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# **ELECTROMAGNETIC FLOW METER**

## **Installation, Operation and Maintenance Manual**

The specifications contained in this manual are subject to change without notice and any user of these specifications should verify from the manufacturer that the specifications are currently in effect. Otherwise, the manufacturer assumes no responsibility for the use of specifications that have been changed and are no longer in effect.

**ELECTROMAGNETIC  
FLOW METER**

**Installation, Operation  
and  
Maintenance Manual**

**TM-68410 REV. F**

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**Thank you for selecting a FLOW TECHNOLOGY, INC. product for your flow measurement application.**

**Virtually every major commercial, government, and scientific organization is making use of our products, expertise and extensive technical support. This is a culmination of years of refinement in our flowmeter and calibrator designs that has resulted in the technological leadership in the flow measurements field that we enjoy.**

**We are proud of our quality products, our courteous service and welcome you, as a valued customer, to our growing family.**

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# WARRANTY

**Limited Warranty.** Seller warrants that goods delivered hereunder will at delivery be free from defects in materials and workmanship and will conform to seller's operating specifications. Seller makes no other warranties, express or implied, and specifically makes NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

**Limitation of Liability.** Seller's obligation under the warranty shall be limited to replacing or repairing at Seller's option, the defective goods within twelve (12) months from the date of shipment, or eighteen (18) months from the date of shipment for destination outside of the United States, provided that Buyer gives Seller proper notice of any defect or failure and satisfactory proof thereof. Defective goods must be returned to Seller's plant or to a designated Seller's service center for inspection. Buyer will prepay all freight charges to return any products to Seller's plant, or other facility designated by Seller. Seller will deliver replacements for defective goods to Buyer freight prepaid. The warranty on said replacements shall be limited to the unexpired portion of the original warranty. Goods returned to Seller for which Seller provides replacement under the above warranty shall become the property of the Seller.

The limited warranty does not apply to failures caused by mishandling or misapplication. Seller's warranty obligations shall not apply to any goods that (a) are normally consumed in operation or (b) have a normal life inherently shorter than the warranty period stated herein.

In the event that goods are altered or repaired by the Buyer without prior written approval by the Seller, all warranties are void. Equipment and accessories not manufactured by Seller are warranted only to the extent of and by the original manufacturer's warranty. Repair or replacement goods furnished pursuant to the above warranty shall remain under warranty only for the unexpired portion of the original warranty period.

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The total liability of Seller (including its subcontractors) on any claim whether in contract, tort (including negligence whether sole or concurrent) or otherwise, arising out of or connected with, or resulting from the manufacture, sales, delivery, resale, repair, replacement or use of any goods or the furnishing of any service hereunder shall not exceed the price allocable to the product or service or part thereof which gives rise to the claim.



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## 1 INTRODUCTION

This manual provides information and guidance for the installation, operation, and maintenance of the Electromagnetic Flow Meters supplied by FTI Flow Technology, Inc., Tempe, Arizona.

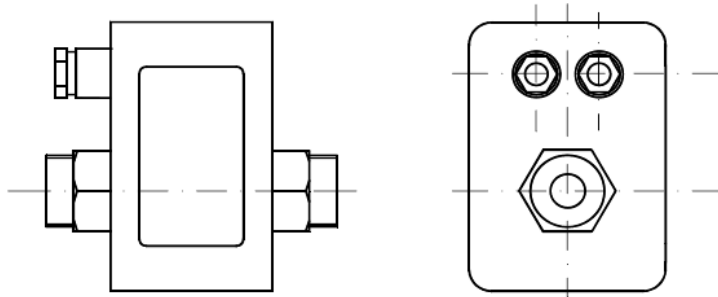
The electromagnetic flow meters are composed of:

The **sensor** that must be mounted between two portions of pipe by flanges, threaded joints, or triclamp fittings.

The **converter** which drives the sensor and displays or transmits data. The converter can be mounted directly on the sensor (compact version) or nearby (remote version). In the case of the remote version the converter is connected to the sensor via two cables.

This manual relates to the following sensor models:

### 1.1 EL500



Body and end connection material is 316 stainless steel with optional material available.

End connections are NPT with additional options.

Lining material is PTFE.

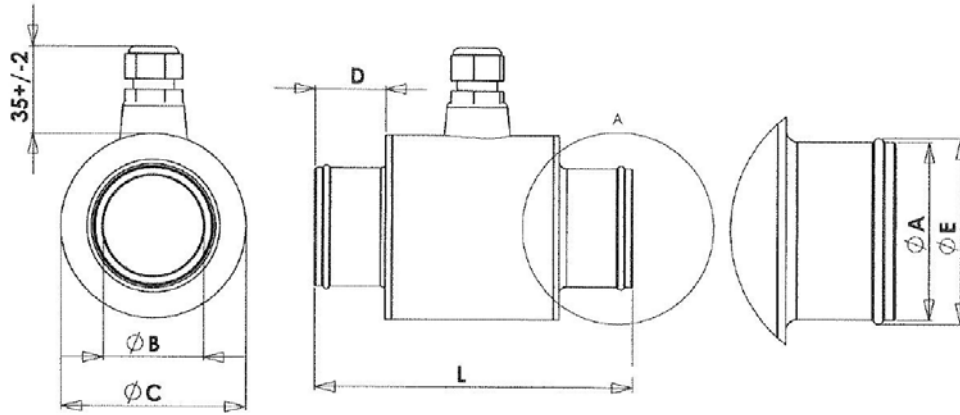
Electrode material is 316L stainless steel with optional material available.

Maximum pressure is 232 PSIG, (16 Bar).

Maximum temperature in compact version is 176°F, (80° C).

Maximum temperature in remote version is 266°F, (130° C).

1.2 **EL4000**



A		B		C		D		E		L	
in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
0.500	13	0.354	9	1.969	50	0.787	20	0.591	15	3.819	97
0.625	16	0.472	12	1.969	50	0.787	20	0.701	17.8	3.819	97
0.750	20	0.591	15	2.362	60	0.866	22	0.890	22.6	4.213	107
1.000	25	0.709	18	2.362	60	1.000	25	1.102	28	4.291	109
1.250	32	1.000	25	2.362	60	1.102	28	1.374	34.9	4.606	117
1.500	38	1.250	32	2.835	72	1.142	29	1.634	41.5	5.354	136
2.000	51	1.730	44	3.150	80	1.250	32	2.165	55	5.512	140

Body and end connection material is galvanized carbon steel.

End connections are hose barb. **CAUTION:** Over tightening the mating connector could damage the sensor.

Lining material PBT and 20% Fiberglass.

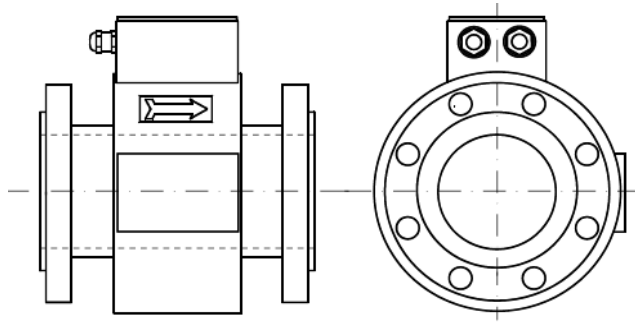
Electrode material is Hastelloy C.

Maximum pressure is 140psi or dependent on fitting.

Temperature range of sensor -13 to 248°F (-25 to 120°C).

Cable length 20 feet

### 1.3 EL2200



Body and end connection material is acrylic painted carbon steel with optional material available.  
End connections are ANSI flange with additional options.

Lining material is PTFE 1" to 6", Ebonite larger than 6" with optional material available.

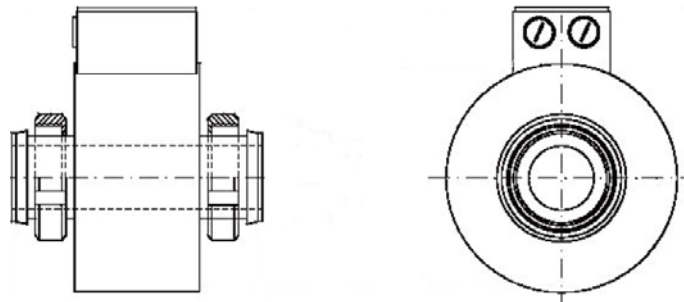
Electrode material is Hastelloy C 22 with optional material available.

Maximum pressure is dependent on fitting.

Maximum temperature in remote version is 356°F, (180° C) for PTFE and 176°F, (80° C) for Ebonite.

Maximum temperature in compact version is 176°F, (80° C).

### 1.4 EL2400



Body and end connection material is 304 stainless steel.

End connections are triclamp with optional DIN 11851.

Lining material is PTFE.

Electrode material is 316L stainless steel with optional material available.

Maximum pressure is 232 PSIG, (16 Bar).

Maximum temperature in remote version is 284°F, (140° C).

Maximum temperature in compact version is 140°F, (60° C).

## 2 INSPECTION UPON RECEIPT

Verify that all parts listed on the packing list are included with your shipment. Note that there may be more than one package for your shipment. Please check the factory set up sheet and verify the meter size, full scale flow rate, and analog/pulse output are set up as required.



### 3 OVERVIEW

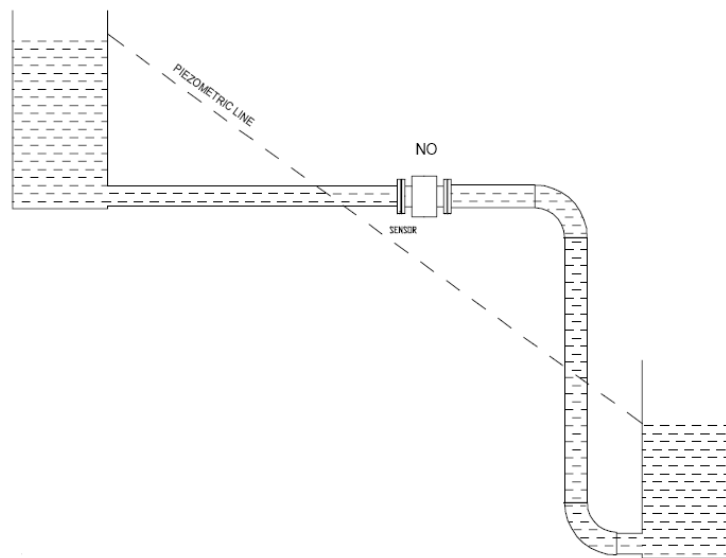
An Electromagnetic Flow Meter works off the principal of Faraday's Law. In this application of the principal the flow meter creates an electromagnetic field perpendicular to the fluid flowing through the meter housing. An electromotive force (voltage) is generated in a conductive medium when it passed through a magnetic field. The voltage created is directly proportional to the density of the magnetic field and the velocity of the conductive medium. Since the conductive medium is the liquid whose flow is to be measured, and the length between the electrodes and the electromagnetic field strength is known, therefore the signal generated is proportional to the velocity of the liquid in the pipe.

In order for this technology to operate correctly the fluid to be measured does need to be conductive. The minimum fluid conductivity required is 5  $\mu\text{S}/\text{cm}$  for most fluids and 20  $\mu\text{S}/\text{cm}$  for DI water.

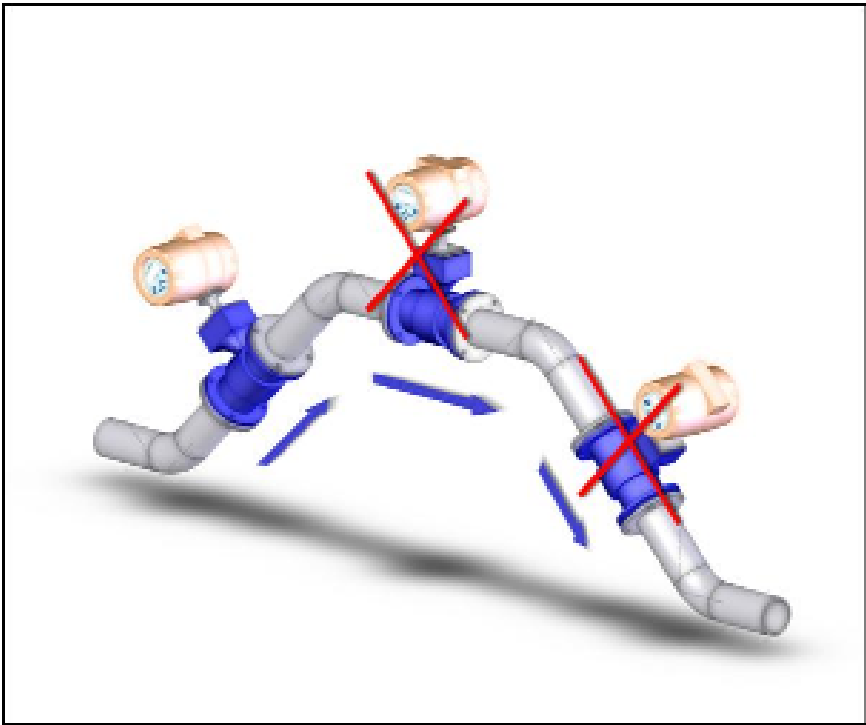
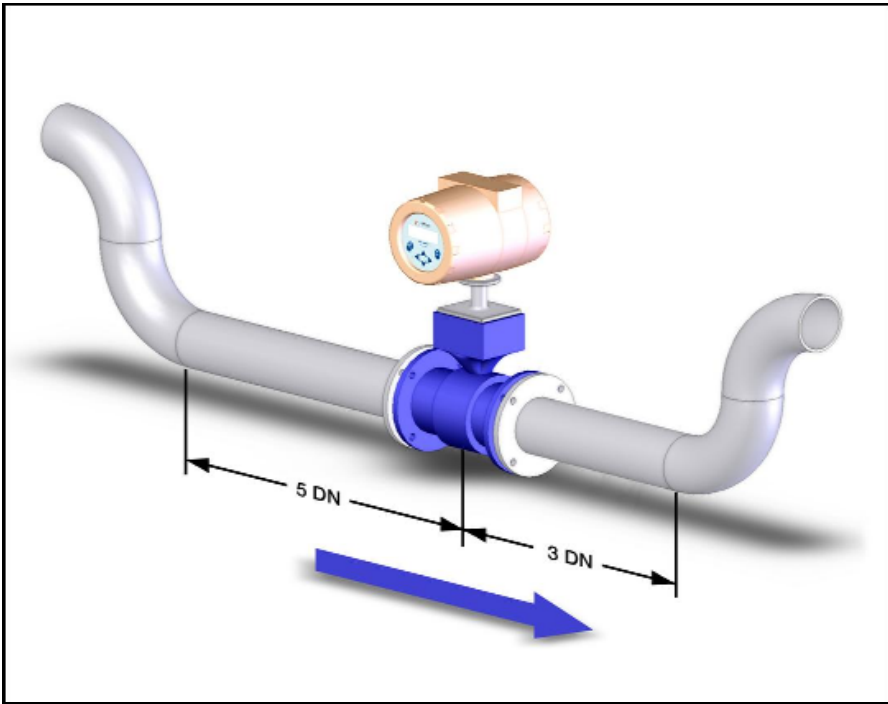
### 4 INSTALLATION

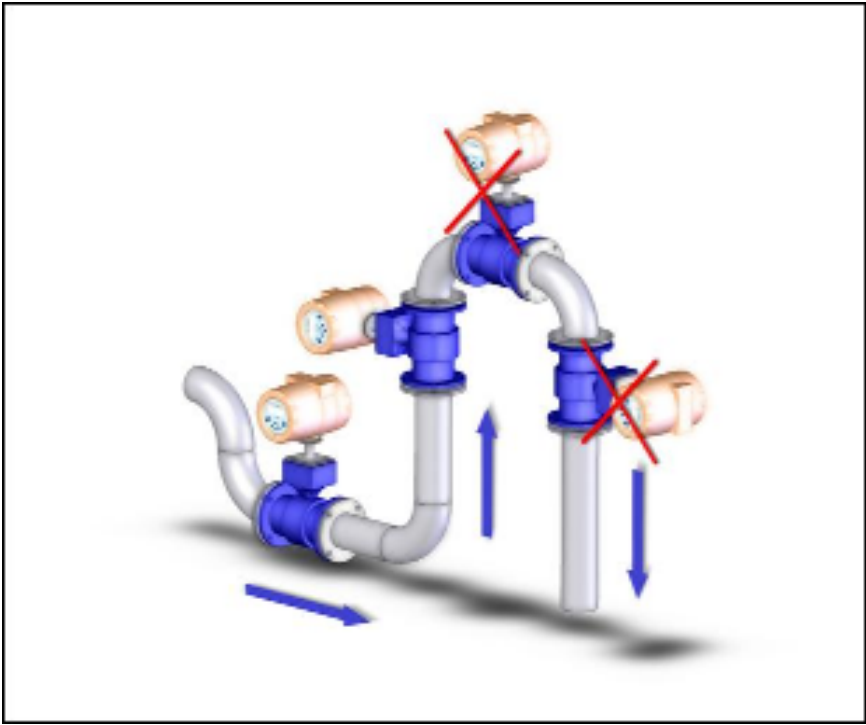
#### 4.1 Flow Sensor

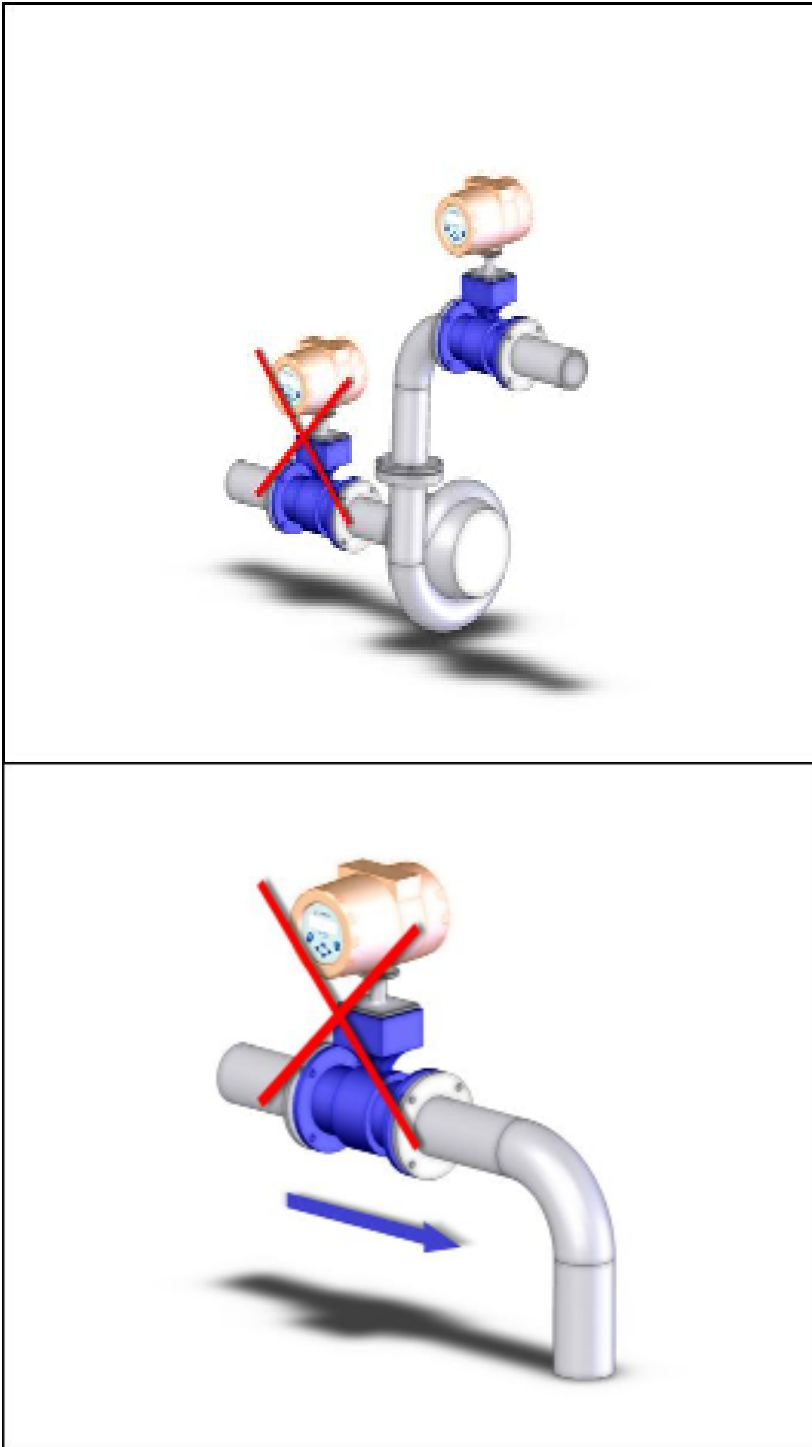
For the flow meter to operate correctly the pipe line must be full of liquid. It should therefore always be installed below the piezometric line. See diagram below:



Example installation diagrams:







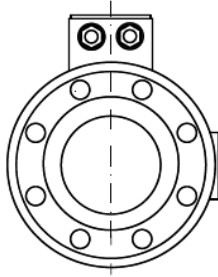
#### 4.2 Flow Direction

Each flow meter is supplied with a flow direction arrow indicating the proper installation direction for positive flow indication. With flow in the direction of the arrow the units will display the flow rate with no additional symbol. If the flow is against the flow arrow the flow rate will be displayed with a negative sign displayed indicating reverse flow.

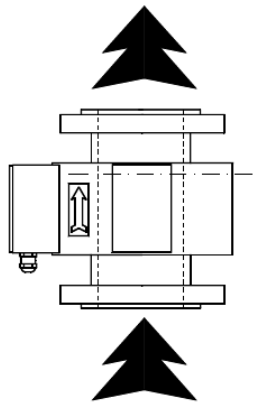


### 4.3 Orientation

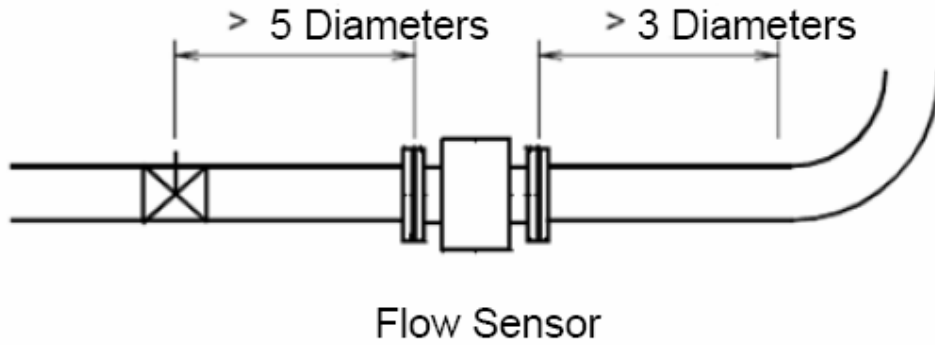
With the flow meter mounted in a horizontal pipe, the converter or junction box must be mounted vertically up.



If the meter is mounted in a vertical pipe, the liquid must flow from bottom to top.

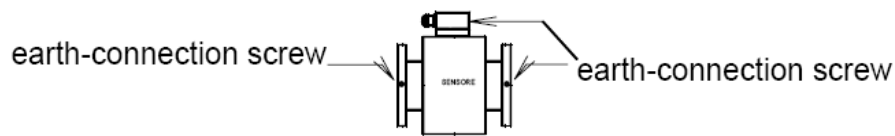


A straight run of pipe (without valves, curves, etc.) with a minimum length of five diameters up and three down stream of the flow meter should be maintained.



#### 4.4 Grounding

The sensor and converter must be properly grounded to earth potential for the system to operate correctly. Earth potential is the reference parameter for the flow meter and without proper grounding issues with zero offset, or flow indication at zero flow will occur. The sensors and converters all have earth grounding points that can be used to insure a direct contact with earth ground.



The Flow Technology electromagnetic flow meters are equipped with a third ground electrode that eliminates the need for grounding rings when installing the flow meter in insulating piping.

#### 4.5 Operating in a Vacuum

If the magnetic flow meter is to be installed in piping that will be under a vacuum it is necessary to verify the lining material will be able to resist the working conditions. The following table provides the minimum acceptable absolute working pressure. These values are dependent on meter diameter, lining material and temperature.


<b>Meter Size</b>	<b>Model</b>	<b>Lining</b>	<b>68° F, (20°C) PSIA</b>	<b>176° F, (80°C) PSIA</b>	<b>284° F, (140°C) PSIA</b>
All	EL 500	PTFE	0.00	0.00	0.00
1" to 3"	EL 2200	PTFE	0.00	0.00	0.13
4" to 6"	EL 2200	PTFE	0.15	0.25	0.40
8" to 16"	EL 2200	Ebonite	0.00	0.00	N/A
1" to 3"	EL 2400	PTFE	0.00	0.25	0.40
4"	EL 2400	PTFE	0.15	0.25	0.40

## 5 INSERTION FLOWMETER

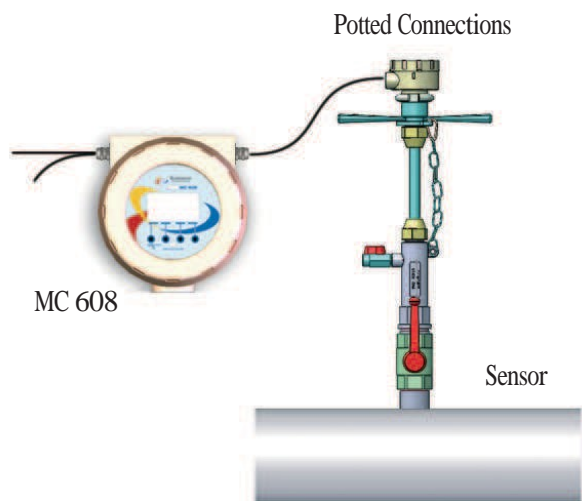
### 5.1 Introduction

The EL1222 electromagnetic insertion flow meter is designed for measurement of the velocity of water. The flow meters, can be installed in any pipeline of internal diameter from 1.5” to 40” (DN40 to DN1000).

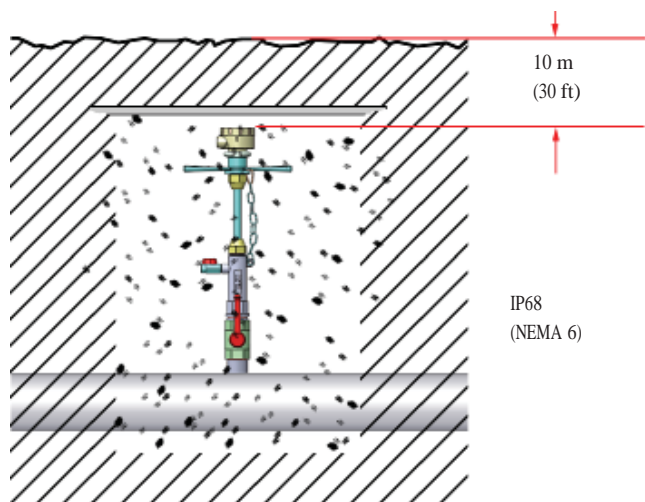
The EL1222 is designed for use in survey applications such as leakage monitoring and network analysis, and in permanent locations where cost or space limitations preclude the use of conventional full bore flow meters.

NOTE	
	<p>Care of the Equipment:</p> <ul style="list-style-type: none"><li>• The tip of the EL1222 is a precision-built and must be handled with care</li><li>• When removing/inserting the probe into the pipe line, ensure that the valve is fully open, to avoid any damage to the tip and or the body of the unit</li><li>• Damage to the probe may compromise the flow meter and its performances</li><li>• Any physical damage to the probe of the flow meter invalidates the warranty</li></ul>

### 5.2 System Schematic



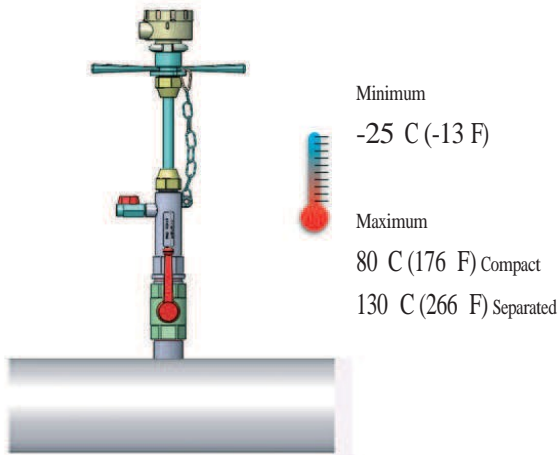
- Within Environmental Rating



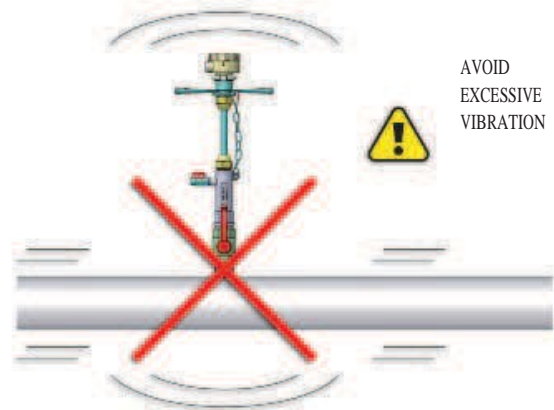


### 5.3 Mechanical Installation

- Location – Environmental installation
- Within Temperature Limits




- Avoid Excessive Vibration

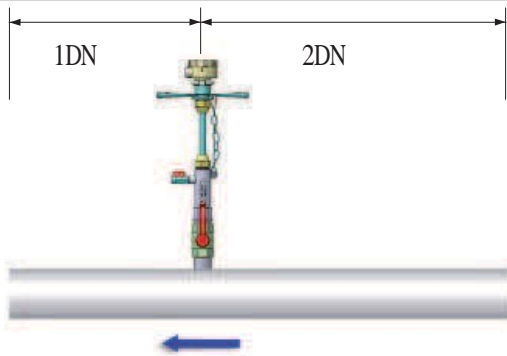


- Location – Flow Conditions

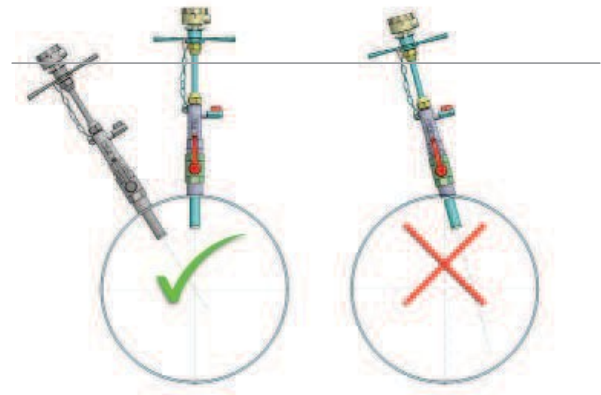
The probe must be installed at the mean axial velocity point, which is at 1/8 of the internal diameter of the pipe

-Orientation

NOTE	
	<p>Ensure that the sensor is installed in the pipe with the flow direction arrow on the probe case matching the pipe flow.</p>



PIPE MUST BE ALWAYS FULL

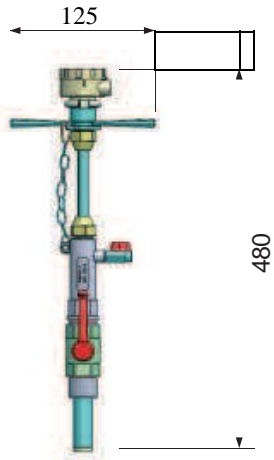


On center line

## 5.4 Installation

- Location - Mechanical

- Clearance Dimensions

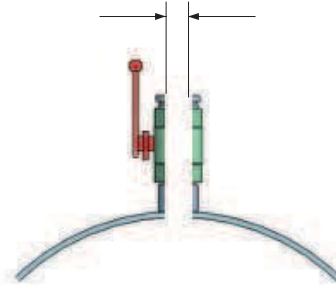


# WARNING!

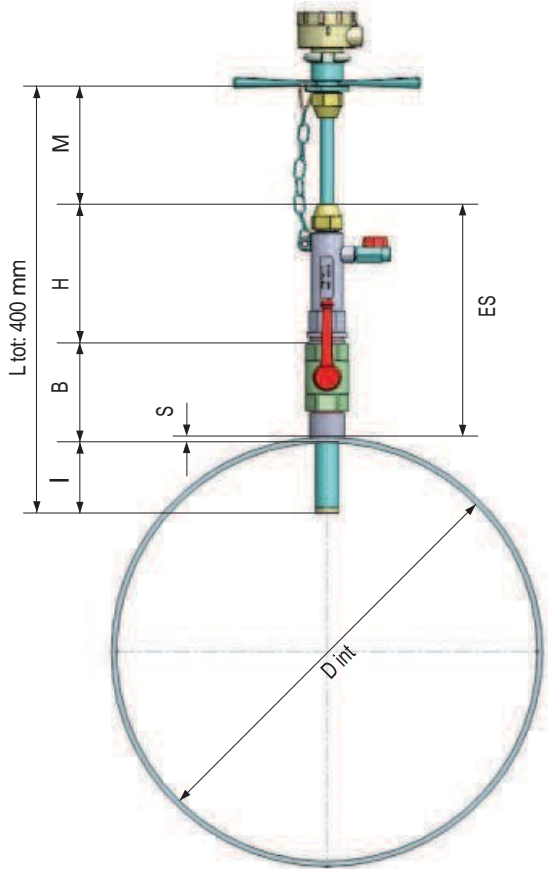


WHEN INSERTING OR REMOVING THE MUT1222, SUITABLE RESTRAINING EQUIPMENT MUST BE USED TO PREVENT THE PROBE BEING FORCED OUT UNDER PRESSURE, SAFETY CHAIN PROVIDED FOR SECURITY. ENSURE THAT THE VALVE IS FULLY OPEN.

25 mm (1") Minimum Clearance



## 5.5 Mean Axial Velocity Point (1/8 internal diameter)



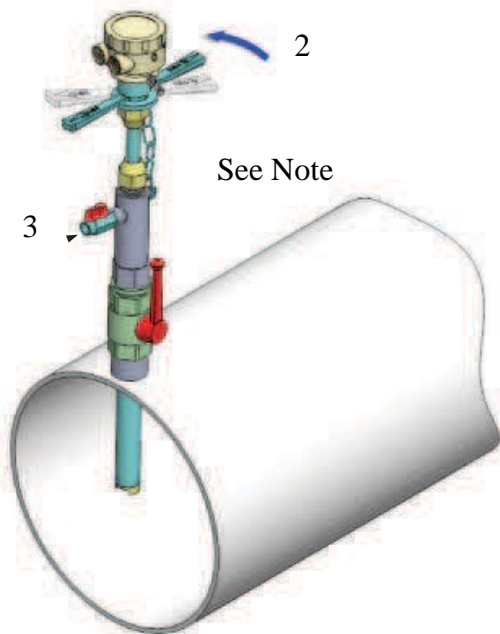
### References:

- D: diameter int. real
- S: tube wall thickness
- B: dead length
- H: hosing constant length (140mm)
- I: insertion depth (Dint./8)
- M: insertion metering control
- ES: Original standard parts (22 mm)
- L: total instrument length(400mm)
- $M = Ltot.-ES-S-(Dint./8)$
- $M = 17 -S-Dint./8$
- Example: D = 200mm, S = 3mm
- $M = 17 -2 -3 = 147$

## 5.6 Alignment

Align the flow direction arrow on the probe case matching the pipe flow.

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### References:

- 1- Slacken the nut
- 2- Align parallel to the pipe (within 2°)
- 3- Tighten to 40Nm (30 ft lbf)

## 6 SPECIFICATION AND OPTIONS

### 6.1 EL 500 Specifications

Accuracy:	+/- 0.2% of reading plus zero stability
Zero Stability:	+/- 0.1% full scale
Repeatability:	+/- 0.1%
Max Fluid Velocity:	10 m/s
Nominal Line Sizes:	1/8", 1/4", 3/8", 1/2", and 3/4"
Tube Material:	316 Stainless Steel
Electrode Material:	316L Stainless Steel (standard) Hastelloy C22 Titanium
Liner Material:	PTFE
Temperature Range:	-4° to 320° F ( -20° to 160° C) with remote electronics -4° to 140° F ( -20° to 60° C) with mounted electronics

Note: Operating temperatures above 284° F, (140° C) require a high temperature resin in the flow meter body. Operation at elevated temperature must be noted at the time of order.

Max Operating Pressure:	232 PSIG, (16 barg)
Max Cable Length:	100 meters
Min Conductivity:	5 µS/cm, 20 µS/cm with DI water
Rating:	IP 68 to a depth of 1.5 meters
Straight Run:	5D upstream and 3D downstream minimum

### 6.2 EL 4000 Specifications

Accuracy:	+/- 0.5% of reading plus zero stability
Zero Stability:	+/- 0.1% full scale
Repeatability:	+/- 0.2%
Max Fluid Velocity:	5 m/s
Nominal Line Sizes:	1/2", 5/8", 3/4", 1", 1 1/4", 1 1/2" and 2"
Tube Material:	Galvanized carbon steel
Electrode Material:	Hastelloy C
Liner Material:	PBT and 20% Fiberglass
Temperature Range:	-13° to 248° F (-25° to 120° C) with remote electronics

Max Operating Pressure:	140 PSIG, (10 barg)
Max Cable Length:	6 meters (20feet)
Min Conductivity:	5 µS/cm, 20 µS/cm with DI water
Rating:	IP 67
Straight Run:	5D upstream and 3D downstream minimum

### 6.3 EL 2200 Specifications

Accuracy:	+/- 0.2% of reading with velocity greater than 0.45 m/s
Repeatability:	+/- 0.1%
Max Fluid Velocity:	10 m/s
Nominal Line Sizes:	1" to 16"
Tube Material:	Carbon Steel or Stainless Steel
Electrode Material:	Hastelloy C22 (standard) 316L Stainless Steel Titanium Platinum Tantalum
Liner Material:	PTFE, 1" thru 6" Ebonite, 8" and larger
Temperature Range:	PTFE: -40° to 356° F (-40° to 180° C) Ebonite: -40° to 176° F (-40° to 80° C)

Note:

- 1) Operating temperatures above 284° F, (140° C) require a high temperature resin in the flow meter body. Operation at elevated temperature must be noted at the time of order.
- 2) Operating temperatures are limited by the electronics when transmitters are mounted on the flow meters.

Max Operating Pressure:	Dependent on flange rating
Max Cable Length:	100 meters
Min Conductivity:	5µS/cm, 20 µS/cm with DI water
Rating:	IP 68 to a depth of 1.5 meters
Straight Run:	5D upstream and 3D downstream minimum

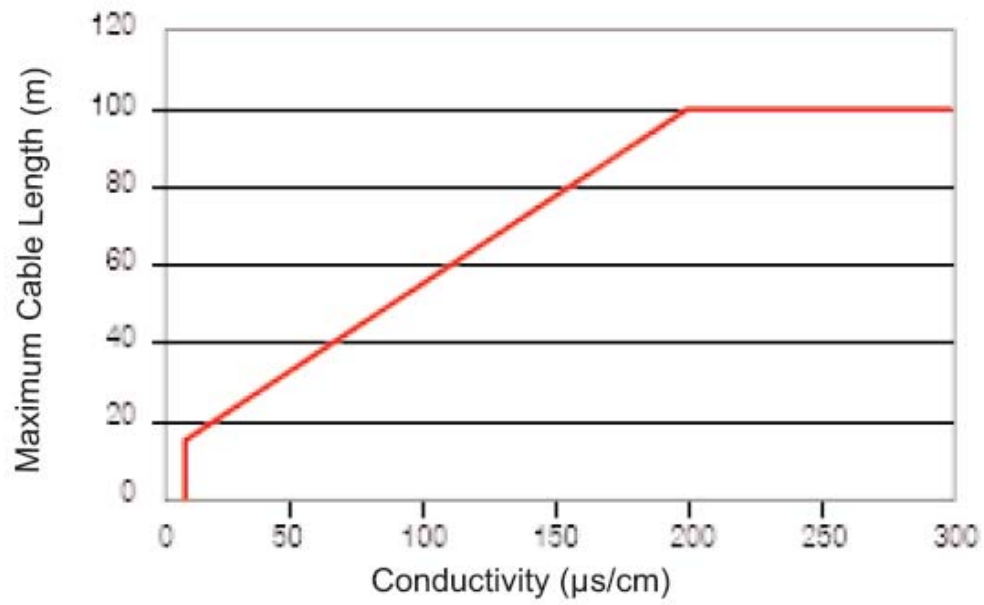
#### 6.4 EL 2400 Specifications

Accuracy:	+/- 0.2% of reading with velocity greater than 0.45 m/s
Repeatability:	+/- 0.1%
Max Fluid Velocity:	10 m/s
Nominal Line Sizes:	1" to 4"
Tube Material:	304 Stainless Steel
Electrode Material:	316L Stainless Steel (standard) Hastelloy C22 Titanium
Liner Material:	PTFE
Temperature Range:	-40° to 284° F (-40° to 140° C) with remote electronics -4° to 140° F (-20° to 60° C) with mounted electronics
Max Operating Pressure:	232 PSIG, (16 barg)
Max Cable Length:	100 meters
Min Conductivity:	5µS/cm, 20 µS/cm with DI water
Rating:	IP 68 to a depth of 1.5 meters
Straight Run:	5D upstream and 3D downstream minimum

#### 6.5 EL 1222 Specifications

Accuracy:	+/- 2.0% Reading plus 0.02% FS
Repeatability:	+/- 0.5%
Max Fluid Velocity:	10 m/s
Nominal Line Sizes:	1.5" to 40" (DN 40 to DN1000)
Tube Material:	304 Stainless Steel
Electrode Material:	AISI 316L
Temperature Range:	-13° to 266° F (-25° to 130° C) with remote electronics -13° to 176° F (-25° to 80° C) with integral electronics
Max Operating Pressure:	20 bar (290psi)
Max Cable Length:	100 meters
Min Conductivity:	5µS/cm, 20 µS/cm with DI water
Rating:	IP 67 (IP68 to 10 meters available on request)
Straight Run:	2D upstream and 1D downstream minimum

#### 6.6 Cable Length vs. Fluid Conductivity





## 7 MODEL NUMBER SYSTEM

### 7.1 EL 500

EL500				P			A
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Meter Size	Order Number
1/8"	-003
1/4"	-006
3/8"	-010
1/2"	-015
3/4"	-020

End Connection	Order Number
Male threaded UNI 338	GAS
Male threaded NPT	NPT
DIN 11851 female	DIN
Triclamp	ATC

End Connection Material	Order Number
AISI 316 (standard)	S
Hastelloy C	C
Titanium	T

Electrode Material	Order Number
AISI 316L (standard)	L
Hastelloy C	C
Titanium	T

Note: Electrode and end connection material should always be the same.

Version	Order Number
Compact	C
Remote with cable connected (The cable is always connected to the sensor and sealed with resin)	A

7.2 EL 4000

	-	A	A	A	-	A	A	A
--	---	---	---	---	---	---	---	---

Meter Size	Order Number
1/2"	69801
5/8"	69802
3/4"	69803
1 1/4"	69804
1 1/2"	69805
2"	69806

7.3 EL 2200

EL2200																																			
<table border="1"> <thead> <tr> <th>Code</th> <th>Size</th> <th>Code</th> <th>Size</th> </tr> </thead> <tbody> <tr> <td>-025</td> <td>1"</td> <td>-125</td> <td>5"</td> </tr> <tr> <td>-032</td> <td>1.25"</td> <td>-150</td> <td>6"</td> </tr> <tr> <td>-040</td> <td>1.5"</td> <td>-200</td> <td>8"</td> </tr> <tr> <td>-050</td> <td>2"</td> <td>-250</td> <td>10"</td> </tr> <tr> <td>-065</td> <td>2.5"</td> <td>-300</td> <td>12"</td> </tr> <tr> <td>-080</td> <td>3"</td> <td>-350</td> <td>14"</td> </tr> <tr> <td>-100</td> <td>4"</td> <td>-400</td> <td>16"</td> </tr> </tbody> </table>		Code	Size	Code	Size	-025	1"	-125	5"	-032	1.25"	-150	6"	-040	1.5"	-200	8"	-050	2"	-250	10"	-065	2.5"	-300	12"	-080	3"	-350	14"	-100	4"	-400	16"		
Code	Size	Code	Size																																
-025	1"	-125	5"																																
-032	1.25"	-150	6"																																
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7.4 EL 2400

EL2400			X	P			
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Meter Size	Order Number
1"	-025
1 1/4"	-032
1 1/2"	-040
2"	-050
2 1/2"	-065
3"	-080
4"	-100

End Connection	Order Number
DIN 11851	DIN
Triclamp	ATC

Electrode Material	Order Number
2 electrodes AISI 316L	L
2 electrodes Hastelloy C	C
2 electrodes Titanium	T
4 electrodes (empty pipe detection) AISI 316L	D
4 electrodes (empty pipe detection) Hastelloy C	F

Version	Order Number
Compact	C
Remote (Cable not included)	S

Approvals	Order Number
Standard	A
EHEDG Approved	E