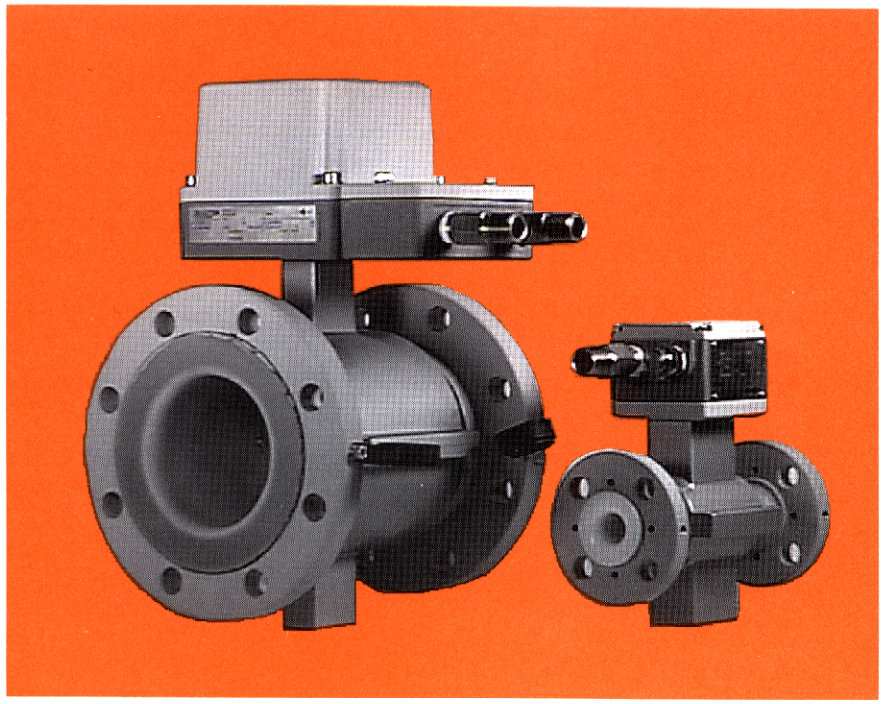
BAILEY
FISCHER
& PORTER

INSTRUCTION BULLETIN
MAGNETIC FLOWMETERS
10DX3111E & 10DX3111/3311G
Sizes 1/2 through 4 Inches

COPA-XM™ and MAG-X®
SERIES 3000 MAGNETIC FLOWMETER



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WARNING notices as used in this manual apply to hazards or unsafe practices which could result in personal injury or death.

CAUTION notices apply to hazards or unsafe practices which could result in property damage.

NOTES highlight procedures and contain information which assist the operator in understanding the information contained in this manual.

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WARNING

POSSIBLE PROCESS UPSETS
Maintenance must be performed only by qualified personnel and only after securing equipment controlled by this product. Adjusting or removing this product while it is in the system may upset the process being controlled. Some process upsets may cause injury or damage.

NOTICE

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SAFETY SUMMARY

GENERAL WARNINGS

POSSIBLE PROCESS UPSETS
Maintenance must be performed only by qualified personnel and only after securing equipment controlled by this product. Adjusting or removing this product while it is in the system may upset the process being controlled. Some process upsets may cause injury or damage.

RETURN OF EQUIPMENT
All Flowmeters and/or Signal Converters being returned to Bailey-Fischer & Porter for repair must be free of any hazardous materials (acids, alkalis, solvents, etc.). A Material Safety Data Sheet (MSDS) for all process liquids must accompany returned equipment. Contact Bailey-Fischer & Porter for authorization prior to returning equipment.

INSTRUCTION MANUALS
Do not install, maintain or operate this equipment without reading, understanding and following the proper Bailey-Fischer & Porter instructions and manuals, otherwise injury or damage may result.

ELECTRICAL SHOCK HAZARD
Equipment powered by AC line voltage presents a potential electric shock hazard to the user. Make certain that the system power is disconnected from the operating branch circuit before attempting electrical interconnections or service.

SPECIFIC WARNINGS

ELECTRICAL SHOCK HAZARD. Equipment powered by an AC line voltage presents a potential electric shock hazard. Servicing of the Magnetic Flow meter or Signal Converter should only be attempted by a qualified electronics technician. (pg. 6-2)

ELECTRICAL SHOCK HAZARD. Equipment powered by an AC line voltage presents a potential electric shock hazard. Make certain that the system power is disconnected before making the following ohmmeter checks. (pg. 6-3)

SPECIFIC CAUTIONS

Do not use a DC ohmmeter for this measurement as polarization effects will produce completely erroneous data. (pg. 4-3)

Some of the IC devices used in the signal converter are static sensitive and may be damaged by improper handling. When adjusting or servicing the signal converter, use of a grounded wrist strap is recommended to prevent inadvertant damage to the integral solid state circuitry. (pg. 6-1)

GÉNÉRAUX AVERTISSEMENTS

PROBLÈMES POTENTIELS. La maintenance doit être réalisée par du personnel qualifié et seulement après avoir sécurisé les équipements contrôlés par ce produit. L'ajustement ou le démontage de ce produit lorsqu'il est lié au système peut entraîner des dysfonctionnements dans le procédé qu'il contrôle. Ces dysfonctionnements peuvent entraîner des blessures ou des dommages.

RETOUR D'ÉQUIPEMENT. Tout débitmètre et(ou) convertisseur retourné à Bailey-Fischer & Porter pour réparation doit être exempt de toute trace de produit dangereux (acide, base, solvant, ...). Un certificat de sécurité matériel doit être joint pour tous les liquides utilisés dans le procédé. Contacter Bailey-Fischer & Porter pour autorisation avant renvoi du matériel.

MANUEL DE MISE EN ROUTE. Ne pas installer, maintenir ou utiliser cet équipement sans avoir lu, compris et suivi les instructions et manuels de Bailey-Fischer & Porter, dans le cas contraire il y a risque d'entraîner blessures ou dommages.

RISQUE DE CHOC ÉLECTRIQUE
Les équipements alimentés en courant alternatif constituent un risque de choc électrique potentiel pour l'utilisateur. Assurez-vous que les câbles d'alimentation amont sont déconnectés avant de procéder à des branchements, des essais ou tests.

SPÉCIFIQUES AVERTISSEMENTS

RISQUE DE CHOC ÉLECTRIQUE
Les équipements alimentés en courant alternatif constituent un risque de choc électrique potentiel. La maintenance sur des équipements électromagnétiques ou des convertisseurs doit être effectuée par des techniciens qualifiés. (pg. 6-2)

RISQUE DE CHOC ÉLECTRIQUE
Les équipements alimentés en courant alternatif constituent un risque de choc électrique potentiel. Assurez-vous que la puissance est déconnectée avant de procéder aux mesures de résistance suivantes. (pg 6-3)

SPÉCIFIQUES ATTENTIONS

N'utilisez pas un ohmmètre de C.C pour cette mesure car les effets de polarisation produiront des données complètement incorrectes. (pg. 4-3)

Certains Circuits Intégrés utilisés dans le convertisseur sont sensibles à l'électricité statique et peuvent être endommagés par une mauvaise manipulation. Pendant l'ajustement ou la maintenance d'un convertisseur, l'utilisation d'un bracelet antistatique est recommandé pour éviter la destruction par inadvertance d'un circuit intégré. (pg. 6-1)

READ FIRST

WARNING

INSTRUCTION MANUALS
Do not install, maintain, or operate this equipment without reading, understanding and following the proper Bailey-Fischer & Porter instructions and manuals, otherwise injury or damage may result.

RETURN OF EQUIPMENT
All Flowmeters and/or Signal Converters being returned to Bailey-Fischer & Porter for repair must be free of any hazardous materials (acids, alkalis, solvents, etc). A Material Safety Data Sheet (MSDS) for all process liquids must accompany returned equipment. Contact Bailey-Fischer & Porter for authorization prior to returning equipment.

Read these instructions before starting installation; save these instructions for future reference.

All magnetic flowmeters supplied after March 1992 are provided with a corrosion resistant NEMA 4X finish. The NEMA 4X rating applies to the meter body and electronics enclosure only. The following accessories (if supplied) may not meet NEMA 4X unless specifically ordered as NEMA 4X:

- meter flanges
- meter installation hardware: studs, nuts, bolts
- enclosure mounting hardware for pipe or wall mounting
- conduit hardware

This product is painted with a high performance epoxy paint. The corrosion protection provided by this finish is only effective if the finish is unbroken. It is the users' responsibility to "touch-up" any damage that has occurred to the finish during shipping or installation of the product. Special attention must be given to: meter flange bolting, pipe mounting of electronics, conduit entries and covers that are removed to facilitate installation or repair. For continued corrosion protection throughout the product life, it is the users' responsibility to maintain the product finish. Incidental scratches and other finish damage must be repaired and promptly re-painted with approved touch-up paint. Provide the model number and size of your product to the nearest Bailey-Fischer & Porter representative to obtain the correct touch-up paint.

1.0 INTRODUCTION

1.1 General

1.1.1 Description

The Bailey-Fischer & Porter Series 3000 Magnetic Flowmeter is a compact, volumetric, liquid flow rate detector that uses as the process transducing method the characteristic of a conductive liquid to generate an induced voltage when flowing through a magnetic field. The amplitude of the voltage produced is directly proportional to the flow rate of the metered liquid.

Being a completely obstructionless metering instrument, the Bailey-Fischer & Porter Series 3000 Magnetic Flowmeter can be used to meter liquids without regard to heterogeneous consistency and will resist plugging or fouling as much as the pipeline it is mounted in. An inherent advantage of obstructionless construction is that pressure losses are reduced to levels occurring in equivalent lengths of equal diameter pipeline. This reduces or conserves pressure source requirements in new or existing hydraulic lines as compared to other metering methods. The compact size of the meter results in a light-weight unit which requires no additional support other than that used normally on pipe runs. Short laying lengths minimize the need for altering existing pipe runs to accommodate metering. A basic construction of corrosive resistant wetted parts and a variety of meter lining materials permit metering of most corrosive and reactant liquids.

Factors such as liquid viscosity and density require no compensation and have no effect on the measurement accuracy of the Magnetic Flowmeter. Metering limitations are confined to a minimum threshold of electrical conductivity inherent to the liquid being metered. The degree of liquid conductivity has no effect upon metering accuracy as long as it is greater than this minimum level. Liquid temperature is limited only to the extent that it may affect liquid conductivity and, like liquid pressure, to the extent that it can not exceed the meter material specification limits.

The associated microprocessor-based electronics package is called the Signal Converter and may be either integrally or remotely mounted. The Flowmeter without the electronics package is used with a remote mounted Signal Converter. A remotely mounted Signal Converter is recommended for any or all of the following conditions:

- for COPA-XM™ (10DX3311), if the summation of ambient and process temperature is greater than 262° F (110° C)
- vibrations above the specification given in Section 1.3

The Signal Converter also contains a magnet driver unit that is used to power the meter's magnet coils. The steady bipolar state magnetic field principle, referred to as the MAG-X® design concept, provides optimum zero point stability at an optimized drive frequency.

For information concerning the Signal Converter, refer to the Signal Converter Instruction Bulletin.

1.1.2 Construction

The Bailey-Fischer & Porter Series 3000 Magnetic Flowmeter consists of a flanged, stainless steel pipe spool which serves as a meter body. A pair of flat magnet coils fit on opposite sides of the meter housing inner surface. Permeable iron straps and pole pieces focus the magnetic field generated by the coils and provide a flux return path.

Construction of the meter is dependent on the type of insulating interior liner used. A TEFLON® (PTFE) liner is inserted into the spool and turned-out against the flange faces. All other liner materials are bonded to the interior and face of the pipe spool. For all liner materials, two cylindrical electrodes are mounted diametrically opposed within the central portion of the meter body and are completely insulated from the metal pipe. The end surfaces of the electrodes are virtually flush with the inner surface of the insulating liner and come into contact with the liquid to be metered. Outline drawings are shown in Figures 2-3 through 2-6.

The primary housing for the continuous submergence & explosion-proof design is different from the other configurations in that it is sealed with a round screw-on access cover. The interior of this housing is filled with a gelatin-like silicone rubber compound which helps give the meter its water-proof rating. The outline drawings showing the construction of this meter are shown in Figures 2-7 & 2-8.

The NEMA 4X rating applies to the meter body and electronics enclosure only. The following accessories (if supplied) may not meet NEMA 4X unless specifically ordered as NEMA 4X:

- meter flanges
- meter installation hardware: studs, nuts, bolts
- enclosure mounting hardware for pipe or wall mounting
- conduit hardware

See the Read First section of this Instruction Bulletin for information on repairing damage to the meter's protective epoxy paint for continued NEMA 4X protection.

1.1.3 10DX3111/3311G EEPROM Data

For 10DX3111/3311G Primaries, the calibration data of the Primary is electronically stored in an EEPROM located in the associated M2 Converter. This EEPROM is specific to an individual Primary and must be installed in conjunction with the Converter for proper operation. 10DX3111G Primaries and associated remote M2 Converters are available either as calibrated systems or individually as spare parts.

When the 10DX3111G Primary is calibrated as a system, the EEPROM is already installed in the remote Converter and the Converter only needs to have power applied to begin operating.

If a 10DX3111G Primary is supplied as a spare part, all calibration information about that Primary is stored in the EEPROM supplied with the Primary. The **new** EEPROM is stored in the terminal compartment of the Primary and must be used to replace the **old** EEPROM in the M2 Converter. For detailed information on replacing and installing the EEPROM, refer to Section 7.3.1 in the M2 Converter Instruction Bulletin.

Replacement integrally-mounted Converters (10DX3311G) already have the EEPROM installed at the factory and require no action on the customer's part.

1.2 Model Number Breakdown

Refer to the Bailey-Fischer & Porter data sheet or data tag on the equipment for the model number of the instrument furnished. The details of a specific number are referenced on the following pages.

1.2.1 Model 10DX3111E

10DX3111	E	_	_	_	_	_	_	_	_	_	_	_	2	_

Engineering Reference
Obstructionless Remote Magnetic Flowmeter

Design Level
Remote with 50XM1000 Converter Electronics — E

Meter Lay Length
Short Form (WMAG) — D
Replacement for 10D1419 & 10D1465 — E
Replacement for 10D1435 — F
Other — Z

Liner Material
Hard Rubber — A
Polyurethane — D
PTFE TEFLON — E
Neoprene — L
TEFZEL — N

Size

mm	(inches)	
15	(1/2)	07
25	(1)	09
40	(1-1/2)	11
50	(2)	12
80	(3)	14
100	(4)	15

Flange Standard Pressure Rating
DIN PN 10 — C
DIN PN 16 — D
DIN PN 25 — E
DIN PN 40 — F
ANSI Class 150 — P
ANSI Class 300 — Q

Flange Material
Carbon Steel — 1
304 Stn. Steel — 2

Protector Plate (TEFLON Liner only)
None Required — A
316 Stn. Steel — B
HASTELLOY C — E

Electrode Type
Flush — 2
Bullet Nose — 3
Flush (Slurry Service) — 7

1.2.1 Model 10DX3111E (continued)

10DX3111 E _ _ _ _ _ _ _	_	_	_	_	2	_
Electrode Material						
316 Stn. Steel	B					
HASTELLOY® B	C					
HASTELLOY® C	D					
Titanium	E					
Tantalum	F					
Platinum / Iridium	H					
Zirconium	L					
Certification						
Standard		A				
FM Approved - Nonincendive for CL I, Div 2, Gp A,B,C & D; Electrodes Intrinsically Safe for CL I, Div 1, Gp A,B,C & D; Outdoor Hazardous Locations, NEMA 4X. Dust-Ignitionproof CL II, Div 1, Gp E,F & G: Suitable for CL III, Div 1.		K				
FM Approved - Explosionproof for CL I, Div 1, GP B, C & D; Dust-Ignitionproof CL II, Div 1, GP E,F & G; Suitable for CL III, Div 1, Electrodes Intrinsically Safe for CL I, Div 1, GP A, B, C & D - Outdoor Hazardous Location, NEMA 4X.		L				
Enclosure Classification						
IEC 529 IP 65, NEMA 4X			1			
Accidental Submergence, IEC 529 IP 67, NEMA 4X, 33ft H_2O/48h (10m H_20/48h)			2			
Accidental Submergence, IEC 529 IP 67, NEMA 4X, 33ft H_2O/48h (10m H_20/48h), tropical high-moisture protection, signal cable permanently installed			4			
Continuous Submergence, IEC 529 IP 68, NEMA 4X, 33ft H_2O (10m H_20)			5			
Accidental Submergence, IEC 529 IP 67, NEMA 4X, 33ft H_2O/48h (10m H_20/48h), tropical improved moisture protection, signal cable permanently installed			9			
Fluid Temperature Range						
Teflon, Rotomolded Tefzel, < 266° F (130° C)				1		
Teflon, Extended Temperature, < 356° F (180° C)				2		
Hard Rubber / Soft Rubber, < 176° F (80° C)				3		
Neoprene / Polyurethane < 190° F (88° C)				4		
Line Excitation Frequency						
50 Hz / 6-1/4 Hz					1	
50 Hz / 12-1/2 Hz					2	
60 Hz / 7-1/2 Hz					3	
60 Hz / 15 Hz					4	
Customer Information Language						
English					2	
Converter Type						
50XM1000						1
none						X

1.2.2 Model 10DX3111G

10DX3111 G _ _ _ _ _ _ _ _ _ _ _ _ _ _

Engineering Reference
Obstructionless Remote Magnetic Flowmeter

Design Level

Remote with M2 Converter Electronics	G

Meter Lay Length

Short Form (WMAG)	D
Replacement for 10D1419 & 10D1465	E
Replacement for 10D1435	F
Other	Z

Liner Material

Hard Rubber	A
Polyurethane	D
PTFE TEFLON	E
Neoprene	L
TEFZEL	N

Size

mm	(inches)	
15	(1/2)	07
25	(1)	09
40	(1-1/2)	11
50	(2)	12
80	(3)	14
100	(4)	15

Flange Standard Pressure Rating

DIN PN 10	C
DIN PN 16	D
DIN PN 25	E
DIN PN 40	F
ANSI Class 150	P
ANSI Class 300	Q

Flange Material

Carbon Steel	1
304 Stn. Steel	2

Protector Plate (TEFLON Liner only)

None Required	A
316 Stn. Steel	B
HASTELLOY C	E

Electrode Type

Flush	2
Bullet Nose	3
Flush (Slurry Service)	7

1.2.2 Model 10DX3111G (continued)

10DX3111 G _ _ _ _ _ _ _ — — — — — . —

Electrode Material

316 Stn. Steel	B
HASTELLOY® B	C
HASTELLOY® C	D
Titanium	E
Tantalum	F
Platinum / Iridium	H
Zirconium	L

Certification

Standard	A
FM Approved - Nonincendive for CL I, Div 2, Gp A,B,C & D; Electrodes Intrinsically Safe for CL I, Div 1, Gp A,B,C & D; Outdoor Hazardous Locations, NEMA 4X. Dust-Ignitionproof CL II, Div 1, Gp E,F & G: Suitable for CL III, Div 1.	K
FM Approved - Explosionproof for CL I, Div 1, GP B, C & D; Dust-Ignitionproof CL II, Div 1, GP E,F & G; Suitable for CL III, Div 1, Electrodes Intrinsically Safe for CL I, Div 1, GP A, B, C & D - Outdoor Hazardous Location, NEMA 4X.	L
CSA Approved - Class I, Div 2, Groups A,B,C & D; Class II, Div 2, Groups E,F & G; Class III, Div.2, Type 4	N

Enclosure Classification

IEC 529 IP 65, NEMA 4X	1
Accidental Submergence, IEC 529 IP 67, NEMA 4X, 33ft H_2O/48h (10m H_2O/48h)	2
Accidental Submergence, IEC 529 IP 67, NEMA 4X, 33ft H_2O/48h (10m H_2O/48h), tropical high-moisture protection, signal cable permanently installed	4
Continuous Submergence, IEC 529 IP 68, NEMA 4X, 33ft H_2O (10m H_2O), Signal cable permanently installed	5
Accidental Submergence, IEC 529 IP 67, NEMA 4X, 33ft H_2O/48h (10m H_2O/48h), tropical improved moisture protection, signal cable permanently installed	9

Fluid Temperature Range

Teflon, Rotomolded Tefzel, < 266° F (130° C)	1
Teflon, Extended Temperature, < 356° F (180° C)	2
Hard Rubber / Soft Rubber, < 176° F (80° C)	3
Neoprene / Polyurethane < 190° F (88° C)	4

Line Excitation Frequency

50 Hz / 6-1/4 Hz	1
50 Hz / 12-1/2 Hz	2
60 Hz / 7-1/2 Hz	3
60 Hz / 15 Hz	4

Customer Information Language

English w/ riveted SS tag	2
English w/ self-adhesive tag	8

Converter Type

M2	1
none	X

1.2.3 Model 10DX3311G

10DX3311 G _ _ — _ _ _ _ _ _ _ 1 _ _ X _ A _ _ _ _

Engineering Reference

Design Level
Integral with M2 Converter Electronics — G

Meter Lay Length
Short Form (WMAG) — D
Replacement for 10D1419 & 1465 — E
Replacement for 10D1435 — F
Other (Refer to Engineering — Z

Liner Material
Hard Rubber — A
Polyurethane — D
PTFE Teflon — E
Neoprene — L
Rotomolded Tefzel — N

Size - Inches (mm)
1/2 (15) — 07
1 (25) — 09
1-1/2 (40) — 11
2 (50) — 12
3 (80) — 14
4 (100) — 15

Flange Standard / Pressure Rating
DIN PN10 — C
DIN PN16 — D
DIN PN25 — E
DIN PN40 — F
ANSI Class 150 — P
ANSI Class 300 — Q

Flange Material
Carbon Steel — 1
304 Stainless Steel — 2

Protector Plates
None Required — A
316 SS — B
Hastelloy-C — E

Electrode Type
Flush — 2
Bullet Nose — 3
Flush (Slurry service) — 7

Electrode Material
316 SS — B
Hastelloy-B — C
Hastelloy-C — D
Titanium — E
Tantalum — F
Platinum/Iridium — H
Zirconium — L

Certification
Standard (None) — A
FM Approved - Nonincendive for CL I, Div 2, Gp A, B, C & D; Electrodes Intrinsically Safe for CL I, Div 1, Gp A, B, C & D; Outdoor Hazardous Locations , NEMA 4X. Dust-Ignition-Proof CL II, Div 1, Gp E, F & G; Suitable for CL III, Div 1; Accidental Submergence, 33 ft H_2O/48 hr (10 m H_2O/48 hr) — K

1.2.3 Model 10DX3311G (continued)

10DX3311 G _ _ __ _ _ _ _ _ _ 1 _ _ X _ A _ _ _ _

Enclosure Classification

General Purpose: IEC 529, IP65, NEMA 4X	1
Accidental Submergence: IEC 529, IP67, NEMA 4X. 33 ft H_2O/48 hr (10 m H_2O/48 hr)	2
Accidental Submergence: IEC 529, IP67, NEMA 4X. 33 ft H_2O/48 hr (10 m H_2O/48 hr). Tropical High-Moisture Protection.	4

Fluid Temperature Range

Standard	1

Excitation Frequency

6 1/4 Hz (50 Hz line)	1
12 1/2 Hz (50 Hz line)	2
7 1/2 Hz (60 Hz line)	3
15 Hz (60 Hz line)	4
12 1/2 Hz (DC power in vicinity of 50 Hz line)	6
15 Hz (DC power in vicinity of 60 Hz line)	8
Other Frequency	9

Customer Information Language

English w/ riveted SS tag	2
English w/ self-adhesive tag	8

Software Level

Generation	X

Pulse Output / Data Link

None / None	0
Active Scaled Pulse Fwd & Rev / None	1
None / RS485 Port	4
None / RS232 Port	5
None / Bailey FSK	9

Measuring Mode

Continuous Flow Measurement	A

Option Terminals

None	A
Alarm, Opto-coupled	D
External Zero Return	F
External Totalizer Reset	G
Forward Pulse Output, Opto-coupled	K

Accessories

Without	A
Empty Pipe Detection (presently not available)	B
HART Protocol	C
Empty Pipe Detection & HART Protocol (presently not available)	D

Power Supply

220/230/240 VAC, 50/60 Hz	A
110/115/120 VAC, 50/60 Hz	C
48 VAC, 50/60 Hz	E
24 VAC, 50/60 hZ	F
48 VDC	G
24 VDC	H

Converter

Required	1
None (Primary only)	2

1.3 Specifications

Power Requirements	Refer to Section 1.2 Model Number Breakdown.
Power Consumption	Refer to Signal Converter Instruction Bulletin.
Flowmeter Characteristics	
Meter Size/Flow Capacity	Refer to Table 1-4.
Span	Factory set at specified range between extremes listed in Table 1-4; can be field adjusted.
Rangeability	100:1
Minimum Liquid Conductivity	5 µS/cm
System Accuracy	Refer to Signal Converter Instruction Bulletin.
Meter Capacity	Specified on Flowmeter data tag (equal to maximum flow capacity in engineering units). Refer to Table 1-4.
Environmental Limits	
Ambient Temperature	Models 10DX3111: -13° to 140° F (-25° to 60° C) Model 10DX3311: -13° to 122° F (-25° to 50° C)
Relative Humidity	10% to 90%

Process Limits

TABLE 1-1. MAXIMUM LIQUID TEMPERATURE

Liner Material	Temperature
TEFLON, Model 10DX3111	356° F [180° C]
TEFZEL, Model 10DX3111	300° F [149° C]
TEFLON / TEFZEL, Model 10DX3311	266° F [130° C]
Neoprene/Polyurethane	190° F [88° C]
Hard Rubber	175° F [80° C]

TABLE 1-2. PRESSURE RATING, MPa (psig)

Flange Class	Flange Material	Temperature				
		100° F [38° C]	175° F [80° C]	190° F [88° C]	266° F [130° C]	356° F [180° C]
ANSI 150	Carbon Steel	1.96 (285)	1.82 (265)	1.81 (262)	1.65 (240)	1.47 (213)
	304 sst	1.90 (275)	1.69 (245)	1.65 (239)	1.48 (215)	1.32 (191)
ANSI 300	Carbon Steel	5.10 (740)	4.76 (690)	4.70 (682)	4.56 (662)	4.44 (644)
	304 sst	4.96 (720)	4.34 (630)	4.22 (612)	3.82 (554)	3.42 (496)
DIN PN6	Carbon Steel	0.60 (87)	0.60 (87)	0.60 (87)	0.59 (86)	0.57 (82)
	304 sst	0.58 (84)	0.57 (82)	0.57 (82)	0.54 (79)	0.50 (73)
DIN PN10	Carbon Steel	1.00 (145)	1.00 (145)	1.00 (145)	1.00 (145)	1.00 (145)
	304 sst	0.97 (140)	0.94 (137)	0.94 (137)	0.92 (133)	0.88 (128)
DIN PN16	Carbon Steel	1.60 (232)	1.60 (232)	1.60 (232)	1.60 (232)	1.60 (232)
	304 sst	1.54 (224)	1.51 (219)	1.50 (218)	1.46 (212)	1.41 (205)
DIN PN25	Carbon Steel	2.50 (362)	2.50 (362)	2.50 (362)	2.50 (362)	2.50 (362)
	304 sst	2.43 (352)	2.28 (331)	2.25 (327)	2.10 (304)	1.93 (280)
DIN PN40	Carbon Steel	4.00 (580)	4.00 (580)	4.00 (580)	4.00 (580)	4.00 (580)
	304 sst	3.89 (564)	3.65 (530	3.62 (525)	3.36 (488)	3.10 (449)

TABLE 1-3. VACUUM LIMIT

Meter Size	Liner Material	Temperature			
		68° F [20° C]	212° F [100° C]	266° F [130° C]	356° F [180° C]
1/2 -4 in (15-100 mm)	TEFLON	Full Vacuum To 266° F [130° C]			6.7 psia
	Neoprene Polyurethane Hard Rubber	Full Vacuum To 190° F [88° C]			
	TEFZEL	Full Vacuum To 300° F [149° C]			

TABLE 1-4. METER CAPACITY VALUES

Meter Size		Meter Capacity*	Flow Ranges 0 to Value Tabulated			
			Minimum		Maximum	
Inch	mm	gpm	gpm	L/min	gpm	L/min
½	15	26.4172	2.65	10.0	26.4	100.0
1	25	52.8344	5.29	20.0	52.8	200.0
1½	40	158.503	15.9	60.0	158.0	600.0
				m^3/h		m^3/h
2	50	264.372	26.5	6.0	264.0	60.0
3	80	792.516	79.3	18.0	792.0	180.0
4	100	1056.68	106.0	24.0	1056.0	240.0

* Each meter is calibrated to determine its flow capacity at a given velocity, which has been established by Bailey-Fischer & Porter as 32.808 ft/s (10 m/s) for the Meter Capacity. The Meter Capacity expressed in gpm is recorded on the meter nameplate.

All series 3000 meters are calibrated at 32.808 ft/s (10 m/s). Note that the display on the Signal Converter supplied may read "Cal Factor" even when configured for 32.808 ft/s (10 m/s).

The Meter Capacity is the base upon which maximum and minimum limits for range settings and outputs are established.

Flow Velocity can be determined as follows:

Meter Capacity:

Flow Velocity (ft/s) = (Operating gpm x 32.808)/Meter Capacity

> NOTE
> The maximum meter flow range is a function of the Signal Converter used. The maximum flow range may exceed the meter capacity to allow for overrange.

Physical Characteristics

Outline Dimensions	See Figures 2-3, 2-4 and 2-5.
Vibration Limits - with integral Converter	5 to 14 Hz, 0.10 inch; 14 to 200 Hz, 1 g

> NOTE
> A remotely mounted Signal Converter must be used when vibration limits are exceeded.

Signal Cable for Remote Converter (supplied by Bailey-Fischer & Porter, when applicable)

Standard Length	30 feet (9 m)
Optional Length	10DX3111E: Up to 500 feet (150 m), as specified. 10DX3111G: Up to 250 feet (75 m), as specified.

Materials of Construction

Meter Liner	see Section 1.2 Model Number Breakdown
Electrode Assembly	see Section 1.2 Model Number Breakdown
Meter Body	304 sst
Flanges	carbon steel or 304 sst, as specified
Meter Housing	aluminum, epoxy finish
Electronics Housing	cast aluminum, epoxy finish, 316 sst attachment screws, gasketed covers

Primary Enclosure Ratings

Watertight Housing (standard)	NEMA 4X, IEC 529 IP65
Accidental Submergence	NEMA 4X, IEC 529 IP67, 33 feet H_2O/48 h (10 m H_2O/48 h)
Continuous Submergence	NEMA 4X, IEC 529 IP 68, 33ft H_2O (10m H_20)
Conduit Connections	Remote Converter - two 1/2 inch NPT internally threaded entrances Integral Converter - three 1/2 inch NPT internally threaded entrances

> NOTE
> Enclosures are suitable for indoor or outdoor installation. Enclosure ratings apply to the Magnetic Flowmeter with or without an integral Signal Converter.

Certifications	refer to Section 1.2, Model Number Breakdown

2.0 INSTALLATION

2.1 Inspection

All Bailey-Fischer & Porter Series 3000 Magnetic Flowmeters are shipped in heavy duty containers which are specially designed to provide adequate protection during transit. Since the Magnetic Flowmeter will be operated in conjunction with an electronic Signal Converter, both instruments may be in the same shipping container. An itemized list of all items included in the shipment is attached to the shipping container. Refer to the Instruction Bulletin supplied with the associated Signal Converter for operation and maintenance procedures for the particular Converter.

If the Magnetic Flowmeter is supplied with a remote Signal Converter, the specified length of interconnection cable and conduit or cable seals will be included in the shipment.

Inspect all items included in the shipment immediately for indications of damage which may have occurred during shipment. All damage claims should be reported to the shipping agent involved before attempting to install or operate this equipment. If the damage is such that faulty operation is likely to result, the damage should be brought to the attention of the Fischer & Porter Service Department.

2.2 Meter Handling

The liner of the flowmeter may be damaged if it comes in contact with a sharp object and must be protected at all times.

When a TEFLON lined meter is specified, two liner protector plates (one on each flange face) are factory installed (when specified at time of order). These plates serve to contain the flared ends of the liner, and to prevent damage to the liner during installation and handling. These protector plates are attached to the meter with flat head screws that securely hold the liner in place. If the pressure on the liner is relieved, the TEFLON will tend to curl away from the flange. These protector plates must remain in place when the meter is installed. Refer to Figure 2-1 for a view of these protector plates. Also, due to the susceptibility of the meter to moisture penetration behind the liner before installation in the pipeline, TEFLON-lined meters should not be stored outdoors in uncovered areas, in wet locations or subjected to cleaning operations with excessive liquids prior to being fully installed in the pipeline.

During shipment, the liner is protected by wood or composition protectors as shown in Figure 2-2 (standard); these are removed before the meter is installed. These protectors should be left in position while moving the meter to the installation site. In the case of wood protectors, make certain there are no wood chips between the liner and the meter flange face prior to installation.

To place the meter in the pipeline a sling and hoist may be necessary. Do not pass any rope or wire sling through the meter; the liner will be damaged if the meter is supported by the liner. Lift the meter as shown in Figure 2-2.

Table 2-1 lists the weights of the remote 10DX3111 meters by size and flange classification. Weights shown are approximate and should be used only as a guide when installing the meter.

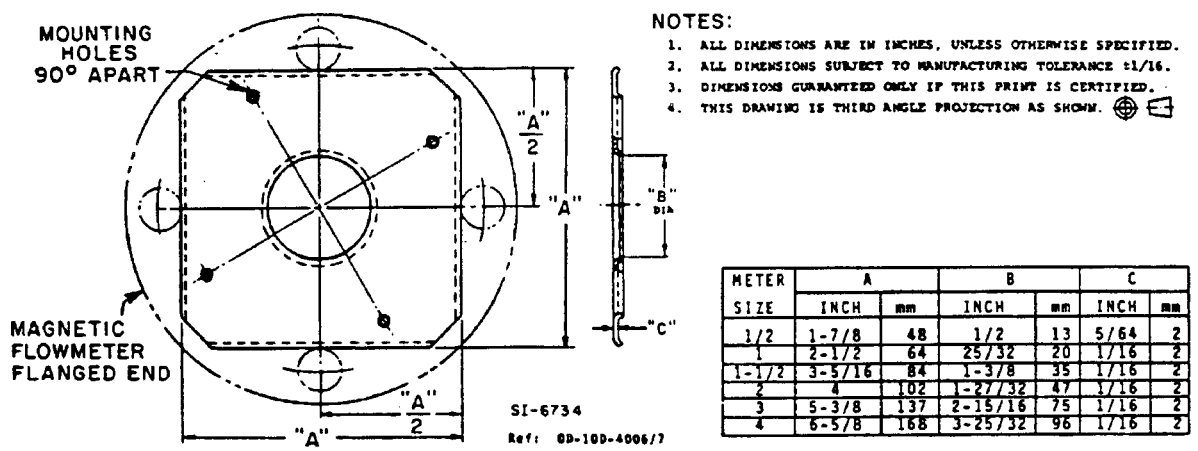
TABLE 2-1. METER WEIGHTS

Meter Size		ANSI Class 150		ANSI Class 300		DIN PN 10		DIN PN 16		DIN PN 25		DIN PN 40	
Inches	mm	lbs	kg	lbs	kg	lbs	kg	lbs	kg	lbs	kg	lbs	kg
½	15	5	2.2	15	6.6	5	2.2	5	2.2	15	6.6	15	6.6
1	25	8	3.5	19	8.4	8	3.5	8	3.5	19	8.4	19	8.4
1½	40	12	5.3	23	10.1	12	5.3	12	5.3	23	10.1	23	10.1
2	50	16	7.1	27	11.9	16	7.1	16	7.1	27	11.9	27	11.9
3	80	26	11.5	36	15.9	26	11.5	26	11.5	36	15.9	36	15.9
4	100	37	16.3	51	22.5	37	16.3	37	16.3	51	16.3	51	16.3

If the continuous submergence option is chosen for Model 10DX3111, the meter weights shown above must be modified by adding the weights shown in the following table:

TABLE 2-2. CONTINUOUS SUBMERGENCE WEIGHT FACTORS

Meter Size		Add to Meter Weight from Table Above	
Inches	mm	lbs	kg
½	15	1.04	.47
1	25	1.01	.46
1 ½	40	0.96	.44
2	50	1.04	.47
3	80	1.08	.49
4	100	1.92	.87



METER SIZE	A		B		C	
	INCH	mm	INCH	mm	INCH	mm
1/2	1-7/8	48	1/2	13	5/64	2
1	2-1/2	64	25/32	20	1/16	2
1-1/2	3-5/16	84	1-3/8	35	1/16	2
2	4	102	1-27/32	47	1/16	2
3	5-3/8	137	2-15/16	75	1/16	2
4	6-5/8	168	3-25/32	96	1/16	2

LINER PROTECTOR PLATES, SIZES 1/2 THROUGH 4 INCHES

FIGURE 2-1. PROTECTOR PLATES FOR TEFLON LINERS

2.3 Location

The Flowmeter is suitable for either indoor or outdoor installation. When selecting the location of the installation, consideration should be given to the ambient and process temperature limits, as stated in the Specifications Sub-Section 1.3.

Several variations of resistance to water-entry are available:

- The Standard meter is rated NEMA 4X (IEC 529 IP65), watertight, and will withstand periods of rain and hose down.
- If periodic flooding may occur, an optional NEMA 4X (IEC 529 IP67) **accidental submergence** Flowmeter is available to withstand submergence up to 48 hours. These ratings apply to TEFLON-lined meters only after the meter is properly installed in the pipeline.
- If periodic flooding is expected to keep the meter submerged for periods longer than 48 hours, an optional **continuous submergence** NEMA 4X (IEC 529 IP68) configuration is available.

It is recommended that the meter not be installed in the immediate vicinity of electrical conductors carrying large currents or equipment generating strong magnetic fields.

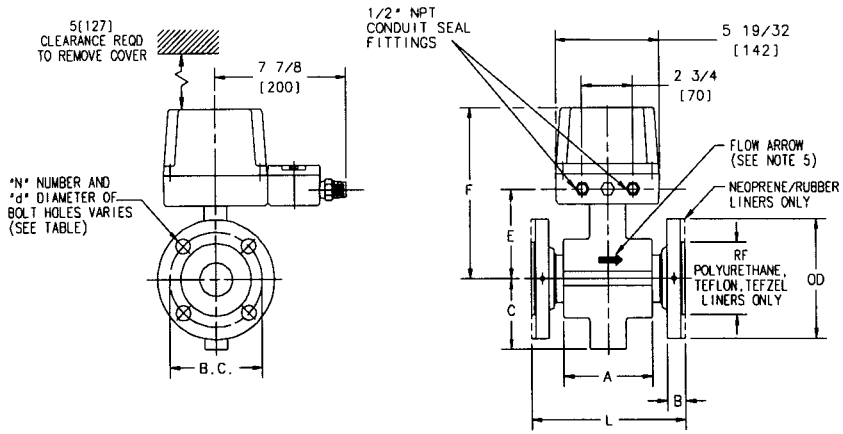
Access for wiring interconnections and servicing of the integrally mounted Signal Converter should be considered when installing the meter. A minimum of five inches of overhead clearance is required for cover removal.

Outline dimensions of the Flowmeter are given in Figures 2-3 through 2-8.

Outline dimensions of the optional remotely mounted Signal Converter are given in the Instruction Bulletin supplied with the Signal Converter.

The installation site must be provided with a convenient source of power as specified for the Signal Converter. The power line should have a disconnect switch and a suitable fuse or circuit breaker as shown on the applicable interconnection diagram provided in the Instruction Bulletin supplied with the Signal Converter.

DIM	SIZE	1/2 [15]		1 [25]		1-1/2 [40]		2 [50]		3 [80]		4 [100]	
	FLANGE CLASS	150	300	150	300	150	300	150	300	150	300	150	300
	MODEL NO.												
L	10DX3311ED	7-7/8 [200]	9 [229]	7-7/8 [200]	9 [229]	7-7/8 [200]	9 [229]	7-7/8 [200]	9 [229]	7-7/8 [200]	9 [229]	9-7/8 [250]	11 [280]
L	10DX3311EE	14 [356]		14 [356]		16 [406]		16 [406]		12 [305]		12 [305]	
L	10DX3311EF	N/A		N/A		N/A		N/A		N/A		N/A	
L	10DX3311EZ	SEE SALES ORDER INFORMATION FOR "L" DIMENSION											
	LINER												
RF	POLY/ TEFL/TEFZ	1-3/8 [35]		2 [51]		2-7/8 [73]		3-5/8 [92]		5 [127]		6-3/16 [157]	
B	POLY/NEO/ RUBBER	N/A		N/A		N/A		15/16 [24]	1-1/16 [27]	1-1/8 [29]	1-5/16 [33]	1-1/8 [29]	1-7/16 [36]
	TEFLON	1/2 [13]	5/8 [16]	11/16 [17]	13/16 [21]	27/32 [21]	31/32 [25]	29/32 [23]	1-1/32 [26]	1-3/32 [27]	1-9/32 [32]	1-3/32 [27]	1-13/32 [35]
	TEFZEL			5/8 [16]	3/4 [19]	3/4 [19]	7/8 [22]	27/32 [21]	31/32 [25]	3/4 [19]	1-1/4 [32]	1-3/32 [27]	1-3/8 [35]
d		5/8 [16]		5/8 [16]	3/4 [19]	5/8 [16]	7/8 [22]	3/4 [19]		3/4 [19]	7/8 [22]	3/4 [19]	7/8 [22]
N		4		4		4		4	8	4	8	8	8
BC		2-3/8 [60]	2-5/8 [67]	3-1/8 [79]	3-1/2 [89]	3-7/8 [98]	4-1/2 [114]	4-3/4 [121]	5 [127]	6 [152]	6-5/8 [168]	7-1/2 [191]	7-7/8 [200]
OD		3-1/2 [89]	3-3/4 [95]	4-1/4 [108]	4-7/8 [124]	5 [127]	6-1/8 [156]	6 [152]	6-1/2 [165]	7-1/2 [190]	8-1/4 [210]	9 [229]	10 [254]
A		2-15/16 [75]		3-7/16 [87]		3-15/16 [100]		4-9/16 [116]		3-15/16 [100]		5-1/8 [130]	
C		2-7/16 [62]		2-7/8 [73]		3-7/32 [82]		3-17/32 [90]		4-11/32 [110]		5-1/8 [130]	
E		3-9/32 [83]		3-23/32 [94]		4-1/16 [103]		4-3/8 [111]		5-5/32 [131]		5-31/32 [152]	
F		7-5/16 [186]		7-3/4 [197]		8-3/32 [206]		8-13/32 [214]		9-3/16 [233]		10 [254]	



NOTES:
1) ALL DIMENSIONS ARE IN INCHES. DIMENSIONS IN BRACKETS [ ] ARE IN MILLIMETERS [MM].
2) DIMENSIONS ARE GUARANTEED ONLY IF THIS PRINT IS CERTIFIED.
3) THIS DRAWING IS THIRD ANGLE PROJECTION AS SHOWN.
4) FLANGE BOLTS STRADDLE CENTERLINES.
5) FLOW MUST BE IN SAME DIRECTION AS FLOW ARROW.
6) METER MUST BE COMPLETELY FILLED WITH LIQUID TO INSURE ACCURACY.
7) ALL DIMENSIONS SUBJECT TO MANUFACTURING TOLERANCES OF +/- 1/8 [3].

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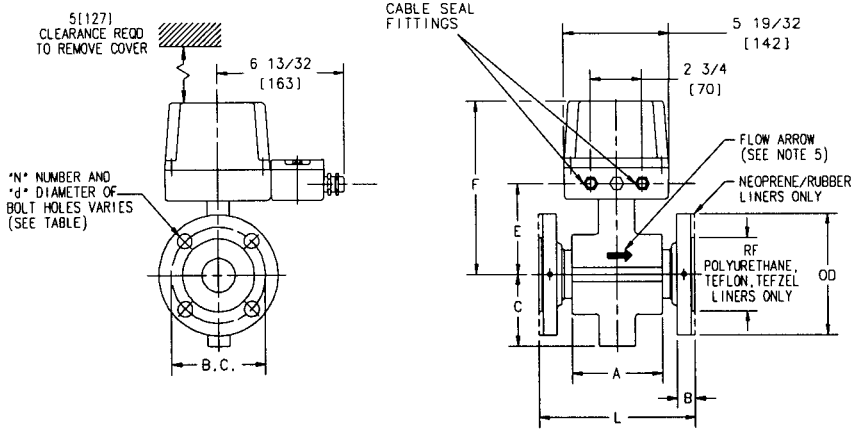
FIGURE 2-3. OUTLINE DIMENSIONS, INTEGRAL CONVERTER WITH ANSI FLANGES (10DX3311G)

DIM	SIZE	1/2 [15]		1 [25]		1-1/2 [40]		2 [50]		3 [80]		4 [100]	
	DIN PN	10/16	25/40	10/16	25/40	10/16	25/40	10/16	25/40	10/16	25/40	10/16	25/40
	MODEL NO.												
L	10DX3311ED	7-7/8 [200]	9 [229]	7-7/8 [200]	9 [229]	7-7/8 [200]	9 [229]	7-7/8 [200]	9 [229]	7-7/8 [200]	9 [229]	9-7/8 [250]	11 [280]
L	10DX3311EE	14 [356]		14 [356]		16 [406]		16 [406]		12 [305]		12 [305]	
L	10DX3311EF	N/A		N/A		N/A		N/A		N/A		N/A	
L	10DX3311EZ	SEE SALES ORDER INFORMATION FOR "L" DIMENSION											
	LINER												
RF	POLY/ TEFL/TEFZ	1-25/32 [45]		2-11/16 [68]		3-15/32 [88]		4 [102]		5-7/16 [138]		6-7/32 [158]	6-3/8 [162]
B	POLY/NEO/ RUBBER	N/A		N/A		N/A		15/16 [24]	1-1/16 [27]	1-1/8 [29]	1-5/16 [33]	1-1/8 [29]	1-7/16 [36]
	TEFLON	1/2 [13]	5/8 [16]	11/16 [17]	13/16 [21]	27/32 [21]	31/32 [25]	29/32 [23]	1-1/32 [26]	1-3/32 [27]	1-9/32 [32]	1-3/32 [27]	1-13/32 [35]
	TEFZEL			5/8 [16]	3/4 [19]	3/4 [19]	7/8 [22]	27/32 [21]	31/32 [25]	3/4 [19]	1-1/4 [32]	1-3/32 [27]	1-3/8 [35]
d		9/16 [14]		9/16 [14]		23/32 [18]		23/32 [18]		23/32 [18]		23/32 [18]	7/8 [22]
N		4		4		4		4		8		8	
BC		2-9/16 [65]		3-11/32 [85]		4-11/32 [110]		4-29/32 [125]		6-5/16 [160]		7-3/32 [180]	7-1/2 [190]
OD		3-3/4 [95]		4-17/32 [115]		5-29/32 [150]		6-1/2 [165]		7-7/8 [200]		8-21/32 [220]	9-1/4 [235]
A		2-15/16 [75]		3-7/16 [87]		3-15/16 [100]		4-9/16 [116]		3-15/16 [100]		5-1/8 [130]	
C		2-7/16 [62]		2-7/8 [73]		3-7/32 [82]		3-17/32 [90]		4-11/32 [110]		5-1/8 [130]	
E		3-9/32 [83]		3-23/32 [94]		4-1/16 [103]		4-3/8 [111]		5-5/32 [131]		5-31/32 [152]	
F		7-5/16 [186]		7-3/4 [197]		8-3/32 [206]		8-13/32 [214]		9-3/16 [233]		10 [254]	



NOTES:
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2) DIMENSIONS ARE GUARANTEED ONLY IF THIS PRINT IS CERTIFIED.
3) THIS DRAWING IS THIRD ANGLE PROJECTION AS SHOWN.
4) FLANGE BOLTS STRADDLE CENTERLINES.
5) FLOW MUST BE IN SAME DIRECTION AS FLOW ARROW.
6) METER MUST BE COMPLETELY FILLED WITH LIQUID TO INSURE ACCURACY.
7) ALL DIMENSIONS SUBJECT TO MANUFACTURING TOLERANCES OF +/- 1/8 [3].

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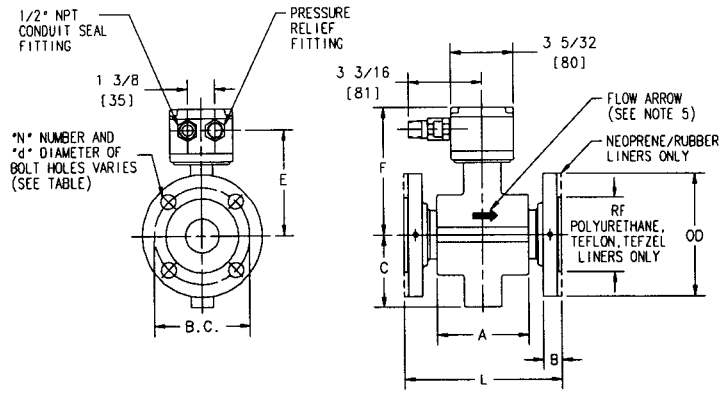
FIGURE 2-4. OUTLINE DIMENSIONS, INTEGRAL CONVERTER WITH DIN FLANGES (10DX3311G)

DIM	SIZE	1/2 [15]		1 [25]		1-1/2 [40]		2 [50]		3 [80]		4 [100]	
	FLANGE CLASS	150	300	150	300	150	300	150	300	150	300	150	300
	MODEL NO.												
L	10D S/X 3111ED	7-7/8 [200]	9 [229]	7-7/8 [200]	9 [229]	7-7/8 [200]	9 [229]	7-7/8 [200]	9 [229]	7-7/8 [200]	9 [229]	9-7/8 [250]	11 [280]
L	10D S/X 3111EE	14 [356]		14 [356]		16 [406]		16 [406]		12 [305]		12 [305]	
L	10D S/X 3111EF	N/A		N/A		N/A		N/A		N/A		N/A	
L	10D S/X 3111EZ	SEE SALES ORDER INFORMATION FOR "L" DIMENSION											
	LINER												
RF	POLY/ TEFL/TEFZ	1-3/8 [35]		2 [51]		2-7/8 [73]		3-5/8 [92]		5 [127]		6-3/16 [157]	
B	POLY/NEO/ RUBBER	N/A		N/A		N/A		15/16 [24]	1-1/16 [27]	1-1/8 [29]	1-5/16 [33]	1-1/8 [29]	1-7/16 [36]
	TEFLON	1/2 [13]	5/8 [16]	11/16 [17]	13/16 [21]	27/32 [21]	31/32 [25]	29/32 [23]	1-1/32 [26]	1-3/32 [27]	1-9/32 [32]	1-3/32 [27]	1-13/32 [35]
	TEFZEL			5/8 [16]	3/4 [19]	3/4 [19]	7/8 [22]	27/32 [21]	31/32 [25]	3/4 [19]	1-1/4 [32]	1-3/32 [27]	1-3/8 [35]
d		5/8 [16]		5/8 [16]	3/4 [19]	5/8 [16]	7/8 [22]	3/4 [19]		3/4 [19]	7/8 [22]	3/4 [19]	7/8 [22]
N		4		4		4		4	8	4	8	8	8
BC		2-3/8 [60]	2-5/8 [67]	3-1/8 [79]	3-1/2 [89]	3-7/8 [98]	4-1/2 [114]	4-3/4 [121]	5 [127]	6 [152]	6-5/8 [168]	7-1/2 [191]	7-7/8 [200]
OD		3-1/2 [89]	3-3/4 [95]	4-1/4 [108]	4-7/8 [124]	5 [127]	6-1/8 [156]	6 [152]	6-1/2 [165]	7-1/2 [190]	8-1/4 [210]	9 [229]	10 [254]
A		2-15/16 [75]		3-7/16 [87]		3-15/16 [100]		4-9/16 [116]		3-15/16 [100]		5-1/8 [130]	
C		2-7/16 [62]		2-7/8 [73]		3-7/32 [82]		3-17/32 [90]		4-11/32 [110]		5-1/8 [130]	
E	STD. TEMP.	4-1/8 [105]		4-9/16 [116]		4-29/32 [125]		5-7/32 [133]		6-1/32 [153]		6-13/16 [173]	
F		5-3/16 [132]		5-5/8 [143]		5-31/32 [152]		6-9/32 [160]		7-3/32 [180]		7-7/8 [200]	
E	HIGH TEMP.	4-1/2 [114]		4-15/16 [125]		5-9/32 [134]		5-19/32 [142]		6-13/32 [163]		7-3/16 [183]	
F		5-9/16 [141]		6 [152]		6-11/32 [161]		6-21/32 [169]		7-15/32 [190]		8-1/4 [210]	



NOTES:
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3) THIS DRAWING IS THIRD ANGLE PROJECTION AS SHOWN.
4) FLANGE BOLTS STRADDLE CENTERLINES.
5) FLOW MUST BE IN SAME DIRECTION AS FLOW ARROW.
6) METER MUST BE COMPLETELY FILLED WITH LIQUID TO INSURE ACCURACY.
7) ALL DIMENSIONS SUBJECT TO MANUFACTURING TOLERANCES OF +/- 1/8 [3].

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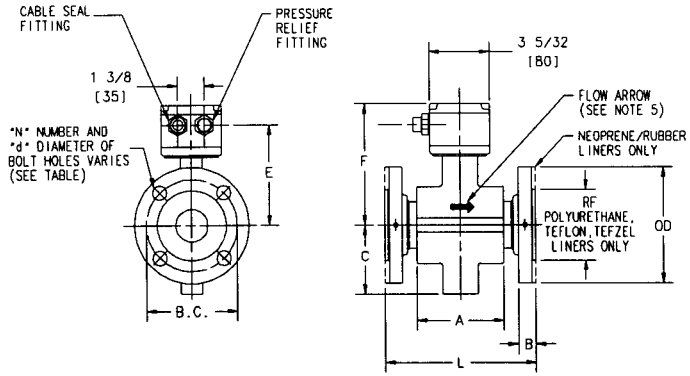
FIGURE 2-5. OUTLINE DIMENSIONS, REMOTE CONVERTER WITH ANSI FLANGES (10DX3111E/G)

DIM	SIZE	1/2 [15]		1 [25]		1-1/2 [40]		2 [50]		3 [80]		4 [100]	
	DIN PN	10/16	25/40	10/16	25/40	10/16	25/40	10/16	25/40	10/16	25/40	10/16	25/40
	MODEL NO.												
L	100 S/X 3111ED	7-7/8 [200]	9 [229]	7-7/8 [200]	9 [229]	7-7/8 [200]	9 [229]	7-7/8 [200]	9 [229]	7-7/8 [200]	9 [229]	9-7/8 [250]	11 [280]
L	100 S/X 3111EE	14 [356]		14 [356]		16 [406]		16 [406]		12 [305]		12 [305]	
L	100 S/X 3111EF	N/A		N/A		N/A		N/A		N/A		N/A	
L	100 S/X 3111EZ	SEE SALES ORDER INFORMATION FOR "L" DIMENSION											
	LINER												
RF	POLY/ TEFL/TEFZ	1-25/32 [45]		2-11/16 [68]		3-15/32 [88]		4 [102]		5-7/16 [138]		6-7/32 [158]	6-3/8 [162]
B	POLY/NEO/ RUBBER	N/A		N/A		N/A		15/16 [24]	1-1/16 [27]	1-1/8 [29]	1-5/16 [33]	1-1/8 [29]	1-7/16 [36]
	TEFLON	1/2 [13]	5/8 [16]	11/16 [17]	13/16 [21]	27/32 [21]	31/32 [25]	29/32 [23]	1-1/32 [26]	1-3/32 [27]	1-9/32 [32]	1-3/32 [27]	1-13/32 [35]
	TEFZEL			5/8 [16]	3/4 [19]	3/4 [19]	7/8 [22]	27/32 [21]	31/32 [25]	3/4 [19]	1-1/4 [32]	1-3/32 [27]	1-3/8 [35]
d		9/16 [14]		9/16 [14]		23/32 [18]		23/32 [18]		23/32 [18]		23/32 [18]	7/8 [22]
N		4		4		4		4		8		8	
BC		2-9/16 [65]		3-11/32 [85]		4-11/32 [110]		4-29/32 [125]		6-5/16 [160]		7-3/32 [180]	7-1/2 [190]
OD		3-3/4 [95]		4-17/32 [115]		5-29/32 [150]		6-1/2 [165]		7-7/8 [200]		8-21/32 [220]	9-1/4 [235]
A		2-15/16 [75]		3-7/16 [87]		3-15/16 [100]		4-9/16 [116]		3-15/16 [100]		5-1/8 [130]	
C		2-7/16 [62]		2-7/8 [73]		3-7/32 [82]		3-17/32 [90]		4-11/32 [110]		5-1/8 [130]	
E	STD. TEMP.	4-1/8 [105]		4-9/16 [116]		4-29/32 [125]		5-7/32 [133]		6-1/32 [153]		6-13/16 [173]	
F	STD. TEMP.	5-3/16 [132]		5-5/8 [143]		5-31/32 [152]		6-9/32 [160]		7-3/32 [180]		7-7/8 [200]	
E	HIGH TEMP.	4-1/2 [114]		4-15/16 [125]		5-9/32 [134]		5-19/32 [142]		6-13/32 [163]		7-3/16 [183]	
F	HIGH TEMP.	5-9/16 [141]		6 [152]		6-11/32 [161]		6-21/32 [169]		7-15/32 [190]		8-1/4 [210]	



NOTES:
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2) DIMENSIONS ARE GUARANTEED ONLY IF THIS PRINT IS CERTIFIED.
3) THIS DRAWING IS THIRD ANGLE PROJECTION AS SHOWN.
4) FLANGE BOLTS STRADDLE CENTERLINES.
5) FLOW MUST BE IN SAME DIRECTION AS FLOW ARROW.
6) METER MUST BE COMPLETELY FILLED WITH LIQUID TO INSURE ACCURACY.
7) ALL DIMENSIONS SUBJECT TO MANUFACTURING TOLERANCES OF +/- 1/8 [3].

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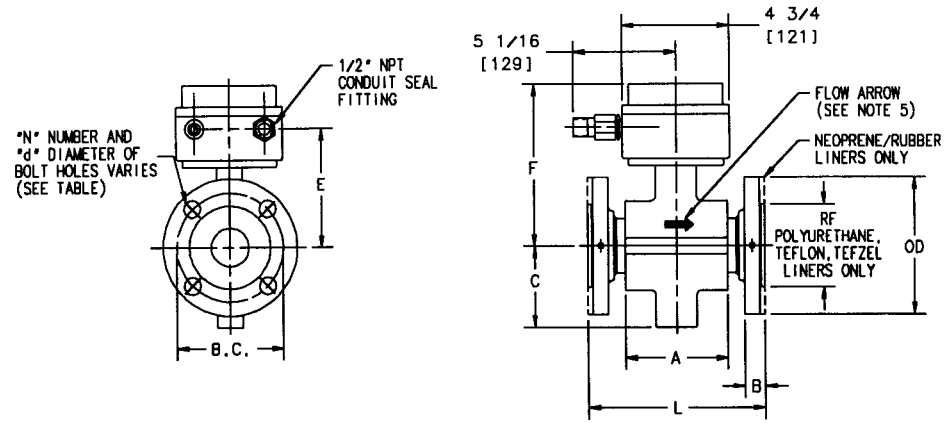
FIGURE 2-6. OUTLINE DIMENSIONS, REMOTE CONVERTER WITH DIN FLANGES (10DX3111E/G)

DIM	SIZE	1/2 [15]		1 [25]		1-1/2 [40]		2 [50]		3 [80]		4 [100]	
	FLANGE CLASS	150	300	150	300	150	300	150	300	150	300	150	300
	MODEL NO.												
L	10D S/X 3111ED	7-7/8 [200]	9 [229]	7-7/8 [200]	9 [229]	7-7/8 [200]	9 [229]	7-7/8 [200]	9 [229]	7-7/8 [200]	9 [229]	9-7/8 [250]	11 [280]
L	10D S/X 3111EE	14 [356]		14 [356]		16 [406]		16 [406]		12 [305]		12 [305]	
L	10D S/X 3111EF	N/A		N/A		N/A		N/A		N/A		N/A	
L	10D S/X 3111EZ	SEE SALES ORDER INFORMATION FOR "L" DIMENSIONS											
	LINER												
RF	POLY/ TEFL/TEFZ	1-3/8 [35]		2 [51]		2-7/8 [73]		3-5/8 [92]		5 [127]		6-3/16 [157]	
B	POLY/NEO/ RUBBER	N/A		N/A		N/A		15/16 [24]	1-1/16 [27]	1-1/8 [29]	1-5/16 [33]	1-1/8 [29]	1-7/16 [36]
	TEFLON	1/2 [13]	5/8 [16]	11/16 [17]	13/16 [21]	27/32 [21]	31/32 [25]	29/32 [23]	1-1/32 [26]	1-3/32 [27]	1-9/32 [32]	1-3/32 [27]	1-13/32 [35]
	TEFZEL			5/8 [16]	3/4 [19]	3/4 [19]	7/8 [22]	27/32 [21]	31/32 [25]	3/4 [19]	1-1/4 [32]	1-3/32 [27]	1-3/8 [35]
d		5/8 [16]		5/8 [16]	3/4 [19]	5/8 [16]	7/8 [22]	3/4 [19]		3/4 [19]	7/8 [22]	3/4 [19]	7/8 [22]
N		4		4		4		4	8	4	8	8	8
BC		2-3/8 [60]	2-5/8 [67]	3-1/8 [79]	3-1/2 [89]	3-7/8 [98]	4-1/2 [114]	4-3/4 [121]	5 [127]	6 [152]	6-5/8 [168]	7-1/2 [191]	7-7/8 [200]
OD		3-1/2 [89]	3-3/4 [95]	4-1/4 [108]	4-7/8 [124]	5 [127]	6-1/8 [156]	6 [152]	6-1/2 [165]	7-1/2 [190]	8-1/4 [210]	9 [229]	10 [254]
A		2-15/16 [75]		3-7/16 [87]		3-15/16 [100]		4-9/16 [116]		3-15/16 [100]		5-1/8 [130]	
C		2-7/16 [62]		2-7/8 [73]		3-7/32 [82]		3-17/32 [90]		4-11/32 [110]		5-1/8 [130]	
E		4-1/8 [105]		4-9/16 [116]		4-29/32 [125]		5-7/32 [133]		6-1/32 [153]		6-13/16 [173]	
F		5-1/4 [133]		5-11/16 [144]		6-1/32 [153]		6-11/32 [161]		7-5/32 [182]		7-15/16 [202]	



NOTES:
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2) DIMENSIONS ARE GUARANTEED ONLY IF THIS PRINT IS CERTIFIED.
3) THIS DRAWING IS THIRD ANGLE PROJECTION AS SHOWN.
4) FLANGE BOLTS STRADDLE CENTERLINES.
5) FLOW MUST BE IN SAME DIRECTION AS FLOW ARROW.
6) METER MUST BE COMPLETELY FILLED WITH LIQUID TO INSURE ACCURACY.
7) ALL DIMENSIONS SUBJECT TO MANUFACTURING TOLERANCES OF +/- 1/8 [3].

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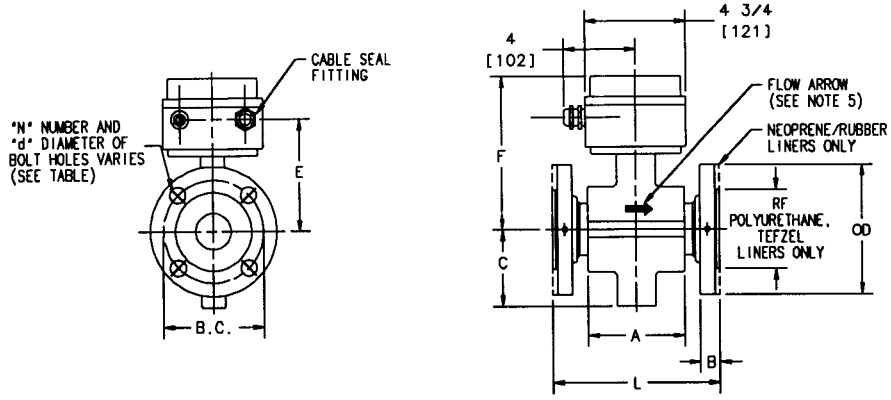
FIGURE 2-7. OUTLINE DIMENSIONS, REMOTE CONVERTER WITH ANSI FLANGES, CONTINUOUS SUBMERGENCE & DIV.1 (10DX3111E/G)

DIM	SIZE	1/2 [15]		1 [25]		1-1/2 [40]		2 [50]		3 [80]		4 [100]	
	DIN PN	10/16	25/40	10/16	25/40	10/16	25/40	10/16	25/40	10/16	25/40	10/16	25/40
	MODEL NO.												
L	10D$^{S}_{X}$3111ED	7-7/8 [200]	9 [229]	7-7/8 [200]	9 [229]	7-7/8 [200]	9 [229]	7-7/8 [200]	9 [229]	7-7/8 [200]	9 [229]	9-7/8 [250]	11 [280]
L	10D$^{S}_{X}$3111EE	14 [356]		14 [356]		16 [406]		16 [406]		12 [305]		12 [305]	
L	10D$^{S}_{X}$3111EF	N/A		N/A		N/A		N/A		N/A		N/A	
L	10D$^{S}_{X}$3111EZ	SEE SALES ORDER INFORMATION FOR "L" DIMENSION											
	LINER												
RF	POLY/TEFZEL	1-25/32 [45]		2-11/16 [68]		3-15/32 [88]		4 [102]		5-7/16 [138]		6-7/32 [158]	6-3/8 [162]
B	POLY/NEO/ RUBBER	N/A		N/A		N/A		15/16 [24]	1-1/16 [27]	1-1/8 [29]	1-5/16 [33]	1-1/8 [29]	1-7/16 [36]
	TEFZEL	1/2 [13]	5/8 [16]	5/8 [16]	3/4 [19]	3/4 [19]	7/8 [22]	27/32 [21]	31/32 [25]	3/4 [19]	1-1/4 [32]	1-3/32 [27]	1-3/8 [35]
d		9/16 [14]		9/16 [14]		23/32 [18]		23/32 [18]		23/32 [18]		23/32 [18]	7/8 [22]
N		4		4		4		4		8		8	
BC		2-9/16 [65]		3-11/32 [85]		4-11/32 [110]		4-29/32 [125]		6-5/16 [160]		7-3/32 [180]	7-1/2 [190]
OD		3-3/4 [95]		4-17/32 [115]		5-29/32 [150]		6-1/2 [165]		7-7/8 [200]		8-21/32 [220]	9-1/4 [235]
A		2-15/16 [75]		3-7/16 [87]		3-15/16 [100]		4-9/16 [116]		3-15/16 [100]		5-1/8 [130]	
C		2-7/16 [62]		2-7/8 [73]		3-7/32 [82]		3-17/32 [90]		4-11/32 [110]		5-1/8 [130]	
E		4-1/8 [105]		4-9/16 [116]		4-29/32 [125]		5-7/32 [133]		6-1/32 [153]		6-13/16 [173]	
F		5-1/4 [133]		5-11/16 [144]		6-1/32 [153]		6-11/32 [161]		7-5/32 [182]		7-15/16 [202]	



NOTES:
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3) THIS DRAWING IS THIRD ANGLE PROJECTION AS SHOWN.
4) FLANGE BOLTS STRADDLE CENTERLINES.
5) FLOW MUST BE IN SAME DIRECTION AS FLOW ARROW.
6) METER MUST BE COMPLETELY FILLED WITH LIQUID TO INSURE ACCURACY.
7) ALL DIMENSIONS SUBJECT TO MANUFACTURING TOLERANCES OF +/- 1/8 [3].

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FIGURE 2-8. OUTLINE DIMENSIONS, REMOTE CONVERTER WITH DIN FLANGES, CONTINUOUS SUBMERGENCE & DIV.1 (10DX3111E/G)

2.4 Mounting

2.4.1 Orientation

The Bailey-Fischer & Porter Series 3000 Magnetic Flowmeter may be installed in horizontal, vertical or sloping pipe runs. However, precautions must be taken to assure that the metering tube is filled at all times during measurement. A vertical installation, with the pipe line carrying liquid upwards assures a filled hydraulic line under low flow rate conditions and also minimizes wear on the meter lining by abrasive grit. Horizontal installations should be made with the meter in the lower section of a pipeline to assure a filled meter condition.

For horizontal or sloping installations the meter should be placed so that the electronic housing of the meter is on top. This will align the meter electrodes in a lateral plane. Positioning the meter in this way eliminates the possibility of entrained air acting as an electrode insulator.

The Magnetic Flowmeter must be oriented in accordance with the direction of process flow, as indicated by the FLOW arrow on the meter body. For accurate metering, a straight pipe run equivalent to a minimum of three straight pipe diameters are required upstream of the magmeter for elbows and tees, measured from the center of the meter (refer to Figure 2-12).

If a control valve is required, it is recommended that it be placed downstream of the meter. Upstream valves can create turbulence that result in air pockets and may affect the meter's accuracy or cause its output to be noisy. A minimum of ten pipe diameters of straight pipe are required upstream between the magmeter and a control valve or pump (refer to Figure 2-12).

2.4.2 Pipe Connections

The TEFLON, TEFZEL and polyurethane lined meters have raised faced flanges rated as specified. The neoprene and hard-rubber lined meters have full faced flanges rated as specified. Two flange gaskets are supplied per meter; the mounting studs and nuts are furnished by the user.

For 4-bolt and 8-bolt flanges, tighten the flange bolts in a "star" pattern as shown in FIGURE 2-9 to avoid localized stresses on the gaskets. Use a similar method for 8-bolt flanges.

Refer to Figure 2-10 for proper gasket locations and Figure 2-11 for recommended piping arrangement.

The meter should be oriented such that the pressure relief valve points in a safe direction should a situation occur where the device could be activated. For further discussion of the pressure relief mechanism and orientation, refer to Section 2.7 of this Instruction Bulletin.

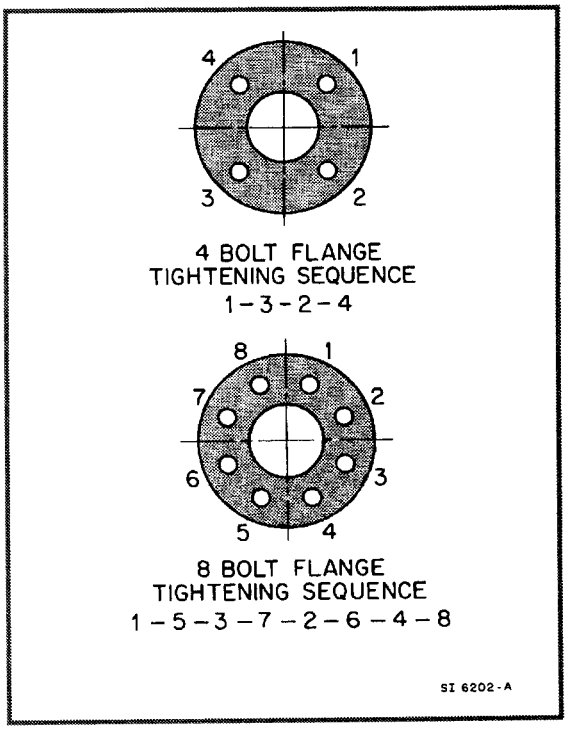

FIGURE 2-9. BOLT TIGHTENING SEQUENCE

2.4.3 Torque Specifications

It is recommended that the bolts and nuts be lubricated and tightened using a torque wrench. The bolts and nuts should be tightened to approximately 50% of the torque value during the first pass, to approximately 80% during the second pass and to the full torque during the third pass. The maximum torque rate values shown in TABLES 2-1 and 2-2 **must not be exceeded**.

For liner materials other than those shown in the tables, the flange bolts should be tightened sufficiently to stop any leaks but should not exceed the values shown in the tables below.

TABLE 2-1 - Torque Recommendations (ANSI)

Liner Material	Size in.	Size mm	ANSI Class 150 Bolt No. & Size (in.)	ANSI Class 150 Max. Torque Rate (ft-lb)	ANSI Class 300 Bolt No. & Size (in.)	ANSI Class 300 Max. Torque Rate (ft-lb)
PTFE / TEFZEL / Hard Rubber	½	15	4 x ½-13	6	4 x ½-13	7
	1	25	"	10	"	15
	1½	40	"	15	4 x ¾-10	25
	2	50	4 x ⅝-11	25	8 x ⅝-11	15
	3	80	"	40	"	25
	4	100	8 x ⅝-11"	35	"	40

TABLE 2-2 - Torque Recommendations (DIN)

Liner Material	Size in.	Size mm	Bolt No. & Size	Max.Torque Rate ft-lb	Max.Torque Rate Nm	PN bar
PTFE/ Hard Rubber	½	15	4 x M12	6.8	9.25	40
	1	25	4 x M12	15.1	20.5	40
	1½	40	4 x M16	31.3	42.5	40
	2	50	4 x M16	41.0	55.5	40
	3	80	8 x M16	35.8	48.5	40
	4	100	8 x M16	34.3	46.5	16

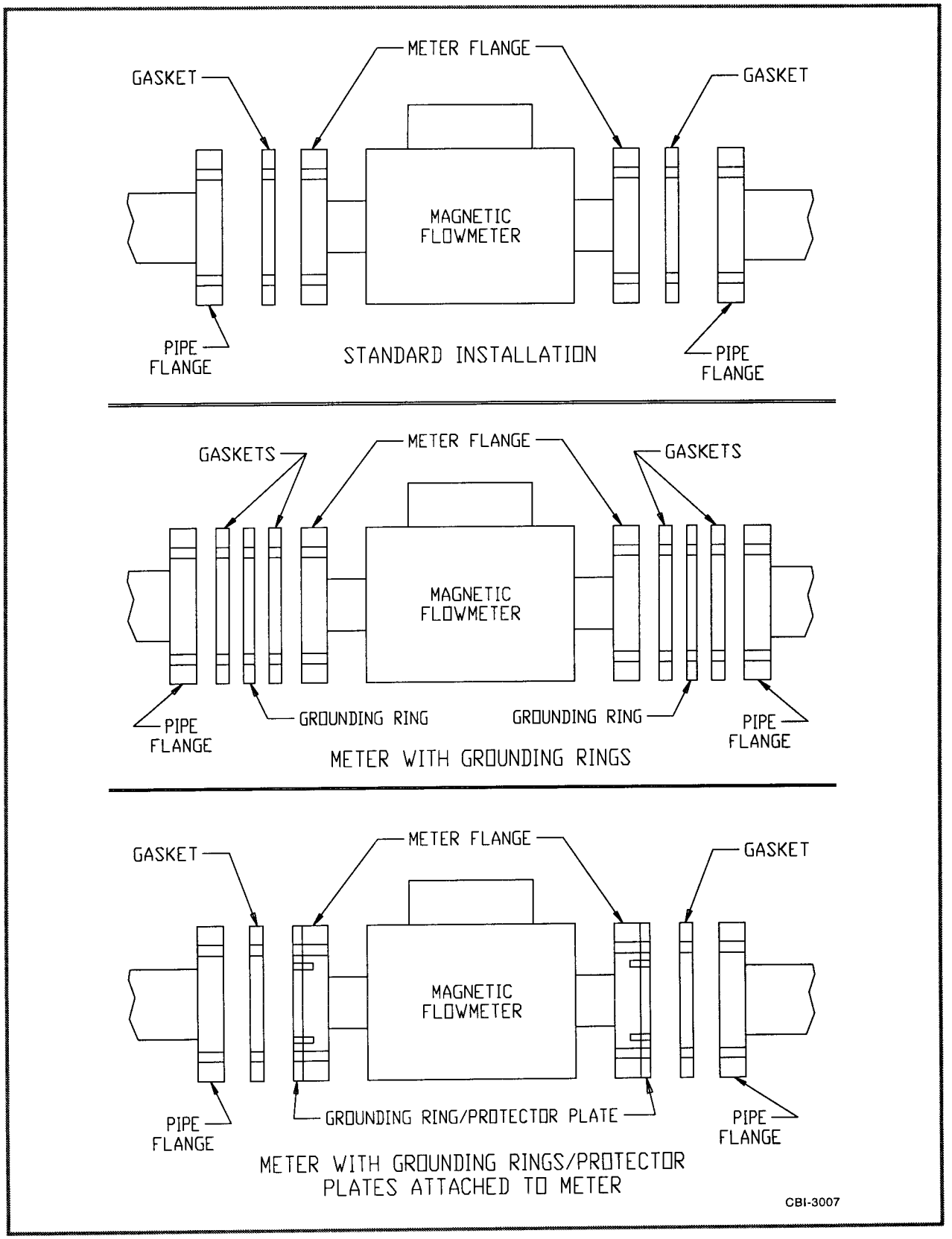

FIGURE 2-10 . GASKET LOCATIONS

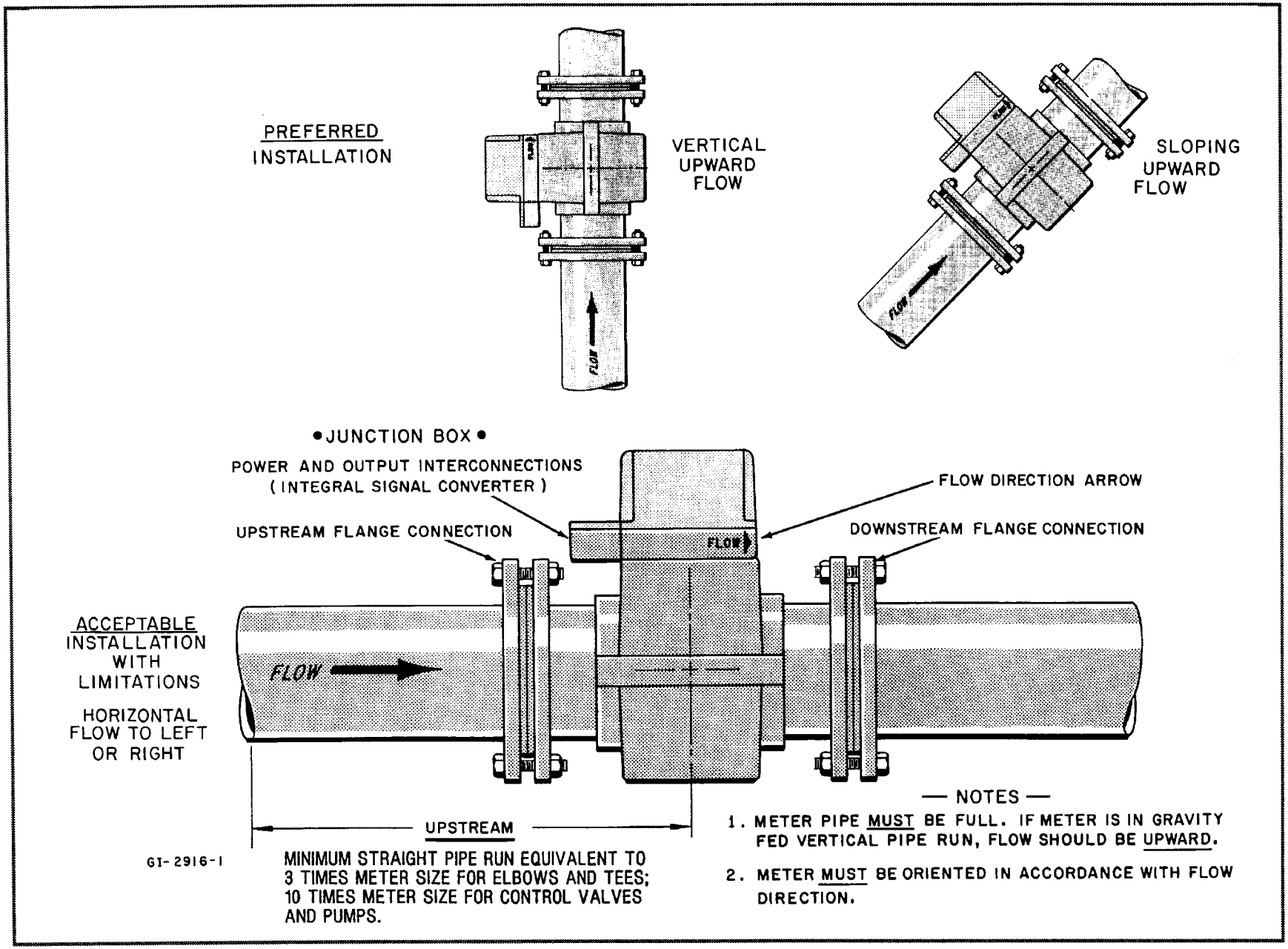

FIGURE 2-11. RECOMMENDED PIPING ARRANGEMENT

This diagram is shown for reference purposes only. The flowmeter shown in this illustration may not be the same model as the meter described in this instruction bulletin.

2.5 Grounding Procedure

2.5.1 General

Satisfactory operation of Bailey-Fischer & Porter Magnetic Flowmeter Systems requires that careful attention be paid to proper grounding techniques. A good ground is one that is in contact with the earth over a large conductive area. An excellent example of this is a cold water pipe which is buried in the earth and travels many miles in its distribution system. A great number of pipe branches form a large conductive area of contact which provides a low resistance connection to earth. A hot water or steam pipe must first return to a boiler before it becomes a cold water pipe, and therefore, its greater length of ungrounded path offers a less desirable ground bus. A metallic structural member of a building, such as a supporting "**I**" beam, may be a good earth ground, but it is a second choice to a cold water pipe.

Meter grounding requirements are really a combination of standard grounding methods and a bonding of the meter body to the process liquid. The most important of these is the process bonding, which is nothing more than ensuring that the meter body is in contact with the process liquid at both ends of the meter body. Basically, the bonding procedure places an electrical short circuit across the meter, thereby routing any stray current around the liquid in the meter (rather than through it).

From the point of view of grounding there are two basic types of piping systems:

- electrically conductive pipeline: the process liquid comes in contact with conductive pipe. This piping requires that each meter flange be connected with a bonding wire to the adjacent pipeline flange. The grounding procedure to use with conductive pipeline is described in 2.5.2.
- non-conductive or electrically insulated pipeline: the pipeline may be made of an electrically non-conductive material (plastic, concrete, etc.) or lined with a non-conductive material (rubber, TEFLON, etc). These non-conductive pipelines require the use of metal grounding rings to bond the process liquid to ground. The grounding procedure to use with nonconductive pipeline is described in 2.5.3.

Proper grounding of the Magnetic Flowmeter is required for optimum system performance.

2.5.2 Conductive Pipeline

If the flowmeter is included as part of a conductive pipeline that is not electrically insulated from the liquid to be metered, the following grounding procedure should be followed.
Refer to Figure 2-12 to supplement the following text.

1) Drill and tap both pipeline flanges adjacent to the bonding connections on the flowmeter. The lugs on the bonding cables are sized for metric M6 fasteners (a 1/4" bolt).

2) Obtain a bright metal surface around the edges of the tapped hole with a file or burnishing tool.

3) Attach the bonding wire and another length of ground wire to the flanges as shown. Use internal tooth lockwashers as shown in the detail. The wire to the good external ground should be #10 AWG, or heavier, copper wire.

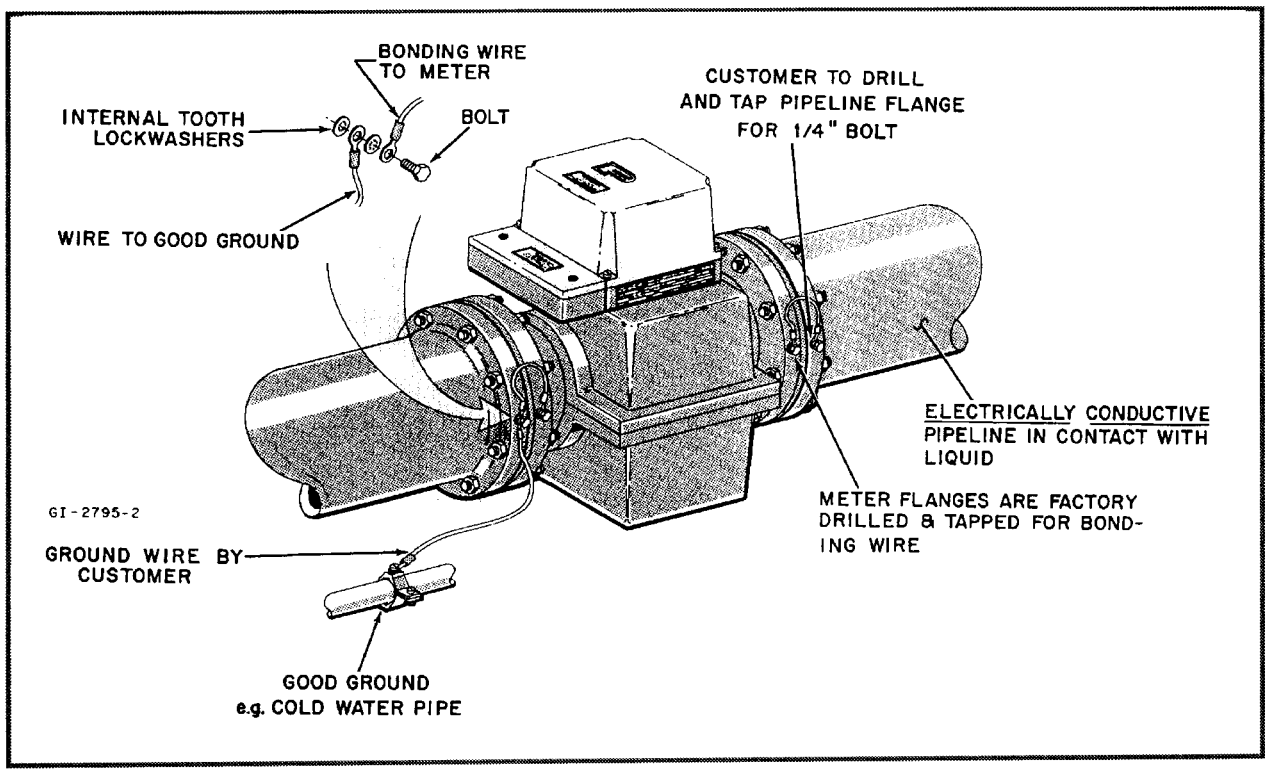

FIGURE 2-12. GROUNDING PROCEDURE; CONDUCTIVE PIPELINE

This diagram is shown for reference purposes only. The flowmeter shown in this illustration may not be the same model as the meter described in this instruction bulletin.

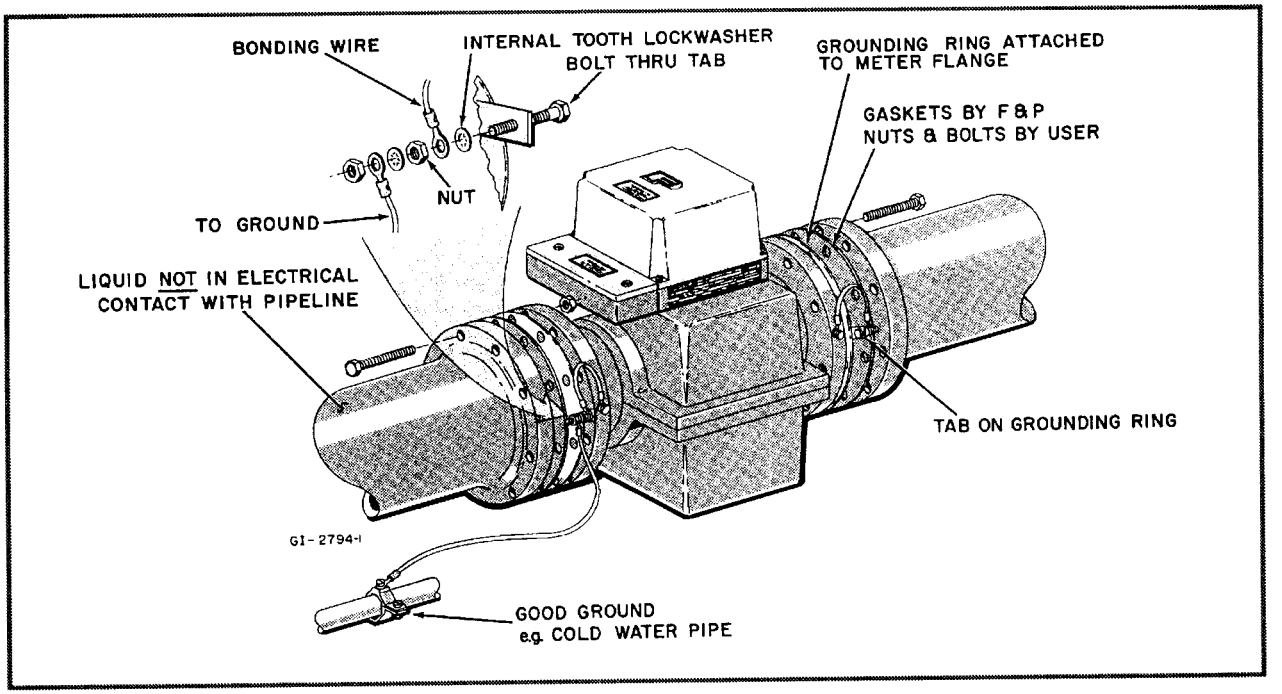

FIGURE 2-13. GROUNDING PROCEDURE; NON-CONDUCTIVE PIPELINE

This diagram is shown for reference purposes only. The flowmeter shown in this illustration may not be the same model as the meter described in this instruction bulletin.

2.5.3 Non-Conductive or Electrically Insulated Pipeline

If the flowmeter is included as part of a non-conductive or liquid insulated pipeline (such as totally plastic pipe, ceramic lined iron pipe, or cast pipe with internal bitumastic coating), the following grounding procedures apply. Refer to Figure 2-13 to supplement the following text.

1) For this service, the meter requires the use of grounding rings. The grounding rings should be installed between the meter flanges and the mating flanges of the pipeline as shown in Figure 2-13. A gasket is required on both sides of the grounding ring. If the meter is supplied with a grounding ring/protector plate fastened to the meter flange,only one gasket is required between the grounding ring/protector plate and the pipeline flange. Proper gasket locations are shown in Figure 2-10.

2) Attach the bonding wire and ground wire to the tab of the grounding ring. Use internal tooth lockwashers and hex head nut and bolts as shown in Figure 2-13. The ground wire should be #10 AWG, or heavier, copper wire.

2.6 Electrical Interconnection

The Series 3000 Magnetic Flowmeter may be furnished with either an integrally or optional remotely mounted Signal Converter. Interconnection wiring is arranged differently for the two systems. Interconnection details are provided in the Instruction Bulletin provided with the Signal Converter.

WARNING

ELECTRICAL SHOCK HAZARD. Equipment powered by ac line voltage constitutes a potential electric shock hazard to the user. Make certain that the system power input leads are disconnected from the operating branch circuit before attempting electrical interconnections.

Regardless of the interconnection procedure used, the grounding procedures given in Section 2.5 must be followed.

For explosion proof meter installation, all interconnection wiring must be installed according to National Electrical Code (NEC) ANSI/NFPA 70 Section 500.

NOTE

For meters capable of continuous submergence, the signal cable has been permanently installed by the factory. Do not loosen the cable seal fitting or remove the connection box lid since this will break the seal and void the warranty.

2.7 Conduit Seal and Pressure Relief

In accordance with the National Electrical Code (NEC) ANSI/NFPA 70, Article 501-5(f)(3), the flowmeters include a conduit entry seal and pressure relief to prevent the process fluid from entering the electrical conduit system. This safety feature is available for NPT fittings only and considers the remote possibility of a primary seal failure, in which case the secondary seal will prevent the process from entering the electrical conduit system. The secondary seal consists of the following:

- Integral Converter - Feed-through's between the electronics housing and field wiring (customer connection) junction box.
- Remote Primary - Conduit entry cable seal on meter customer connection box.

It is the user's responsibility to properly install the conduit entry cable seal fitting supplied with the signal cable provided with the remote mounted signal converter. This will ensure proper performance of this safety feature. See Figure 2-13.

The electronics housing for the integrally mounted signal converter contains an integral pressure relief system while the customer connection box on the remote mounted flowmeter contains a pressure-relief valve. In the unlikely event that the primary seal should fail, the pressure relief mechanism will vent the process, preventing a potentially dangerous over pressurization and possible failure of the electronics housing. This feature is not necessary and, consequently is not provided, on explosion-proof or continuously submersible models.

It is the user's responsibility to be aware of this safety feature, when provided, and to consider the unlikely event of its functioning. Based on knowledge of the process and meter application, the user should consider the installation orientation of the meter and possible use of deflectors to safely direct the vented process.

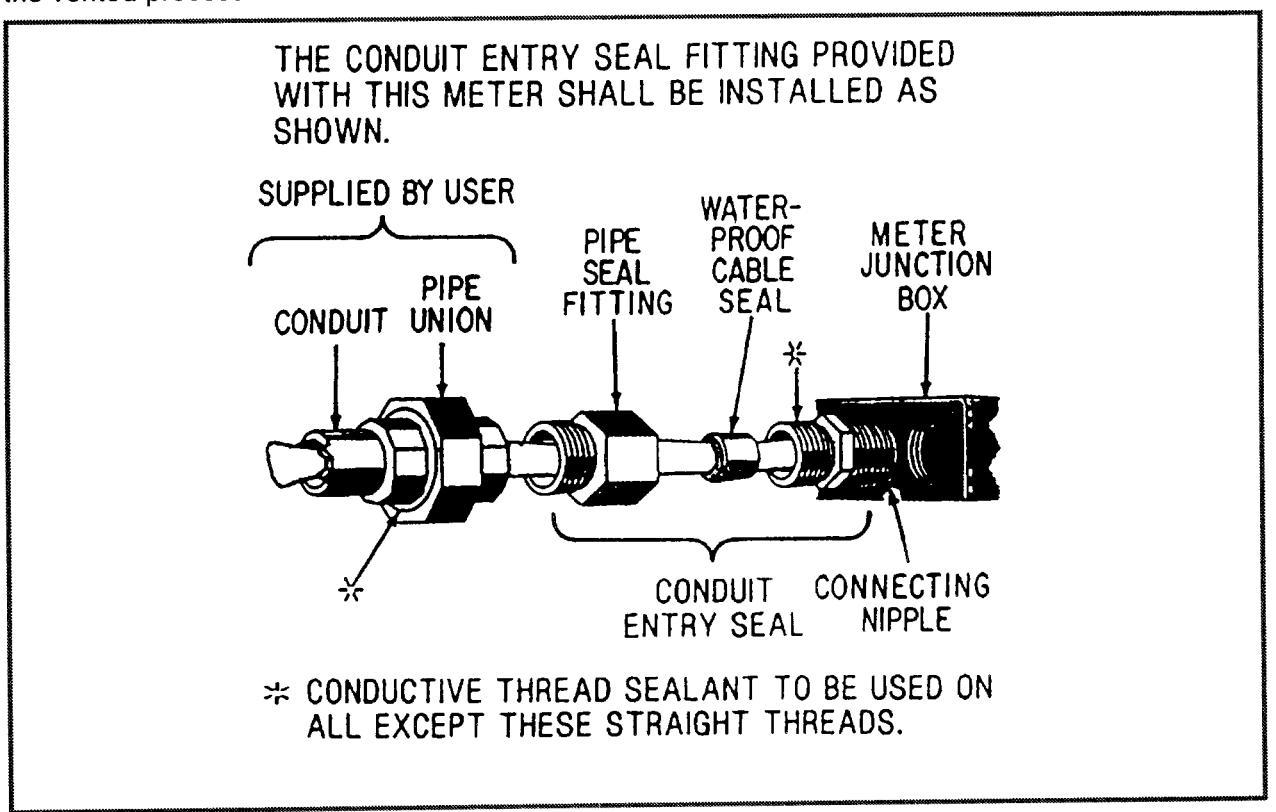

FIGURE 2-14. CONDUIT ENTRY SEAL INSTALLATION

3.0 START-UP and OPERATION

The Bailey-Fischer & Porter Series 3000 Magnetic Flowmeter (which includes the integral or remote Signal Converter) is calibrated at the factory. Each Flowmeter is calibrated to determine its meter capacity at a given velocity. Refer to Table 1-4.

There are no operating controls that require field adjustment unless the full scale range setting was not specified. If a change in the full scale range setting is required, refer to the Instruction Bulletin supplied with the Signal Converter. If no change is required, the equipment is ready for operation as received.

Prior to initial system start up, verify that the meter is properly installed; check flow direction, wiring interconnection and grounding as discussed in Section 2.0 Installation. Particular attention should be given to the meter grounding procedures; improper grounding may result in unsatisfactory performance. Refer to the Signal Converter Instruction Bulletin for interconnection grounding.

Start flow through the process piping system that includes the meter. Allow a nominal flow through the pipeline for several minutes to purge entrapped air. The pipeline must be full for accurate flow measurement.

Apply the appropriate power for the 10DX3111/3311 Magnetic Flowmeter by closing the external switch or circuit breaker; there are no switches inside of the equipment. Also energize any auxiliary equipment associated with the flow metering system, such as remote analog recorders, controllers or rate indicators.

Initiate process flow through the pipeline. Flow measurement and concurrent output signal transmission will commence with flow through the meter. Information concerning operation of the Signal Converter is provided in the Instruction Bulletin supplied with the Converter.

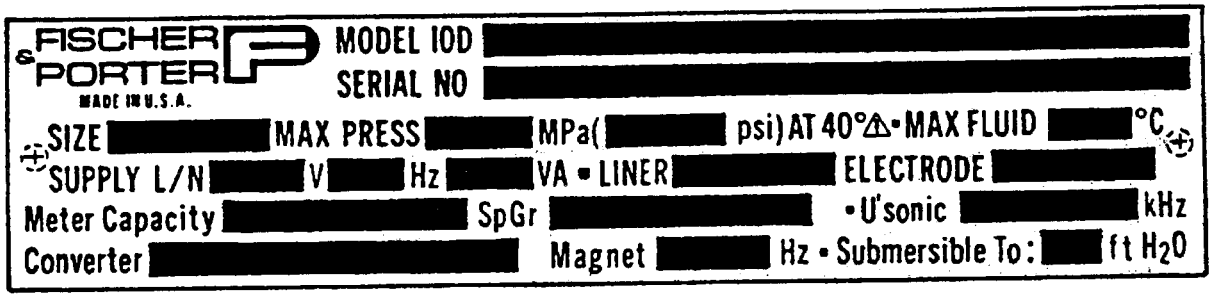

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FIGURE 3-1. TYPICAL INSTRUMENT TAG

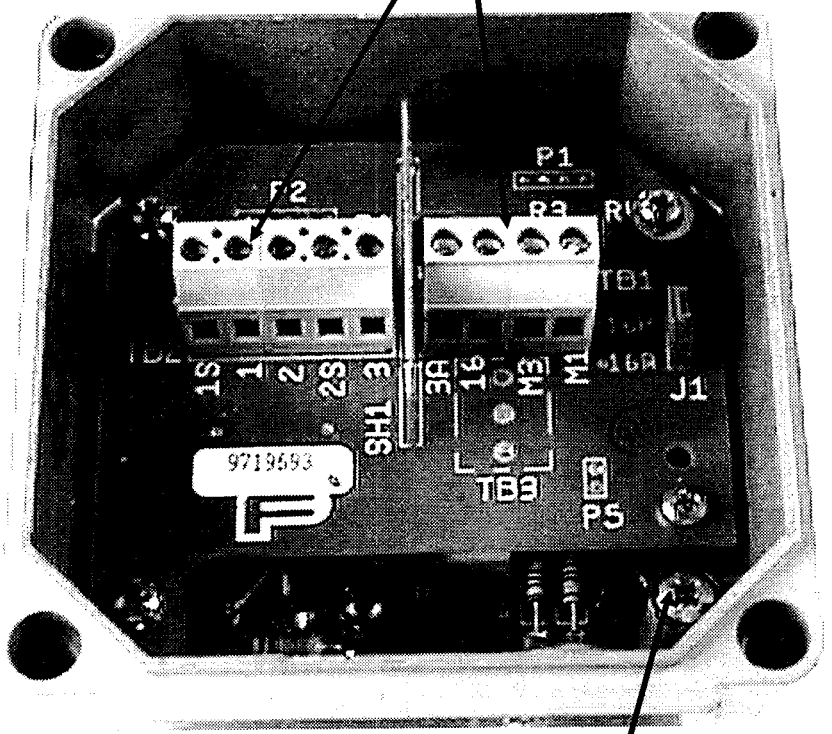


FIGURE 3-2 . 10DX3111E PRIMARY CONNECTIONS FOR REMOTE MOUNTED SIGNAL CONVERTER

Note: The assembly shown is a "typical" assembly and may not represent the configuration of your specific model. Newer models may be different from the configuration shown.

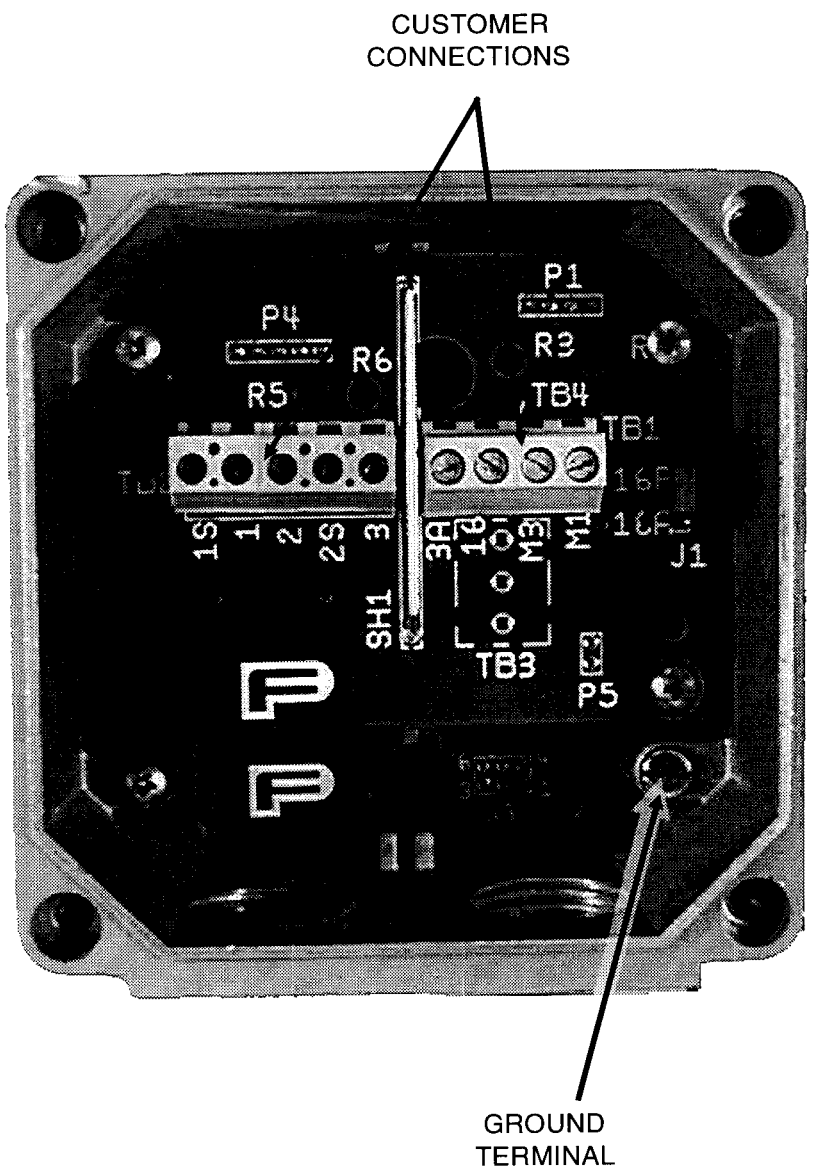


FIGURE 3-3. 10DX3111G PRIMARY CONNECTIONS FOR REMOTE MOUNTED SIGNAL CONVERTER

Note: The assembly shown is a "typical" assembly and may not represent the configuration of your specific model. Newer models may be different from the configuration shown.

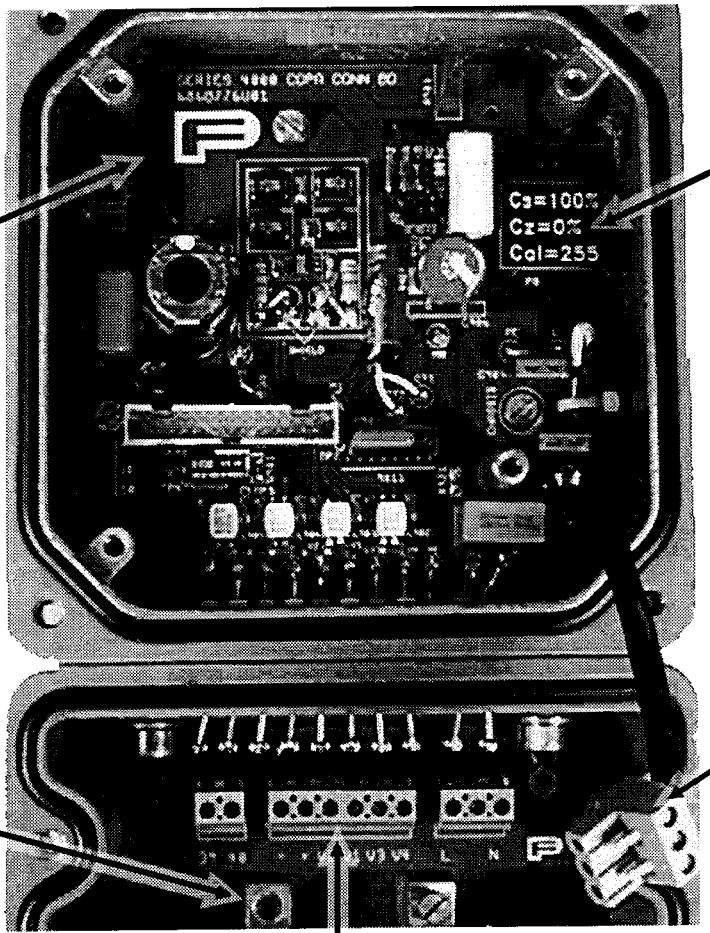


FIGURE 3-4. 10DX3311G INTEGRALLY MOUNTED M2 SIGNAL CONVERTER (SHOWN WITHOUT CONVERTER MODULE)

Note: The assembly shown is a "typical" assembly and may not represent the configuration of your specific model. Newer models may be different from the configuration shown.

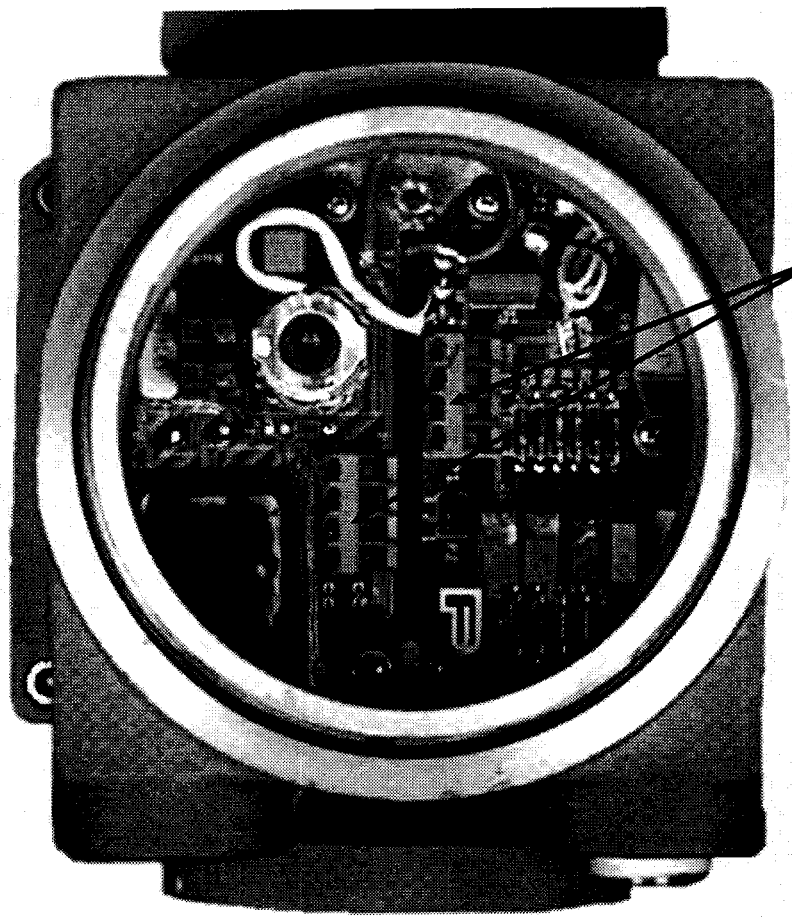


FIGURE 3-5. CONTINUOUS SUBMERGENCE PRIMARY CONNECTIONS FOR REMOTE MOUNTED SIGNAL CONVERTER

Note: Figure shows electronics without encapsulation material. Normally the converter housing is filled with a silicone rubber encapsulant.

4.0 FUNCTIONAL DESCRIPTION

The Magnetic Flowmeter body houses two signal electrodes and two flux producing magnet coils, as shown schematically in Figure 4-1. All primary intraconnection wiring is terminated at a printed circuit assembly located in the base mounted on the meter housing.

Primary models 10DX3111E & 10DX3311G provide two output signals to the associated Signal Converter:

- two electrode signals that contain the flow rate information
- the reference voltage signal which is proportional to the magnet excitation current and the flux density in the metering section

The reference voltage is derived across a precision constant meter capacity (CMC) resistance network that is connected in series with the magnet coils. Changes in magnet drive voltage, which cause a variation of flow signal, will simultaneously cause a proportional variation of the reference voltage. The Converter's measurement circuitry will calculate an exact ratio and thereby provide immunity to power supply variation. The magnet coil drive circuitry is contained in the Signal Converter.

Primary Models 10DX3111G also provide the above two electrode signals to the Signal Converter and also have provision for connecting a pair of coil excitation wires from the Converter. A reference voltage, as described above for the 10DX3111E & 10DX3311G models, is not developed in the Model 10DX3111G Primaries.

4.1 Basic Operating Principle

4.1.1 Signal Voltage Generation

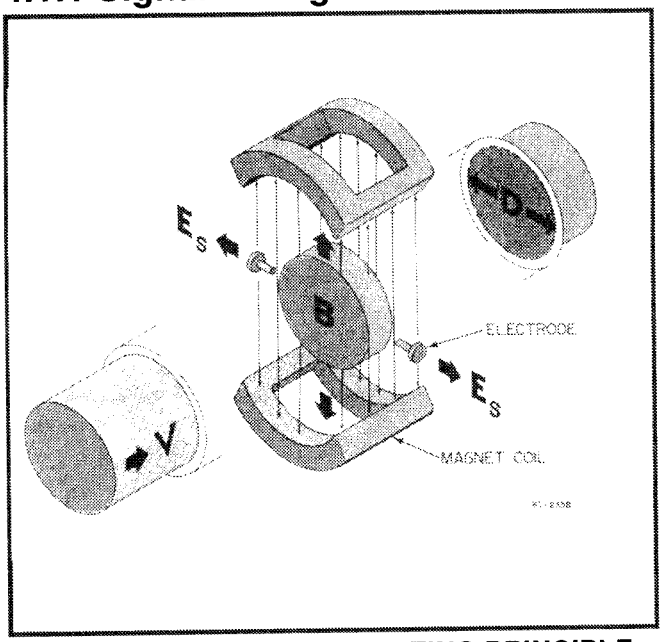


FIGURE 4-1. BASIC OPERATING PRINCIPLE

The operating principle of the Bailey-Fischer & Porter Series 3000 Magnetic Flowmeter is based upon Faraday's Law of Induction which states that the voltage induced across any conductor as it moves at right angles through a magnetic field will be proportional to the velocity of that conductor. This principle finds common application in direct and alternating current generators. Essentially, the Bailey-Fischer & Porter Magnetic Flowmeter constitutes a modified form of a generator.

Figure 4-1 graphically illustrates the basic operating principle. A magnetic field, "B", being generated in planes which are perpendicular to the axis of the meter pipe. A disk of the metered liquid can be considered as a conductor. The transverse length "D" is equal to the meter pipe diameter. Since the velocity "V" of the liquid disk is directed along the axis

of the meter pipe, a voltage, signal "E_S", will be induced within this liquid which is mutually perpendicular to the direction of the liquid velocity and the flux linkages of the magnetic field; i.e., in the axial direction of the meter electrodes. This electrode voltage is the summation of all incremental voltages developed within each liquid particle that passes under the influence of the magnetic field.

This may be expressed mathematically as:

(Equation #1)

$$E_S = \frac{1}{\alpha} BDV$$

where:

E_S = induced electrode voltage
B = magnetic field strength
D = meter pipe diameter
α = dimensionless constant
V = liquid velocity

The metered liquid constitutes a continuous series of conductive liquid disks moving through a magnetic field. The more rapid the rate of liquid flow, the greater the instantaneous value of signal voltage as monitored at the meter electrodes.

4.1.2 Magnet Coil Drive Circuits

In older conventional Magnetic Flowmeters the integral magnet coils are driven directly by the customer's 50/60 Hz power service. Notably, however, the design of the Bailey-Fischer & Porter Series 3000 Magnetic Flowmeter uses magnet drive circuits which are alternately energized bi-directionally at a low frequency rate as commanded by the associated Converter/Driver assembly. This provides maximum zero stability.

4.1.3 Volumetric Flow Rate Measurement

The Bailey-Fischer & Porter Magnetic Flowmeter is a volumetric flow rate measuring instrument. This can be shown by substituting the physical equivalent of liquid velocity into equation #1 as follows:

(Equation #2)

$$V = \frac{Q}{A} = \frac{4Q}{\pi D^2}$$

Substituting for V in equation #1

$$E_S = \frac{1}{\alpha} BD \frac{4Q}{\pi D^2}$$

and solving for Q:

$$\therefore Q = \frac{\pi \alpha D}{4} \bullet \frac{E_S}{B}$$

Since $B = b E_r$

and since a, D and b are constant:

(Equation #3)

$$Q = \gamma \frac{E_s}{E_r}$$

where:

Q = volumetric flow rate
A = cross-sectional area
D = pipe section diameter
E_s = induced signal voltage
E_r = reference voltage
B = magnetic flux density
a = dimensionless constant
b & g = dimensional constant
V = liquid velocity

Therefore, volumetric flow rate is directly proportional to the ratio of the induced signal voltage to the reference voltage as measured by the Bailey-Fischer & Porter Magnetic Flowmeter.

4.2 Operating Characteristics

4.2.1 Liquid Variables

4.2.1.1 Liquid Conductivity

The Series 3000 Magnetic Flowmeter requires a liquid conductivity of 5 microsiemens per centimeter or higher for operation. This minimum liquid conductivity requirement is not affected by the length of the signal interconnection cable when remote mounting of the Signal Converter is required, as long as the Bailey-Fischer & Porter supplied or Bailey-Fischer & Porter approved interconnection cable (with driven shields) is used. The nominal maximum transmission distance is limited to 30 meters (100 feet); however longer distances can be accommodated (contact Bailey-Fischer & Porter for details). Thirty feet of cable is supplied as standard for remotely mounted Signal Converters.

The conductivity of a given liquid, σ, may be determined experimentally under a filled meter condition, as follows:

1) Turn off power to the Signal converter. Remove the Converter housing cover. Disconnect and identify the electrode signal interconnection leads from terminals "1" and "2" of the Signal Converter.

2) Measure the resistance between signal leads "1" and "2" with an ac ohmmeter.

CAUTION
Do not use a dc ohmmeter for this measurement as polarization effects will produce completely erroneous data.

5.0 CIRCUIT DESCRIPTION

Flowmeters of the pulsed DC type operate on the principle that unwanted electrode signals occur while the magnetic flux is changing. Accordingly, the signal converters have been designed to capture the electrode voltage only during that portion of the excitation cycle when the magnetic flux is constant. This interval occurs during the last 25% of each half excitation cycle. By using sampling techniques, the flow (differential mode) signal is measured only during the intervals that magnetic flux is constant.

$$\left(\frac{d\Phi}{dt} = 0\right)$$

Therefore, zero-instability due to changing flux is eliminated by use of the MAG-X design concept (sampling technique), providing a meter totally free of zero drift. Pulsed DC operation of a magmeter system eliminates those variables capable of causing drift of the meter zero point. A thorough discussion of Signal Converter operation is provided in the Instruction Bulletin supplied with the particular Signal Converter.

5.1 Primary Signals

5.1.1 Models 10DX3111E & 10DX3311G

The Flowmeter body houses two flux producing magnet coils wired in series and a pair of diametrically opposed signal electrodes mounted at 90 degrees to the coil flux plane. Meter coils are excited with approximately ±10 volts of pulsed DC. A precision current sensing network is mounted in series with the coils. The current sense network produces what Bailey/Fischer & Porter refers to as a "Reference Voltage", which is typically ±70 millivolts. The reference voltage is directly proportional to the strength of the magnetic field in the measuring tube and is measured by the signal converter. Reference voltage must be measured, since any variation in reference voltage will also produce a proportional change in electrode signal voltage, assuming an unchanged flow velocity. All Flowmeter intraconnection wiring is terminated at the CMC/ZERO PC board located in the base of the meter housing.

The Flowmeter provides two output signals to the associated Signal Converter:

- an electrode signal that contains the flow rate information
- a signal which is proportional to the magnet excitation current

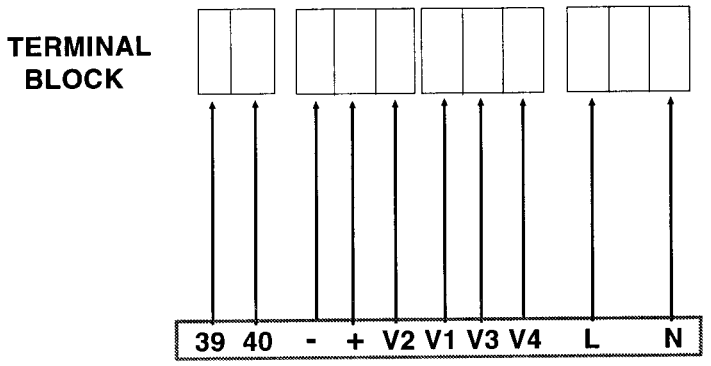
Models 10DX3111E and 10DX3311G Primaries provide a reference signal to the Converter, as discussed above. In Model 10DX3111G, this reference signal is produced in the remote Converter. The magnet coil drive circuitry is contained in the Signal Converter.

5.1.2 Model 10DX3111G

The Primary for this model includes two circuit boards mounted inside the customer connection box. The lower circuit board assembly provides the customer connections for the electrode, circuit common and coil excitation wiring. It also contains resistors that provide energy limiting protection for the electrodes as required for FM approval (refer to Figure 3-3). The electrode area is often covered with an approved encapsulant.

5.3 Terminal Numbering

THE FOLLOWING INFORMATION PROVIDES TERMINAL NUMBERING AND FUNCTION FOR THE INTEGRAL MODEL 10DX3311G CUSTOMER CONNECTION TERMINALS (Refer to Figure 3-4)



MARKINGS

TERMINALS	TERMINAL FUNCTION
39/40	a) Zero return or totalizer reset (software selectable) b) Solid-state status contact (39 = emitter) c) Forward flow scaled pulse output, open collector (39 = emitter)
-/+	4-20 mA current output
V2/V1	a) Forward scaled pulse output (V1 = negative) b) Data link transmit (V1 = negative)
V3/V4	a) Reverse scaled pulse output (V3 = negative) b) Data link receive (V3 = negative)
L/N	Signal converter power supply (N is negative or neutral)

6.0 MAINTENANCE

6.1 General

Except for an occasional performance verification check, there is no required routine maintenance for the Series 3000 Magnetic Flowmeter. For practical reasons it is suggested that the meter body not be disassembled. If disassembled, complete waterproof sealing is required for satisfactory operation and is best done at the factory. Replacement of faulty magnet drive coils and electrode replacement is a factory operation. Factory calibration after this type of repair is the only way to guarantee meter accuracy.

Bailey-Fischer & Porter offers a Repair/Exchange Program to facilitate replacement of a defective meter or Converter. If the equipment is beyond the warranty limit, under this program a fixed price will be charged for replacement of defective equipment, with appropriate credit issued when the repairable unit is received by Bailey-Fischer & Porter (charges prepaid). The equipment available under this program is as follows:

- the complete meter with integrally mounted Signal Converter
- the meter and associated primary board; that is, the hydraulic portion without the Signal Converter
- the Signal Converter

WARNING

All Flowmeters and/or Signal Converters being returned to Bailey-Fischer & Porter for repair must be free of any hazardous materials (acids, alkalis, solvents, etc.). A Material Safety Data Sheet (MSDS) for all process liquids must accompany returned equipment. Contact Bailey-Fischer & Porter for authorization prior to returning equipment.

NOTE

Operation and maintenance procedures for the Signal Converter are provided in the Instruction Bulletin supplied with the Signal Converter.

When communicating with Bailey-Fischer & Porter in regard to replacement of a complete meter (with integrally mounted Converter), the meter body, or the Signal Converter, it is important to refer to the complete instrument serial number to assure that the correct replacement will be supplied. This information is provided on the manufacturing specification sheet supplied with the Magnetic Flowmeter, and on the instrument data tag.

CAUTION

Some of the IC devices used in the signal converter are static sensitive and may be damaged by improper handling. When adjusting or servicing the signal converter, use of a grounded wrist strap is recommended to prevent inadvertant damage to the integral solid state circuitry.

6.2 System Troubleshooting

In the event that faulty operation of the Magnetic Flowmeter is evident, the following procedure can be used as a guide to isolate the malfunctioning device to either the primary meter or the Signal Converter. A standard multimeter and an oscilloscope are suitable for making most of the test measurements.

To supplement the following discussion refer to:

Section 5.0 Circuit Description

Signal Converter ... refer to applicable Instruction Bulletin

NOTE

The Series 3000 Magnetic Flowmeter housing is supplied as a sealed unit. Therefore, customer field repairs to these meters are not recommended. In the event of a malfunction, repairs should only be performed by an Bailey-Fischer & Porter field service engineer, or the complete meter returned (shipping charges prepaid) to Bailey-Fischer & Porter for service.

WARNING

ELECTRICAL SHOCK HAZARD. Equipment powered by an AC line voltage presents a potential electric shock hazard. Servicing of the Magnetic Flowmeter or Signal Converter should only be attempted by a qualified electronics technician.

1. If improper meter operation is suspected, proceed as follows:

   a) Remove access covers from the junction box and the Converter housing (remote or integral).

   b) Inspect for evidence of water entry in the junction box and Converter housing.

If water is present in either the junction box or converter housing of the flowmeter, immediately de-energize system power to eliminate the possibility of a shock hazard.

The presence of water in either the converter housing or the terminal box atop the remote primary most often results in irreparable damage to the circuit board assemblies inside. If such damage is evident, the meter should be removed from the process pipeline and returned to Bailey-Fischer & Porter for repair. It is also important that the source of the water-entry be found so that the situation doesn't reoccur when the meter is placed back into service.

Should water be found inside the wiring compartment of an integrally mounted converter housing, the circuit board assembly in this section may be replaced in the field (Consult the factory for additional instructions if this procedure becomes necessary).

2. Since signal wiring and operating procedures are dependent upon the type of Converter and the mounting option selected, the user should refer to the instruction bulletin supplied with the associated Signal Converter for system troubleshooting procedures. A static performance test for the primary mounted components is discussed in Section 6.3.

The Signal Converter options available for use with the Magnetic Flowmeter are:

- integrally mounted M2 Microprocessor Signal Converter
- remotely mounted M2 or 50XM1000N Microprocessor Signal Converter

3. Possible causes of erroneous flow rate indication are:

- incorrect grounding
- excessive noise due to a heavy slurry process or a non-homogeneous process
- loose or intermittent wiring
- non-full or empty meter pipe
- excess air entrained in process liquid

6.3 Static Test

If improper operation of the Magnetic Flowmeter is suspected, the following resistance measurements can be made to establish whether an electrical malfunction has occurred. An analog multimeter is required for checking the electrodes. Either an analog or digital multimeter can be used for checking the coils. These measurements can be made at the flowmeter PC board.

WARNING
ELECTRICAL SHOCK HAZARD. Equipment powered by an ac line voltage presents a potential electric shock hazard. Make certain that the system power is disconnected before making the following ohmmeter checks.

6.3.1 Magnet Coil Check

6.3.1.1 Integrally Mounted Signal Converter

There are two magnet coils in the meter that are wired in series and brought up to terminals M1 & CT and MR & CT1 of the flowmeter PC board in the electronics base.

Verify that the system power service has been de-energized. Loosen and remove the four screws that hold the Signal Converter to the base. Disconnect the connector from signal (P1) on the CMC PC board and the power (P3) connector to the Converter (refer to Figure 3-2) and set the Converter Module aside. Measure the series resistance of the magnet coils by connecting the ohmmeter between terminals M1 and MR. The value displayed should be within ± 20% of the value indicated in Table 6-1.

If it is suspected that process fluid or excess moisture has entered the Primary housing, unsolder the coil wires from the M1 and MR pads. Verify that the resistance of each coil lead (M1, MR and CT) to the flowmeter body is greater than 20 MΩ or infinite. If the resistance value is incorrect, the coils are defective and the meter must be returned to the factory for service.

7.0 PARTS LIST

TABLE 7-1. FLANGE GASKETS FOR METER BODY

NOTE
Polyurethane, neoprene & hard-rubber lined meters use neoprene gaskets. TEFLON & TEFZEL lined meters use TEFLON gaskets.

Two gaskets are required for each meter. If the meter has grounding rings, two additional gaskets are required for each meter.

Meter Size		Flange Class	Liner Material			
Inches	mm		TEFLON / TEFZEL	Polyurethane	Neoprene	Hard-Rubber
½	15	ANSI 150	333N123P30	----------	----------	
		ANSI 300	333N240P30	----------	----------	
1	25	ANSI 150	333N239P30	----------	----------	
		ANSI 300	333N205P30	----------	----------	
1½	40	ANSI 150	333C526U20	----------	----------	
		ANSI 300	333N314P30	----------	----------	
2	50	ANSI 150	333N415P30	333N415Q10	333C376Q10	
		ANSI 300	333N416P30	333N416Q10	333C373Q10	
3	80	ANSI 150	333N509P30	333N509Q10	333C377Q10	
		ANSI 300	333N510P30	333N510Q10	333C374Q10	
4	100	ANSI 150	333N604P30	333N604Q10	333C370Q10	
		ANSI 300	333N702P30	333N702Q10	333C375Q10	
½	15	DIN PN 10-40	333C609U01	-	-	
1	25	DIN PN 10-40	333C609U02	-	-	
1-½	40	DIN PN 10-40	333C609U03	-	-	
2	50	DIN PN 10-40	333C608U05	333C609U01	333C609U01	
3	80	DIN PN 10-40	333C608U06	333C609U02	333C609U02	
4	100	DIN PN 10/16	333C608U07	333C609U03	333C609U03	
		DIN PN 25/40	333C608U08	333C609U04	333C609U04	

TABLE 7-2. PROTECTOR PLATES FOR TEFLON & TEFZEL LINED METERS

Order number consists of two protector plates and mounting screws. Grounding rings are not available for this application. When ordering, specify **614B452U**__ and suffix from the table below.

Protector Plate Material	Meter Size Inches = (mm) =	Flange Rating ANSI Class 150					
		½ (15)	1 (25)	1½ (40)	2 (50)	3 (80)	4 (100)
316 sst	Suffix =	02	03	04	05	06	07
HAST "C"	Suffix =	16	17	18	19	20	21

Protector Plate Material	Meter Size Inch = (mm) =	Flange Rating ANSI Class 300
		4 (100)
316 sst	Suffix =	40
HAST "C"	Suffix =	47

TABLE 7-3. GROUNDING RINGS - SIZES 1/2 THROUGH 4 INCHES

Order number consists of two grounding rings and mounting screws. When ordering, add suffix to the BM number.

Meter Size		Material =	Flange Rating ANSI Class 150		Flange Rating ANSI Class 300	
			316 sst	HAST "C"	316 sst	
Inches	mm	BM No.	Suffix		BM No.	Suffix
½	15	800D508	U01	U09	800D708	U02
1	25	800D508	U02	U10	800D708	U03
1½	40	800D508	U03	U11	----------	---
2	50	800D508	U04	U12	800D708	U04
3	80	800D508	U05	U13	800D708	U05
4	100	800D508	U06	U14	800D708	U06

TABLE 7-4. CONVERTER BASE AND JUNCTION BOX GASKETS

Integrally mounted Converter	
Converter Base Gasket	D333F021U01
Large Cover Gasket	D101A009U01
Small Cover Gasket	D333F004U01

Remotely mounted Converter	
Junction Box Base Gasket	D333F021U01
Base to Spacer Gasket	D333F009U01
Spacer to Cover Gasket	D333F008U01

Continuous Submergence Converter	
Cover O-Ring	101A820U01

TABLE 7-5. HARDWARE

Description	Integral Converter	Remote Converter
Cover Mounting Screws	----------	09G114AU20 - Qty. 4
Large Cover Mounting Screws	09J114AU20 - Qty. 4	----------
Small Cover Mounting Screws	22J114AU20 - Qty. 2	----------

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