Positive Displacement Flowmeters

Operational Manual

For Model:
Model 243 Only

240 Helical Series

Positive Displacement Flow Meters

Max Machinery, Inc. **Discontued:** 243 Manual

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Custom Instructions for Hazardous Locations/Explosion Proof Housing:
http://www.maxmachinery.com/content/explosion-proof-installation-instructions

DO NOT ATTEMPT TO INSTALL OR START FLOW METER WITHOUT READING THIS ENTIRE MANUAL

Max Machinery, Inc. (MMI) reserves the right to make changes to the product in this Instruction Manual to improve performance, reliability, or manufacturability. Consequently, contact MMI for the latest available specifications and performance data. Although every effort has been made to ensure accuracy of the information contained in this Instruction Manual, MMI assumes no responsibility for inadvertent errors.

Meter General Description

The Max 240 Series Flow Meters are positive displacement helical rotor type units capable of precise measurements over a wide range of flow rates and fluid viscosities.

The three sizes of this series (241, 242, and 243) will measure flows from 0.1 L/min to 1400 L/min. Material viscosities between 3 and 1,000,000 centipoise may be accommodated.

In a helical rotor type flow meter, a precise amount of the fluid being measured is trapped between the rotors as they turn. This motion is used to turn a gear coupled to a magnet. An external transmitter senses the motion of the magnet and converts this signal into a voltage, pulse or 4-20 mA current flow rate output. For some transmitter models, the magnet is eliminated and the motion of the gear itself is sensed.

The Max Series 240 Meters are of simple and rugged construction. They can be expected to perform superbly if treated within the confines of the design envelope. For this reason, it is important to read this manual and understand the operational requirements and limits of the meter.

Our Technical Service staff will be happy to answer any questions that this manual does not cover.

Meter Specifications

Model	**243**
[1] **Maximum flow rate,**	
Gal/min	370
Liters/min	1400
Maximum pressure, bar (psi)	
Standard NPT	35, (500)
600 lb ANSI RF flanges	105 (1500)
1500 lb ANSI RF flanges	245 (3500)
2500 lb ANSI RF flanges	---
Pressure drop, bar (PSI)	
Operating maximum	5.3 (75)
Absolute maximum	10 (150)
100% flow, 3 CPS	0.7 (10)
[2] **Maximum temperature**	Up to 265° C (500° F)
[3] **Recommended filtration**	150 micron
Displacement, L/Rev	0.574
Weight, Kg (Lb)	45.5 (100)
[4] **Typical K-Factor, (pulses/liter)**	
295 Transmitter	1500
289-700 Transmitter	58.8
Port size	
NPT	3"
ANSI RF flanges	4" (DN100)

Notes:

[1] For viscosities of 3 CPS or less. Derate per pressure drop curves for higher viscosites.
[2] Limited by meter seal material, transmitter model, orientation and ambient temp. See manual. Consult factory.
[3] Some materials may have different filter requirements. Consult factory
[4] Typical. See flow meter/transmitter calibration sheet for actual K-factor and accuracy data.

Dos and Don'ts

DO:	DON'T:
• Install a bypass line around the meter • Clean the filter on a regular basis • Purge air from the meter before operating your system (Flowing near the meters maximum flow rate for a given viscosity will purge air bubbles. Tilting, tapping or shaking the meter at lower flow rates will also dislodge entrapped air)	• Run water or aqueous solutions through the meter (except the 234 Series of meters) • Put steam or compressed air through the meter. • Disassemble the meter • Apply excessive differential pressure across the meter • Exceed the maximum flow rates or pressure ratings for your meter • Let materials solidify in the meter • Try to pump through the meter if it contains frozen material. Re-melt the material completely before trying to pump through the flow meter.

Transmitter Specifications - Analog

Supply Voltage	12 Vdc (Models 29X-XXX-100) 24 Vdc (Models 29X-XXX-000)
Supply Current Short Circuit Current	90 mA max@ 12 Vdc, 45 mA max@ 24 Vdc 21 mA
[1] Output Update Rate Resolution	1 ms Adjustable without recalibration to any range of ± 10 Vdc
	Model 29X-3XX-XXX or ± 20 mA Model 29X-2XX-XXX
Ambient Temperature Range	Transmitter (Storage)-40ºC to 85ºC (-40ºF to 185ºF) [2] Transmitter (Operation)-40ºC to 80ºC (-40ºF to 175ºF)
Maximum Temperature, Process Fluid For explosion proof models see: http://www.maxmachinery.com/content/explosion-proof-installation-instructions (20ºC Ambient, 5V supply)	Standard Model 90ºC (195ºF) - Models 295 & 296 High Temp Model - Model 296 Ultra-High Temp Model 225ºC (435ºF) - Models 295 & 296
Anti-dither Range	Software selectable from 1-100% of 1 revolution. 50% of a meter revolution - unidirectional 2% bidirectional are typical default settings
Signal Filtering	Software selectable from 1 ms to 64 sec. time constant

[1] Full step change is subject to signal damping

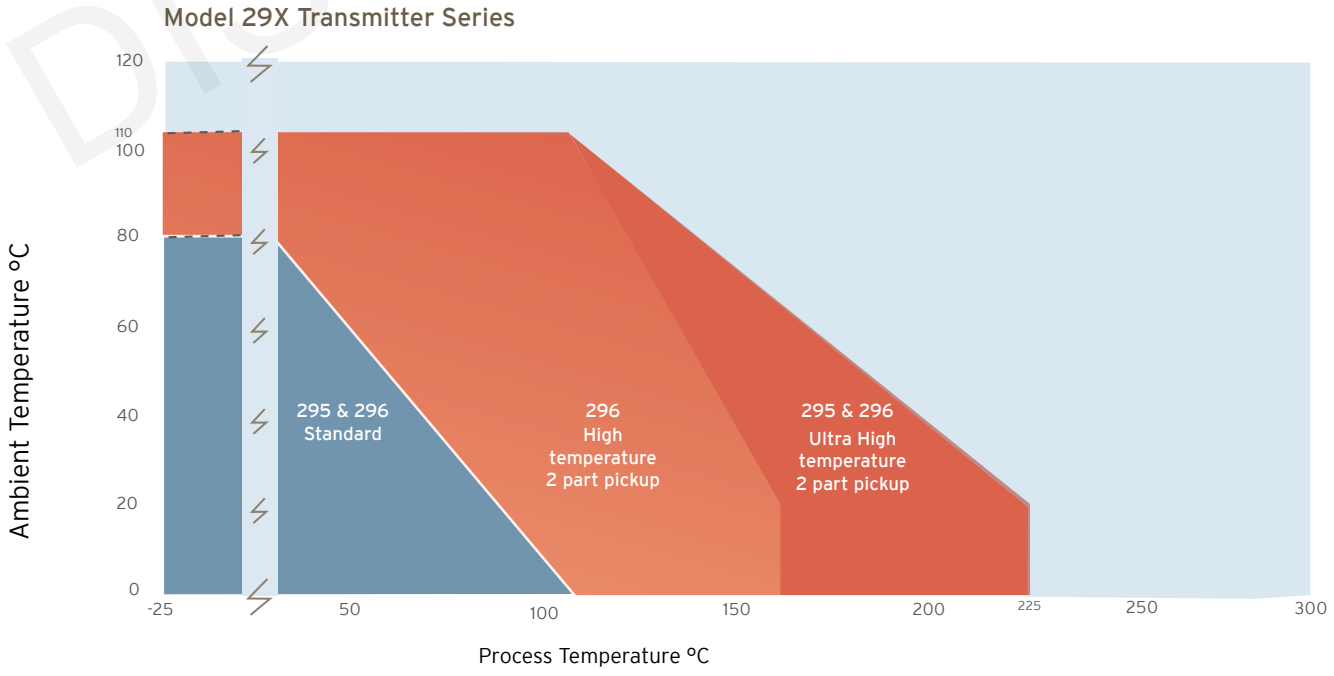
[2] Temperature of metered fluid will affect transmitter temperature, see graph below

Transmitter Specifications - Frequency (Pulse)

Supply Voltage Supply Current	5-26 Vdc 25-30 mA typical	
Output (5.0 Volt Supply) (TTL and CMOS compatible)	No Load 2.5K Load to Common 2.5K Load to +5 Volts	0.00 / 4.80 Volts 0.00 / 4.60 Volts 0.25 / 4.80 Volts
Short Circuit Current	45 mA	
Output Impedance	100 Ω	
Rise/Fall Time	0.2 µSec	
[1] Output Update Rate	1 ms	
Min/Max Frequency	0-60 kHz	
Resolution	1 - 1000 pulses/rev, Single Phase 1 - 500 pulses/rev/phase, Quadrature	
Ambient Temperature Range	Transmitter (Storage)-40ºC to 85ºC (-40ºF to 185ºF) [2] Transmitter (Operation) -40ºC to 80ºC (-40ºF to 175ºF)	
Maximum Temperature, Process Fluid For explosion proof models see: http://www.maxmachinery.com/content/explosion-proof-installation-instructions (20ºC Ambient, 5V supply)	29X-X0X-XXX Standard Model 90ºC (195ºF) 29X-X5X-XXX High Temp Model – 2 part model 225ºC (435ºF)	
Anti-dither Range	Software selectable from 1-100% of 1 revolution. 50% of a meter revolution - unidirectional 2% bidirectional are typical default settings	
Signal Filtering	Software selectable from 1ms to 250ms time constant	

[1] Full step change is subject to signal damping
[2] Temperature of metered fluid will affect transmitter temperature, see graph on previous page

Temperature Range Specification (Analog & Freq.)



Installation

For optimum performance, install the flow meter on the discharge side of the pump, in one of the configurations shown on page 7.

The following items and conditions should be considered:

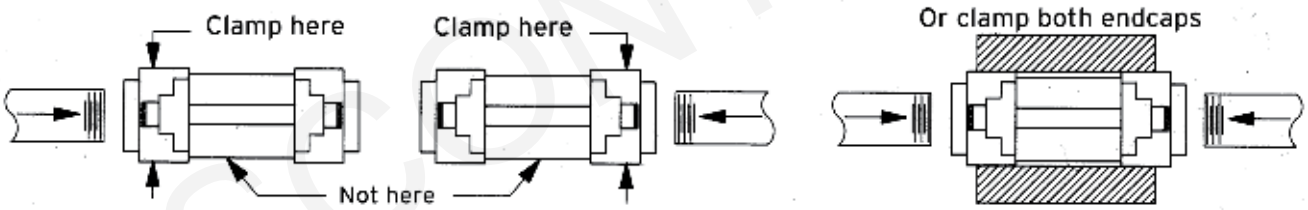
Location: Install the flow meter in a clean, dry area if possible. Avoid areas with high vibration levels.

Line and Bypass Valves: These valves allow filter cleaning or flow meter removal without completely shutting the system down and draining the lines. They are important for system start up under conditions which could damage the meter, such as: air in the lines, solid materials (at room temperature), high temperature materials, or initial line surges.

Filtration: Any dirt present in the system can jam or damage the meter. A 150 micron filter is generally recommended, although materials with very high viscosities may require a coarser filter. For bidirectional flow applications, use a filter on each side of the flow meter. Materials with fibrous or non abrasive particulate matter may have to be run without filters. Follow the recommendation of your Max Sales Engineer or consult Technical Service.

Clean Plumbing: Before installing the flow meter, clean the inside of the pipe line with compressed air or steam (especially when using new pipe). Don't use water, steam, or compressed air on the meter itself! Remove any protective covering from the flanges (if applicable).

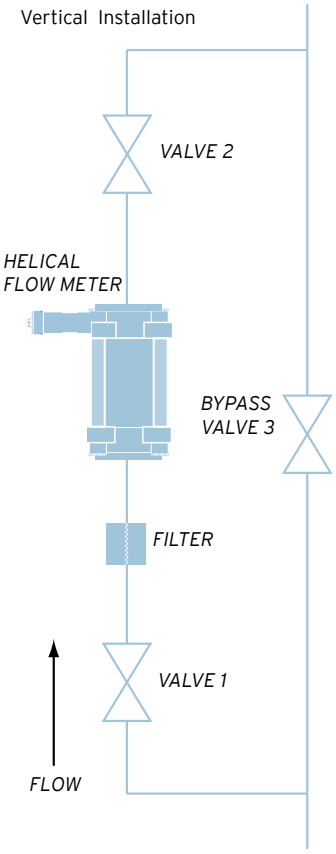
Pipe Threading: When installing pipe to the flow meter, support the nearest end cap or both end caps (as in a vise). Don't clamp the flow meter body. This avoids possible misalignment of flow meter components when the pipe is screwed tight. Check for proper flow meter operation by rotating the timing gear through the transmitter mounting hole. It should move freely and without noise.

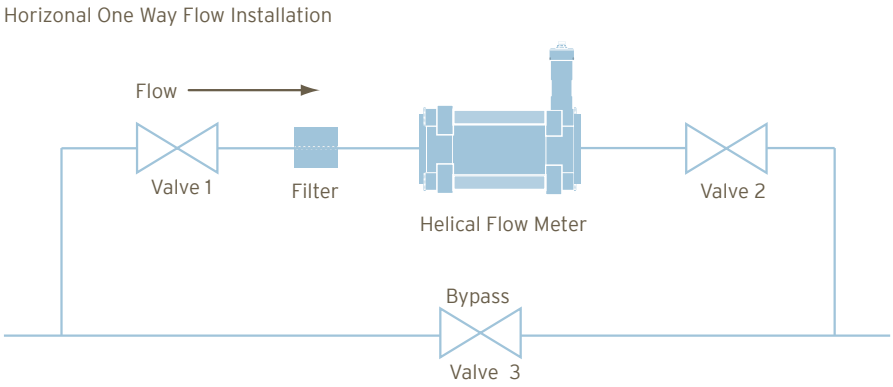


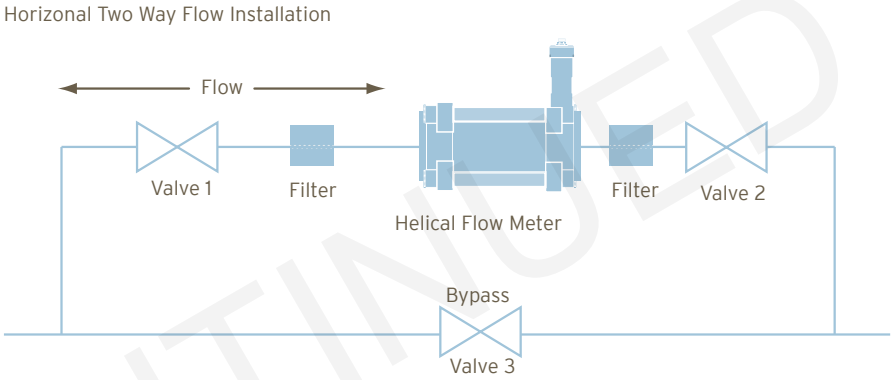
High Temperatures: Use the "Vertical Installation" drawing. This minimizes heat transfer by convection from the flow meter to the transmitter. The transmitter is the most heat sensitive element in the system and the transmitter manual should be consulted for specific limits. Optional heating fluid ports are available for the flow meter to keep it at operating temperature during standby conditions. For substances that are solid at room temperature, these ports are generally required to keep the material molten and flowing through the meter.

ANSI Flanges: Using the 241, 242 or 243 meters at pressures greater than 500 psi will also require flanges. See the specifications and bolt torque table on page 8. Max has bolt kits available for flange installations.

Piping Diagrams







ANSI Flange Stud Torque

240 Series ANSI Flange Stud Torque Requirements. This table shows the minimum torque required for a 2:1 tightening factor at the indicated pressures using zinc plated studs and nuts. These values were calculated using studs with a yield strength of Sy = 75,000 psi.

Meter (Flange)	Studs		Torque For Line Pressure ft-lb (N-m) See notes below					Absolute Max Torque ft-lb (N-m)	Stress at Max Torque (psi)*
	Qty	Size	500	1000	1500	2500	3500		
241 (600# Flange)	4	3/4-10	24 (33)	49 (67)	73 (99)			200 (271)	47,904
241 (2500# Flange)	4	1-1/8-7	37 (50)	73 (99)	110 (149)	183 (248)	256 (247)	681 (924)	47,789
242 (600# Flange)	8	3/4-10	24 (33)	47 (64)	71 (96)			200 (271)	47,904
242 (1500# Flange)	8	1-8	31 (42)	63 (86)	94 (128)	157 (213)	219 (297)	483 (656)	47,822
243 (600# Flange)	8	7/8-9	53 (72)	106 (144)	159 (216)			322 (437)	47,972
243 (1500# Flange)	8	1-1/4-7	76 (103)	151 (205)	227 (308)	378 (513)	529 (718)	965 (1310)	47,802

Notes:

Using the 241, 242 or 243 meters at pressures greater than 500 psi *will require flanges*. Max has bolt kits available for flange installations.

For unplated non-lubricated nuts and studs, multiply the above torque by 1.5.

For lubricated nuts and studs, multiply the above torque by 0.9.

For cadmium plated nuts and studs, multiply the above torque by 0.8.

*Stress in bolt calculated for thread root diameter.

Operation

Determine that the following parameters of your flow metering system are within specifications for the specific 240 Series Meter being used:

Maximum System Pressure	(Specifications)
Differential Pressure across meter	(Pressure Drop Curves)
Maximum Flow Rate	(Pressure Drop Curves)
Metered Fluid Temperature	(Sales specification, transmitter manual)

If the metered fluid is greater than 80°F (28°C) over ambient, see the "High Temperature Start Up" section.

With valves one and two closed, slowly open valve three (bypass) to clear the lines of foreign particles and air. Slowly open the inlet valve (# I). Slowly open the outlet valve (# 2). Completely close the bypass valve.

No routine maintenance, cleaning, or lubrication of the flow meter is required. A routine filter cleaning schedule should be established. The system should be shut down if abnormal noises occur or if unusual differential pressures across the meter are encountered.

High Temperature Start Up: For fluids above 150°F (82°C) based on 70°F ambient, a special procedure is required to prevent thermal shock and permanent damage to the flow meter.

The warm up time is determined by the equation below:

$$\text{TIME (minutes)} = \frac{\text{connector size (in inches) x (operating temperature (F) -125)}}{10}$$

—OR—

$$\text{TIME (minutes)} = \frac{\text{connector size (in inches) x (operating temperature (C) -52)}}{10}$$

Valves one and two must be closed. Open the bypass valve (# 3) in gradual steps until the bypass piping is stabilized at operating temperature. Open valve one slightly and allow the temperature to stabilize around the flow meter. Valve one can then be opened completely. Open valve two slightly. The flow meter may make unusual noises or bind at this point. Leave the valve at this setting until normal meter operation occurs, at which point valve two can be gradually opened all the way. Slowly close the bypass valve (# 3).

Electrical Installation - Wiring
290 Series Transmitters

Removal note: The transmitter does not need to be removed from the flow meter for any field servicing or adjustments. Normally, the flow meter and transmitter are shipped back to the factory for calibration or service as a unit. If the transmitter needs to be removed from the flow meter for installation, be sure to retighten the transmitter snugly in order to ensure proper sensor alignment.

Mechanical Installation
1. The transmitter is attached to the flow meter's threaded magnet shield. Hand tighten only. (~ 3 ft-lb)
2. The transmitter lid has four thread paths. To realign the cable, remove the lid and rotate up to 180° and retighten using an alternate starting point. Tighten to compress the O-ring seal.

Removal
1. Remove electrical connections
2. Unscrew transmitter, using a wrench if necessary.

WARNING
Installation and removal should only be facilitated by trained personnel
Verify transmitter output type (ANALOG or FREQUENCY) before wiring, inappropriate wiring could result in damaging the circuit.

Moisture Seal Protection
On all models, the housing is designed as a liquid and vapor-tight enclosure. There are O–ring seals at the lid and possibly also the base of the housing – these need to be fully seated. A properly sealed transmitter will prevent the formation of damaging moisture inside the housing.
Turck connector Model: The connector is sealed to the lid at the factory and is ready for use.
NPT Model: To ensure a moisture-tight seal, apply appropriate sealant to the threads at installation.

Wiring ANALOG

The electrical connector versions are pre-wired inside the transmitter and ready to accept a mating cable (available from the factory). The liquid-tight, NPT models need to be wired during installation as shown in the table below:

Analog	294 NPT model	All Other Models	Mating Cable Wire Color	Turck Pin #
Case Ground	In-lid	Case	Blue	3
Common	1	Com	Black	4
Power *	2	V+	Brown	1
Signal Output (+)	3	Sig	Grey	5
Signal Output (-)**	4	Ret	White	2

*Model 29X-xxx-000, 24vdc powered, Model 29X-xxx-100, 12vdc powered
** Signal output is fully isolated: If attached to a true differential input a 10K Ohm pulldown resistor should be installed between (–) and common at the receiving end.

Electrical Installation - Wiring

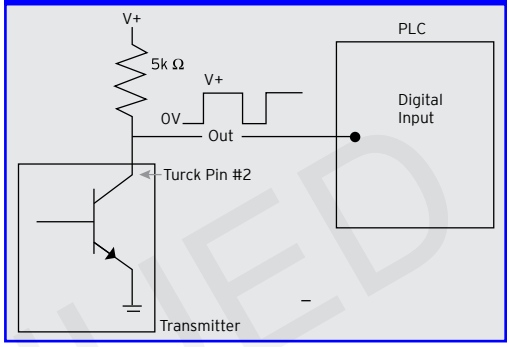
Wiring FREQUENCY

The electrical connector versions are pre-wired inside the transmitter and ready to accept a mating cable (available from the factory). The liquid-tight, NPT models need to be wired during installation as shown in the table below:

Frequency Single Phase	All Other Models	Mating Cable Wire Color	Turck Pin #
Case Ground	Case	Blue	3
Common	Com	Black	4
Power 5-26 Vdc	V+	Brown	1
Pulse Output	Ph A	White	2
N/A	NC	Grey	5

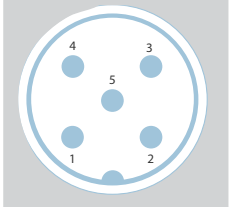
* A current sinking device produces an output pulse which is the opposite of a sourcing device. A positive DC voltage must be applied to the wire running between PhA and your PLC. When the output is triggered, this voltage will be grounded to zero volts. Note: use a 5k ohms resistor to limit the current flow in the signal line.

Current Sinking* Wiring (models 29X-6XX)



Frequency Quadrature	All Other Models	Mating Cable Wire Color	Turck Pin #
Case Ground	Case	Blue	3
Common	Com	Black	4
Power 5-26 Vdc	V+	Brown	1
Output Phase A	Ph A	White	2
Output Phase B	Ph B	Grey	5

Turck Connector

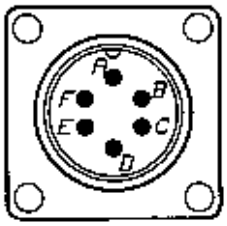


Electrical Installation - Wiring 280 Series Transmitters

Wiring

The 6-pin connector version is pre-wired inside the transmitter and is ready to accept a mating cable (available from the factory). The Liquid-Tight and NPT models need to be wired during installation as shown in the table below:

	NPT Models	6-Pin Connector	
	Circuit Board Terminal #	Mating Cable Wire Color	Pin #
Case Ground	1	Green	A
Common	2	Black	B
Power (+5-24 VDC)	3	Red	C
Pulse Output	4	White	D

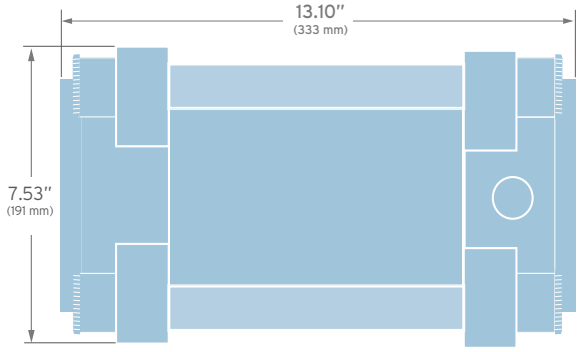


Troubleshooting

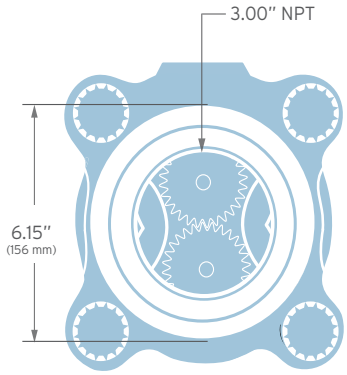
Trouble	Corrective Action
No Flow through meter or high pressure drop across meter	
Solidified material blocking rotation	Heat meter to melt material.
Debris blocking rotation	Remove meter from line. Flush with an organic solvent or petrochemical. Try to work debris out of the meter.
Meter broken	If you find damaged parts in the meter, return the meter to the factory for repair.
Fluid is passing through the meter, but there is no indication of flow	
Improper hook-up of transmitter	Verify that DC power is present at the PCA. Use a multi-meter to measure the transmitter output independent of the display or PLC. Inspect cabling.
Indicated flow does not agree with expected readings	
Air in the line	Air bubbles displace the meter just as a liquid would. If you are over-reporting, verify that there is no air in the lines.
Indicator not calibrated properly	Verify the K-Factor for the meter in use and compare this value to the setting used in the display.
Excessive reverse flow in system	Max transmitters have anti-dither functions which can buffer up to 1 revolution of reverse flow. An incorrect flow total can be reported if the pumping causes a flow and ebb of greater than 1 meter revolution.

243 Helical Flow Meter

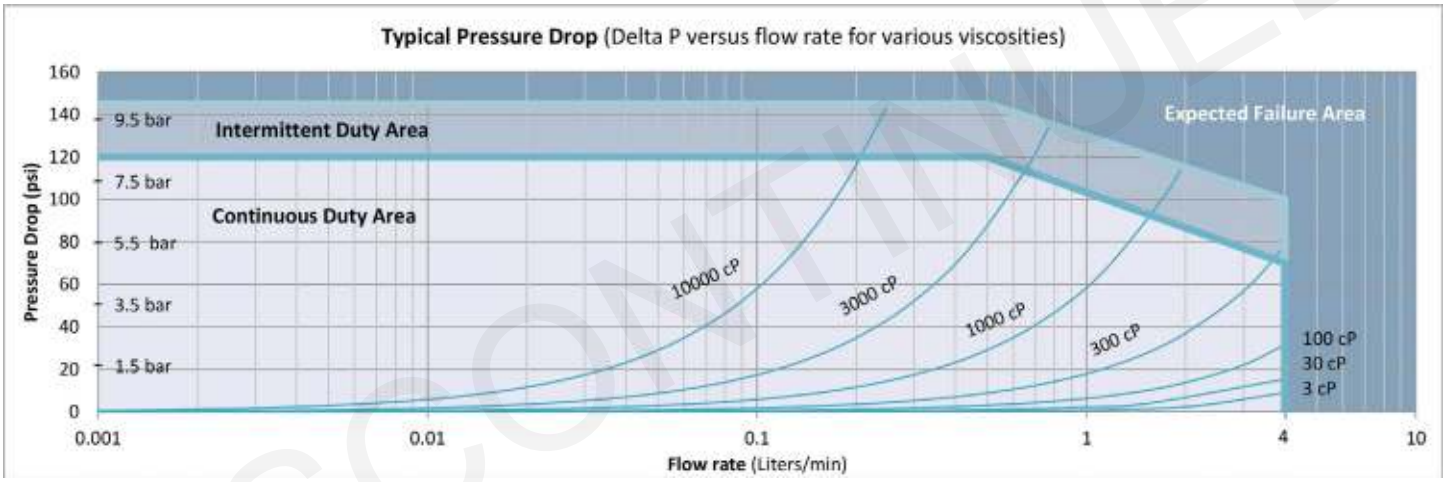
CONNECTIVITY/DIMENSIONS



- Top View -



- End View -



Contact for Repairs & Calibration Services

Your Max 240 Series Meter should be repaired at the factory or under the direct supervision of the Max Technical Service Department. Unauthorized repair work may damage the meter and will void the product warranty. Please make note of model and serial numbers on the flow meter before calling the factory. A return goods authorization number (RMA) will be issued if the flow meter has to be sent back for repair.

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