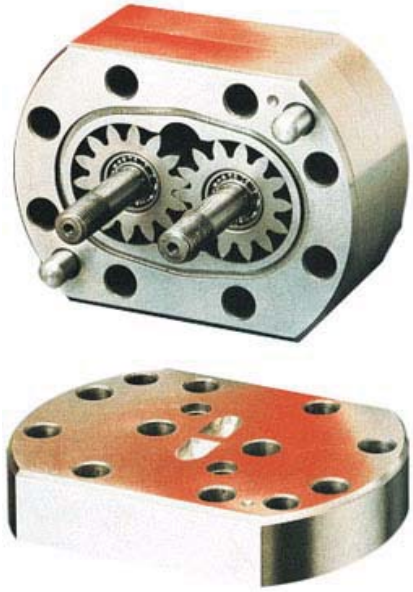
ZDM Positive Displacement Flow Meter

User Instructions



USA

1801 Parkway View Drive
Pittsburgh, PA 15205
PH 412-788-2830

Canada

9A Aviation
Point Claire, QC H9R 4Z2
PH 514-428-8090

www.koboldusa.com

ZDM_manual_05/17

Table of Contents

	Topic	Page
1.0	General	1
2.0	Description	2
2.1	Principle of Operation	2
2.2	Specifications	2
2.2.1	Mechanical Data	2
	Filtration Requirements	3
	Electrical Data	3
2.2.3	Accuracy	3
2.2.2	Pressure Loss	4
3.0	Installation Instructions	4
3.1	Mechanical Installation	4
3.1.1	Installing the Mounting Plate	4
3.1.2	Attaching the Flow Sensor to the Mounting Plate	4
3.1.3	Bolt Torque Specifications	4
3.1.4	Connecting Piping to the Sensor	5
3.2	Electrical Connections	5
4.0	Operating Instructions	6
4.1	Turning the Unit On	6
4.2	Flow Measurement	6
4.3	Turning the Unit Off	7
5.0	Arrival of Damaged Equipment	7
6.0	Maintenance	7
7.0	Need Help with your ZDM Sensor?	7
	Appendix A: Pressure Loss vs. Flow Rate at Various Viscosities	9

List of Diagrams

Diagram 3.2.1	ZDM Wiring Schematic	5
Diagram 4.2.1	ZDM Frequency Output Waveform	6

List of Tables

Table 1:	ZDM Wetted Parts	2
Table 2:	Volume per Pulse for Various ZDM Ranges	7

KOBOLD ZDM POSITIVE DISPLACEMENT FLOWMETER

User Instructions

CAUTION: For safety reasons, please read the cautionary information located at the end of this manual, before attempting installation.

1.0 General

Congratulations on your purchase of a Kobold ZDM Positive Displacement flowmeter. The ZDM is one of the most precise and reliable low volume, liquid flow measuring products available today.

The ZDM operates on the viscosity and density independent volumetric principle. Two gears are brought into counter-rotation by the force of liquid moving past the gears along the meter's housing. Engagement of the gear teeth with the housing walls entraps a defined volume in the cavity between the gear teeth. A detector counts the gear teeth as the cavities empty into the exit port. The precision of the meter is defined by the gear cavity volume. The ZDM can meter volumes as low as 0.02 CC (cubic centimeters.) This ultra-high precision is coupled with bi-directional flow capability, viscosity compatibility to 100,000 cSt and a mechanical robustness capable of pressures to 6500 PSIG (450 BAR).

The ZDM is the ideal choice for difficult clean liquid applications involving media with lubricating properties ranging from very slight, to extensive.

2.0 Description

2.1 Principle of Operation

The ZDM operates on the volumetric displacement principle. The meter moves pockets of liquid from the inlet port to the exit port in discrete segments of known volume. These pockets are defined by the space between adjacent gear teeth and the internal housing wall.

As liquid enters the meter, the inlet cavity fills. The liquid pressure forces the meter's gears to rotate from the gear mesh-point inwards. The gear teeth cavities fill with liquid in the inlet side of the meter and remain filled as the teeth come into near-contact with the meter's interior walls. The gear teeth then drag the liquid to the exit cavity at the opposite side of the meter. This process causes the exit cavity to fill since the liquid is squeezed out of the spaces between the teeth at the gear mesh point. The liquid then flows out the exit port of the meter.

A proximity sensor in the housing senses the passage of individual gear teeth. Since the passage of a tooth signals the passage of its trailing space (filled with liquid), the system as a whole signals with an electrical pulse every time a displaced amount is emptied into the exit port. The resolution of the ZDM is, therefore, determined by the volume between the gear teeth.

This entire procedure is completely independent of the properties of the liquid, making the system applicable to a wide variety of media (even liquids with dynamically changing characteristics.) The only limitations to the system are mechanical ones. Since metal to metal contact is involved, the liquid must have some lubricating properties in order to prevent excessive wear of the gear teeth. If the gear teeth wear down, liquid will leak past them excessively. This excess leakage will degrade the meter's accuracy. The required amount of media lubricity is very slight.

Another limitation is caused by the relatively high pressure loss inherent to positive displacement technology. The pressure loss through the ZDM becomes unacceptable if the media viscosity exceeds 100,000 cSt.

2.2 Specifications

2.2.1 Mechanical Data

Table 1: ZDM Wetted Parts

Wetted Component	Nominal Construction Material	
	Cast Iron (ZDM-X1XX)	Stainless Steel (ZDM-X2XX)
Housing	Cast Iron	SS
Gears	SS	SS
Seals	FKM	FKM
Bearings	SS	SS

Filtration Requirements

ZDM-XX02, -XX04, -XX07:	10 μM (1600 mesh)
ZDM-XX08, -XX09:	20 μM (750 mesh)
ZDM-XX10, -XX20, -XX40:	50 μM (250 mesh)

Maximum Pressure Rating:	Cast Iron: 4500 PSIG St. Steel: 6500 PSIG
Maximum Temperature Rating	
Standard:	-40 to 248°F
Accuracy:	±0.3% of reading (Ranges: 02-40) ±0.5% of reading (Range: 50) (viscosity >20 cSt)
Repeatability:	±0.05% of reading

Electrical Data

Sensor Type:	Qty. 2 Push-Pull Outputs (Channels A & B) A & B Signals are 90° out of phase. Phase difference can be used to determine flow direction using suitable receiving equipment.

Power Requirements

Voltage (V_{cc}):	10-28 VDC
Current:	80 mA max. @ 24 VDC
Power:	1.92 W max. @ 24 VDC

Output Signal

Type:	DC voltage pulse
Form:	Square wave
Amplitude:	Low = GND, High = V_{cc} - 1.0 VDC

2.2.2 Pressure Loss

Pressure loss is a function of the viscosity of the liquid being metered, and its rate of flow. Detailed pressure loss information may be found in Appendix A of this manual.

3.0 Installation Instructions

CAUTION: For safety reasons, please read the cautionary information located at the end of this manual, before attempting installation.

3.1 Mechanical Installation

The ZDM is shipped from the factory in two pieces (not counting the electrical connecting cable or the sensor-mounting plate fastening bolts) consisting of the mounting plate and the sensor body. We recommend that you install the mounting plate first, then attach the sensor and finally connect the piping.

3.1.1 Installing the Mounting Plate

The sensor may be rigidly held in place on your installation through use of the four threaded holes in the base of the mounting plate. These holes are metric and sized as follows:

ZDM-XX02 to ZDM-XX08:	M6 (6 mm metric)
ZDM-XX09 to ZDM-XX40:	M8 (8 mm metric)

3.1.2 Attaching the Flow Sensor to the Mounting Plate

The sensor comes supplied with a set of four steel bolts and O-rings for fastening the sensor to the mounting plate.

- 3.1.2.1 Install the O-rings into the grooves in the body of the sensor.
- 3.1.2.2 Position the sensor on the mounting plate so that the bolt holes in the sensor line up with the bolt holes in the mounting plate.
- 3.1.2.3 Insert the bolts into the bolt holes and thread into mounting plate until they are finger tight.
- 3.1.2.4 With an appropriately sized wrench, tighten the bolts to the specified torque in a diagonal bolt tightening pattern.

3.1.3 Bolt Torque Specifications

The following are the nominal torque specifications for all ZDM bolts.

Meter Model	Torque (N-m)	Torque (lb.-ft.)
ZDM-XX02 to ZDM-XX08:	15	11.1
ZDM-XX09 to ZDM-XX20:	35	25.8
ZDM-XX40:	120	88.5

3.1.4 Connecting Piping to the Sensor

The procedure for attaching piping to the sensor depends on the type of thread that was ordered with the sensor. The most common thread in North America is NPT (series ZDM-3XXX and ZDM-4XXX sensors.) Occasionally, the European pipe thread (BSP) is ordered because of its superior leak resistance. Series ZDM-1XXX and ZDM-2XXX sensors all have BSP threaded fittings.

If the fittings on your ZDM are incorrect for your application, you can correct the situation by purchasing a different mounting plate.

3.1.4.1 If you have NPT threads, coat the threads with a paste type pipe sealant before threading into the mounting plate.

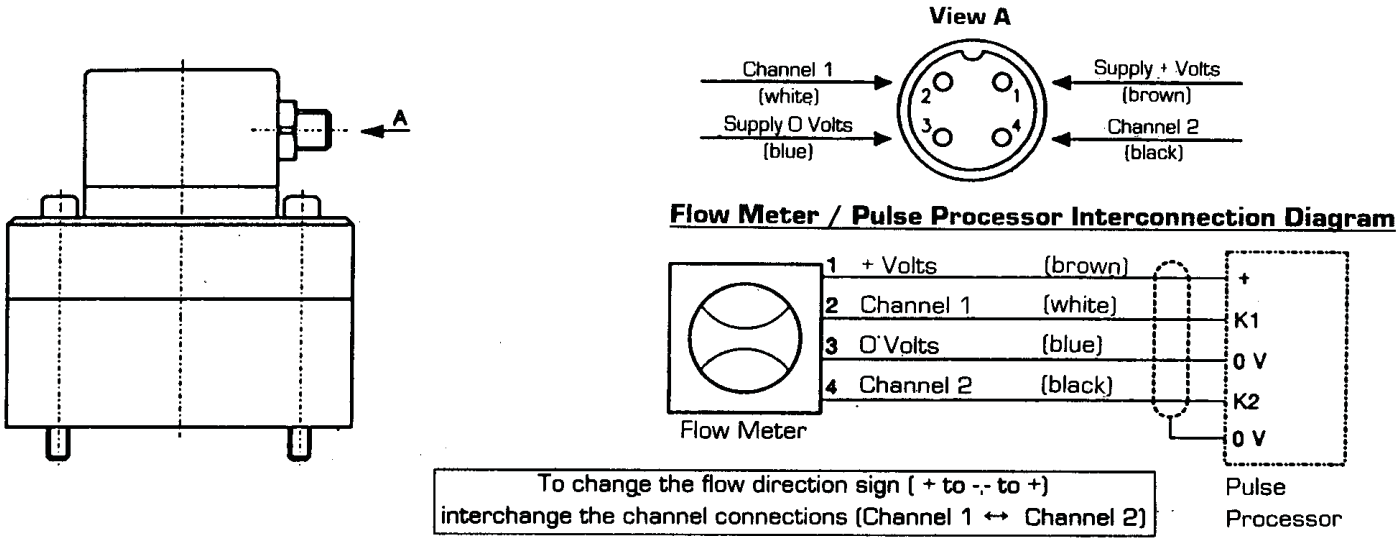
We recommend that PTFE tape NOT be used since pieces of it may find their way into the sensor, possibly causing the gears to bind. Should you have no alternative to PTFE tape, make sure that it is properly trimmed and does not extend beyond the first thread on your pipe fittings.

3.1.4.2 If you have BSP threads, place the sealing gaskets over the ends of your pipe fittings and thread fittings into the mounting plate.

3.2 Electrical Connections

The standard ZDM operates on a power supply of: 10-28 VDC.

Diagram 3.2.1: ZDM Wiring Schematic



4.0 Operating Instructions

4.1 Turning the Unit On

Supply power.

4.2 Flow Measurement

The ZDM transmits a frequency based electronic signal in response to flow through its mechanism. This signal takes the form of a square wave, the amplitude of which is the supply voltage (V_{cc}) minus 1.0 VDC. A representation of the waveform is given in Diagram 4.2.1, "ZDM Frequency Output Waveform", on page 6. Each pulse in the transmitted signal represents a fixed quantity of liquid passing through the meter. The exact amount of liquid represented by each pulse is a function of the range of the meter. To determine the sensitivity of your meter, consult Table 2, "Volume per Pulse for Various ZDM Ranges", on page 7.

Diagram 4.2.1: ZDM Frequency Output Waveform

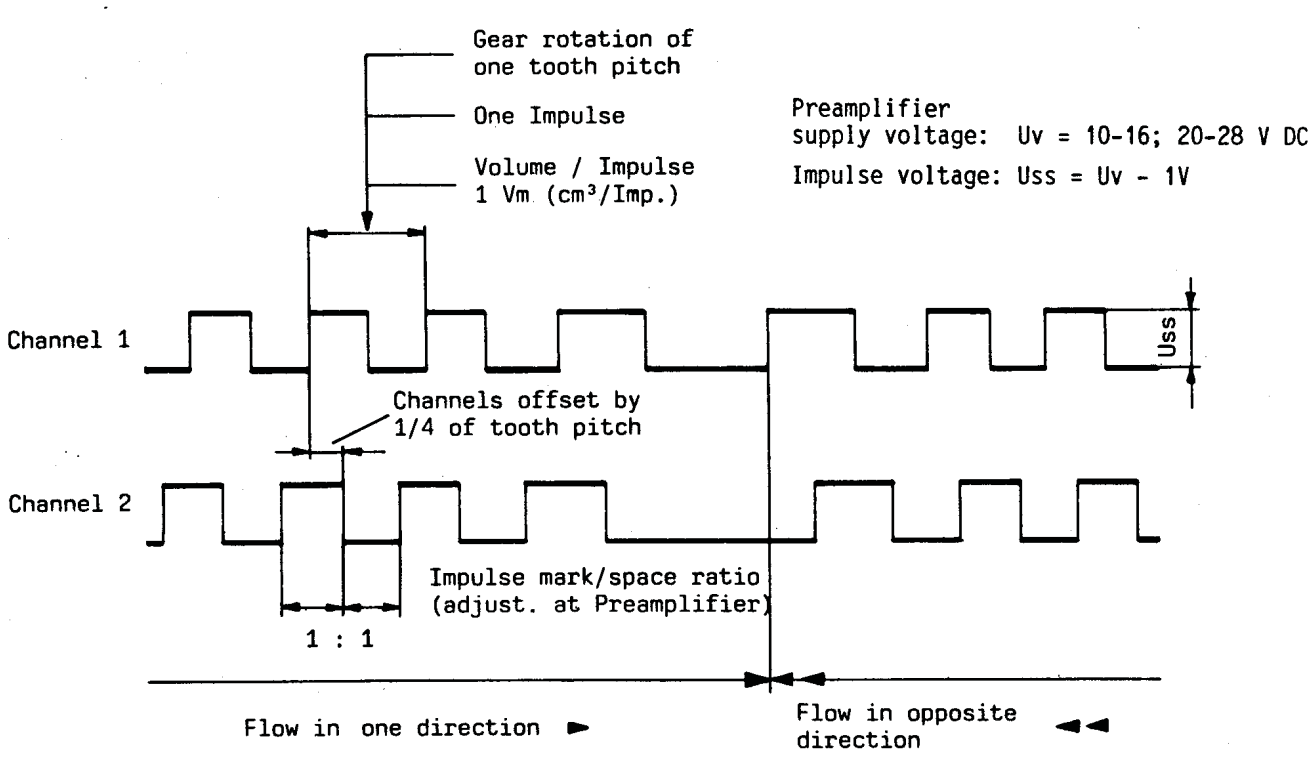


Table 2: Volume per Pulse for Various ZDM Ranges

ZDM Model Number	Range (GPM)	Frequency(Hz)	Pulses per Gallon
ZDM-XX02	0.0005 - 0.53	1.577-1671.90	189,272
ZDM-XX04	0.0011 - 1.06	1.735-1671.90	94,636
ZDM-XX07	0.0026- 2.64	1.640-1665.59	37,854.4
ZDM-XX08	0.0053 - 4.76	1.672-1501.56	18,927.2
ZDM-XX09	0.0079 - 10.57	1.246-1667.17	9,463.6
ZDM-XX10	0.0132 - 21.13	0.833-1333.11	3,785.44
ZDM-XX20	0.0264 - 31.70	0.833-1000.00	1,892.72
ZDM-XX40	0.2642 - 66.00	4.167-1041.00	946.36

4.3 Turning the Unit Off

Remove power.

5.0 Arrival of Damaged Equipment

Your instrument was inspected prior to shipment and found to be defect-free. If damage is visible on the unit, we advise that you carefully inspect the packing in which it was delivered. If damage is visible, notify your local carrier at once. The carrier is liable for a replacement under these circumstances. If your claim is refused, please contact KOBOLD Instruments.

6.0 Maintenance

The ZDM is continuously lubricated by the medium flowing through its internal components, so no extra lubrication is required.

Please note the following typical filtration requirements:

ZDM-XX02 to ZDM-XX07: 10 um
ZDM-XX08 to ZDM-XX09: 25 um

ZDM-XX10 to ZDM-XX40: 50 um

Make sure that the filter is kept in proper functioning condition. The frequency of filter replacement and maintenance will depend on the level on cleanliness of the metered liquid.

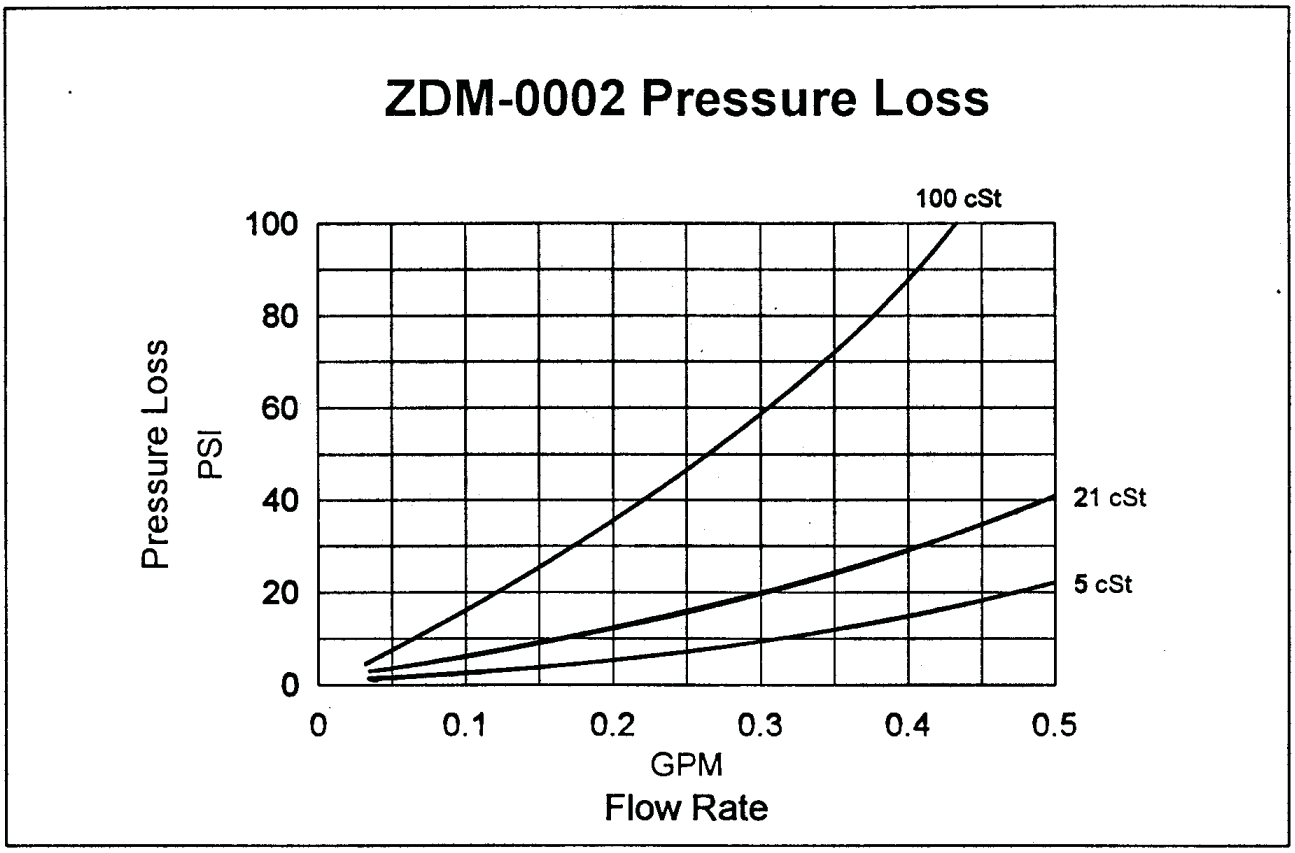
The only wear component in the ZDM are the gear teeth. The gear teeth will wear with time. The rate of wear depends on the time of operation and the abrasion/lubrication properties of your measured liquid. We recommend that users perform a periodic (every six months is suggested) check of the meter calibration. The most effective way to do this is to use a calibrated container, a timer and accurate weight scale.

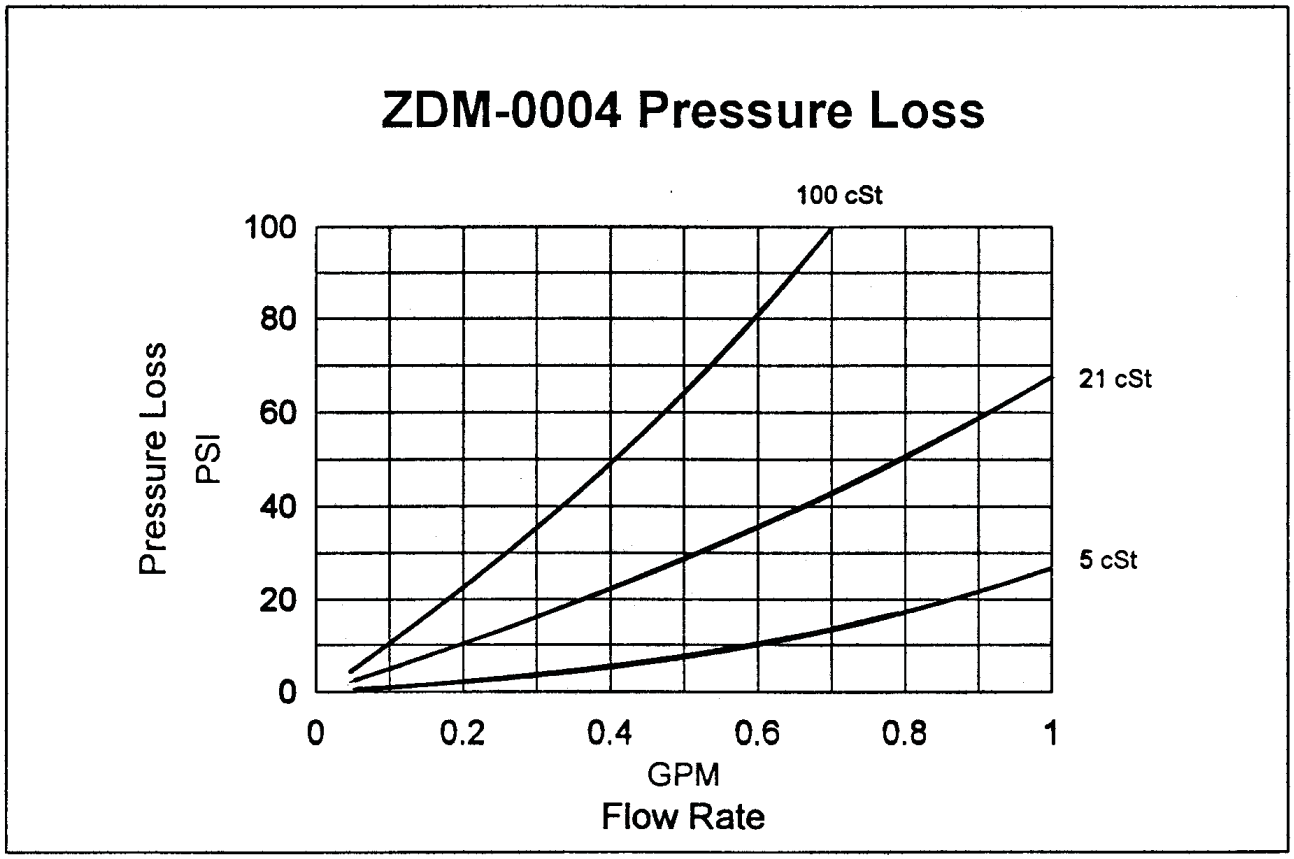
7.0 Need Help with your ZDM Sensor?

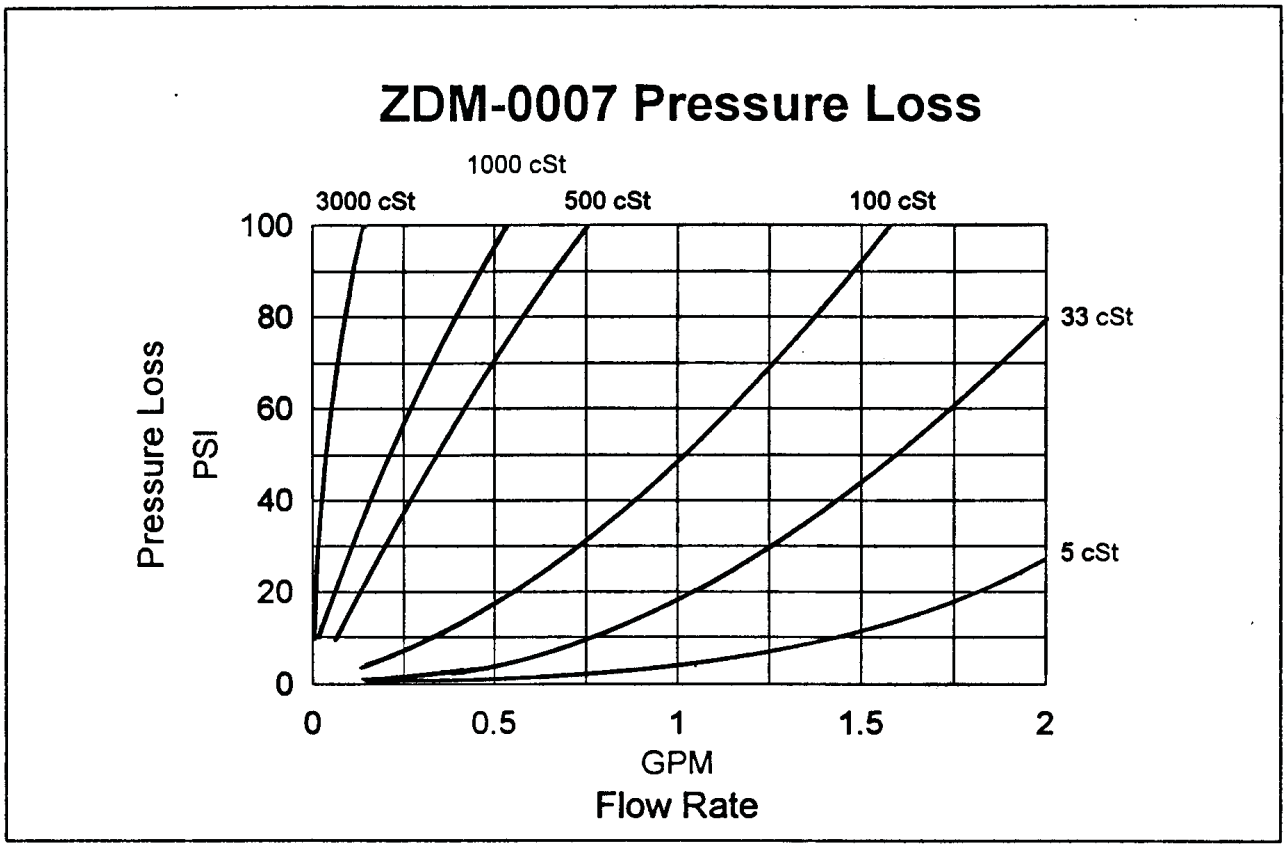
Call one of our friendly engineers at 412-788-2830.

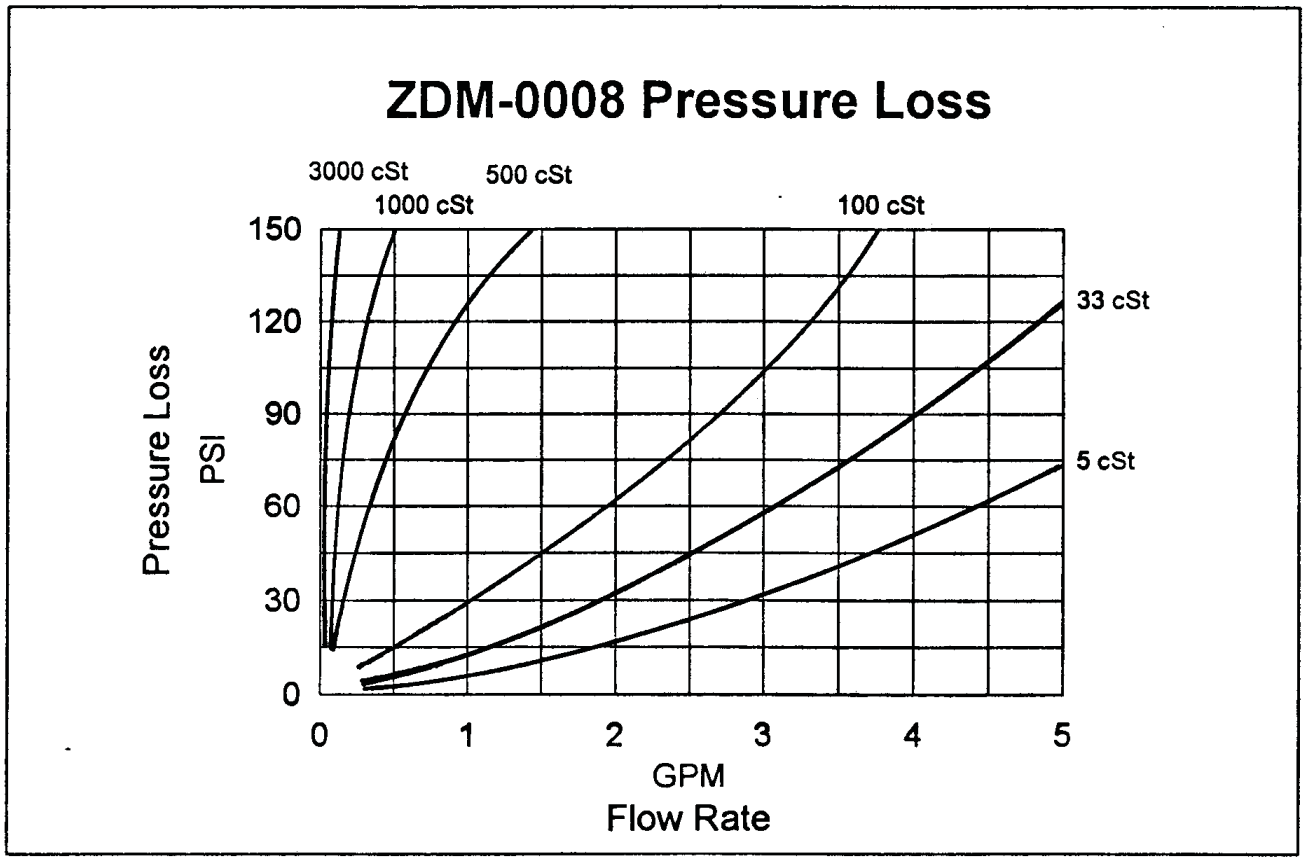
Appendix A:

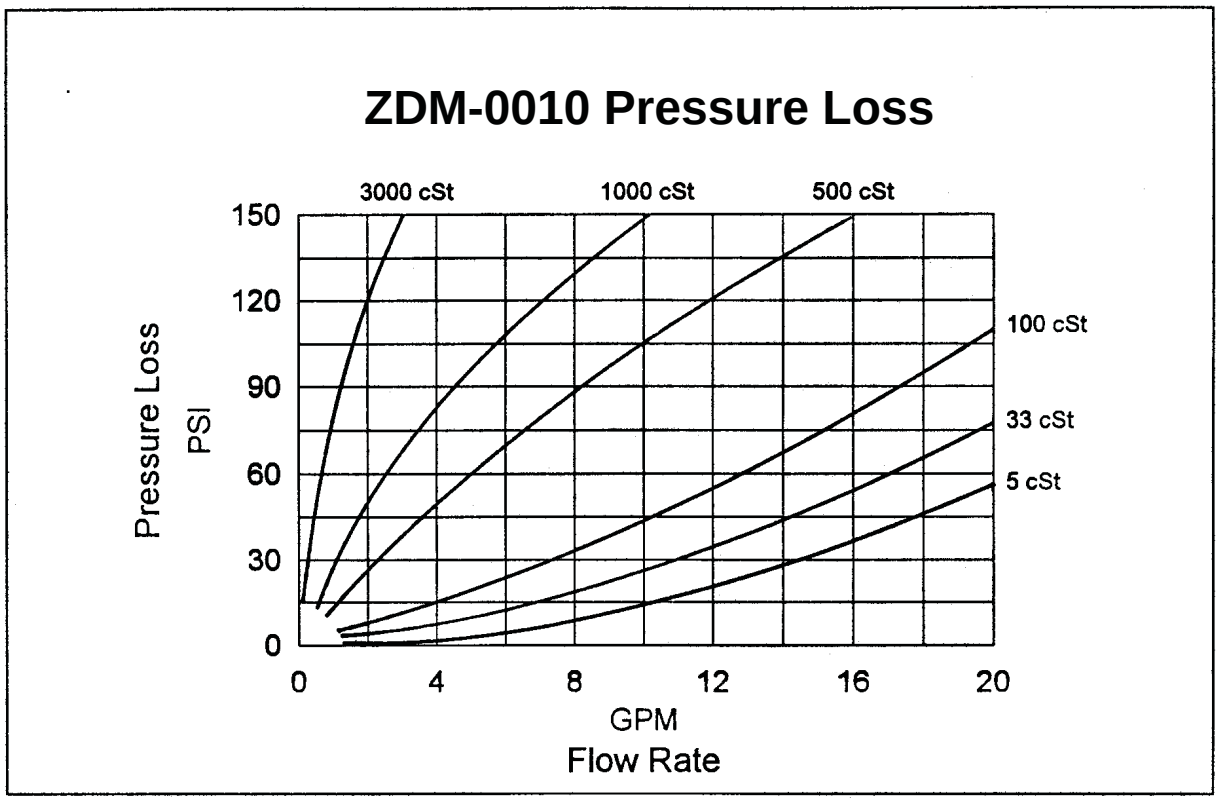
Pressure Loss vs. Flow Rate at Various Viscosities


ZDM-0002 Pressure Loss
100 cSt
21 cSt
5 cSt
Pressure Loss
PSI
100
80
60
40
20
0
0
0.1
0.2
0.3
0.4
0.5
GPM
Flow Rate

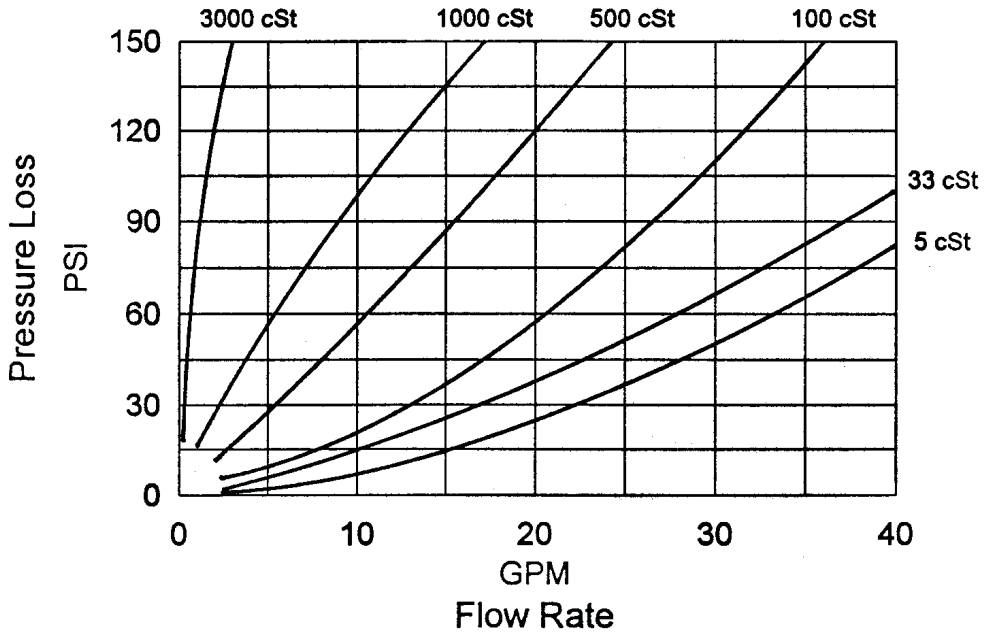

ZDM-0004 Pressure Loss
100 cSt
21 cSt
5 cSt
Pressure Loss
PSI
100
80
60
40
20
0
0
0.2
0.4
0.6
0.8
1
GPM
Flow Rate


ZDM-0007 Pressure Loss
1000 cSt
3000 cSt
500 cSt
100 cSt
33 cSt
5 cSt
Pressure Loss
PSI
100
80
60
40
20
0
0
0.5
1
1.5
2
GPM
Flow Rate

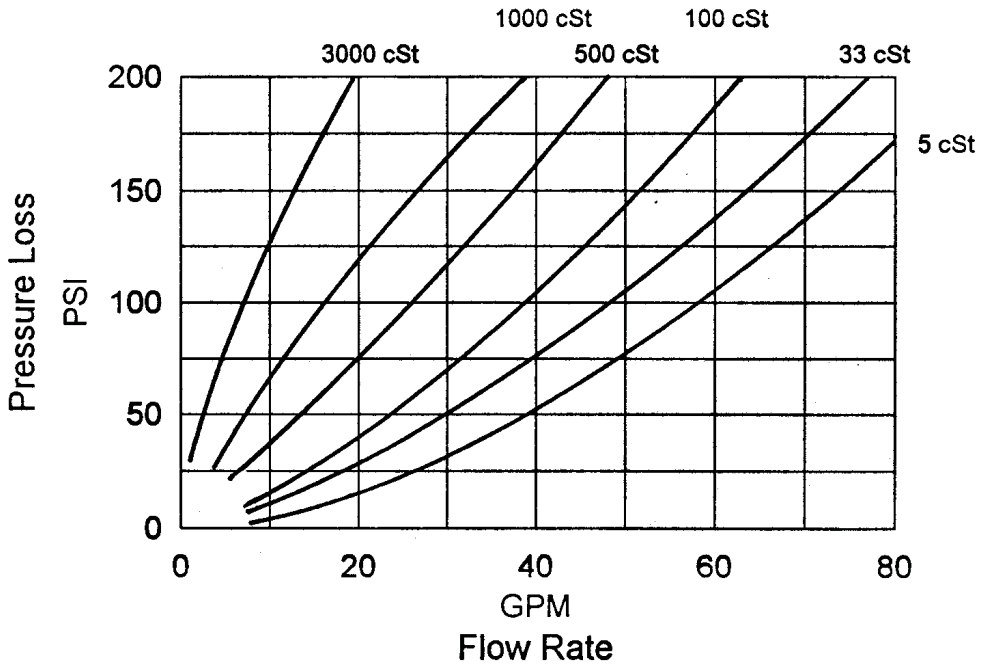

ZDM-0008 Pressure Loss
3000 cSt
500 cSt
1000 cSt
100 cSt
33 cSt
5 cSt
Pressure Loss
PSI
150
120
90
60
30
0
0
1
2
3
4
5
GPM
Flow Rate


ZDM-0010 Pressure Loss
3000 cSt
1000 cSt
500 cSt
100 cSt
33 cSt
5 cSt
150
120
90
60
30
0
Pressure Loss
PSI
0
4
8
12
16
20
GPM
Flow Rate

ZDM-0020 Pressure Loss



ZDM-0040 Pressure Loss



CAUTION

PLEASE READ THE FOLLOWING WARNINGS BEFORE ATTEMPTING INSTALLATION OF YOUR NEW DEVICE. FAILURE TO HEED THE INFORMATION HEREIN MAY RESULT IN EQUIPMENT FAILURE AND POSSIBLE SUBSEQUENT PERSONAL INJURY.

- **User's Responsibility for Safety:** KOBOLD manufactures a wide range of process sensors and technologies. While each of these technologies are designed to operate in a wide variety of applications, it is the user's responsibility to select a technology that is appropriate for the application, to install it per these installation instructions, to perform tests of the installed system, and to maintain all components. The failure to do so could result in property damage or serious injury.
- **Proper Installation and Handling:** Use a proper sealant with all installations. Never overtighten fittings. Always check for leaks prior to system startup.
- **Wiring and Electrical:** A supply voltage of: 10-28 VDC is used to power the ZDM. The sensor systems should never exceed this rating. Electrical wiring of the sensor should be performed in accordance with all applicable national, state, and local codes.
- **Temperature and Pressure:** The ZDM is designed for use in media temperatures from -40 to 248°F, and for use at pressures up to 6500 PSIG, depending on model. Operation outside these limitations will cause damage to the unit and possible personal injury.
- **Material Compatibility:** Check your model number with the wetted materials specifications of this manual. Make sure that the model which you have selected is chemically compatible with the application liquids. While the electronics housing is liquid resistant when installed properly, it is not designed to be immersed. It should be mounted in such a way that it does not normally come into contact with fluid.
- **Flammable, Explosive and Hazardous Applications:** The ZDM with option Ex or EXA are intrinsically safe and are the only units which are to be used in hazardous locations. Other ZDM models should not be used in areas where an explosion proof design is required.
- **Make a Fail-Safe System:** Design a fail-safe system that accommodates the possibility of switch or power failure as well as operator error. In critical applications, KOBOLD recommends the use of redundant backup systems and alarms in addition to the primary system.