature to resume pump status in the event of power outage interruption.
 - f. Multilingual menu: include programming menus in eleven languages, including at a minimum English, Spanish, and French.
 - g. Programmable "Maximum Speed" to allow operator to set the maximum speed of the pump within 0.1-265 rpm

2. Pumps must be capable of two-way digital communication over an Ethernet/IP network with baud rate of 10/100 mbps full/half duplex operation and meet the following minimum functionality requirements. All control signal features must be located internally to the pump. Pumps not meeting this minimum functionality or that require additional external control boxes with gateways are not acceptable.
 - a. Control Inputs
 1. Speed Control, Start/Stop, Direction of Rotation and Flow Calibration all configurable via digital command
 2. Leak Detector Run/Stop Control: via dry contact from leak detector
 3. Remote Pressure/Flow Sensor: via analog 4-20 mA signal
 - b. Control Feedback
 1. Measured Speed, Running Status, Ethernet Control Enabled status, Leak Detected Status, Flow Totalizer, Remote Pressure, Remote Flow and Current Calibration Information being utilized by the pump
 - c. Extended Diagnostic Feedback
 1. Continuous monitoring and feedback of the following:
 - a) General Error
 - b) Motor Stalled
 - c) Over Current
 - d) Under Voltage
 - e) Over Voltage
 - f) Overload
 - g) Over Temperature
 - h) Speed Error
 - i) Signal Out of Range
 - j) Over Signal
 - k) Tacho Fault
 - l) Leak Detect

E. Spares

1. Supply four spare tube elements of the specified size per pump.
2. Supply one spare pumphead assembly and rotor.
 - **For regular preventative maintenance and normal corrective maintenance, only tube elements need be stocked and are supplied with the pump in sufficient quantity for this purpose. For additional corrective maintenance, it is advisable to have a spare pumphead stocked.)**

Part 3 – Execution

3.01 Installation (By Contractor)

- A. Contractor shall install items in accordance with manufacturer's printed instructions and as indicated and specified.
- B. Contractor to supply fittings for connection of pump to process.