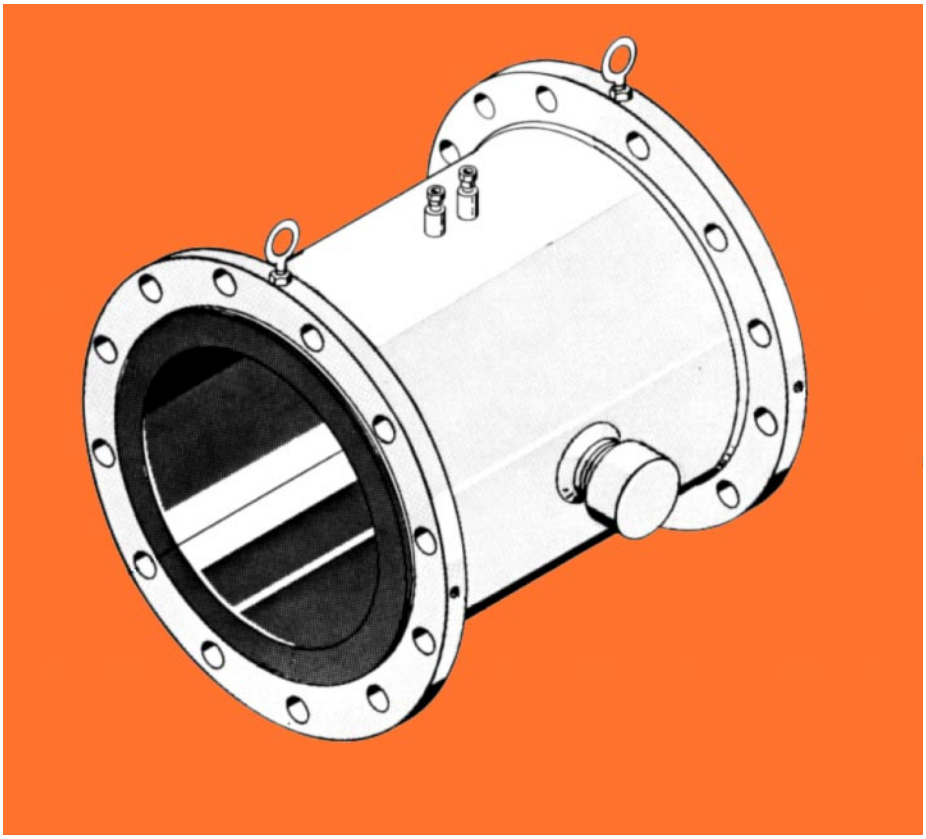
INSTRUCTION MANUAL

FLOW PRODUCTS
10DX3111G
Sizes 30" through 78"

MODEL 10DX3111G MAGNETIC FLOWMETER



PN24968

ABB Instrumentation

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NEOPRENE

The following is a trademark of Haynes International Inc.:

HASTELLOY

The following is a trademark of International Nickel Co., Inc.:

MONEL

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.

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
The information contained in this document is subject to change without notice.

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FIGURE LIST

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 equipment being returned to ABB Instrumentation 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 ABB Instrumentation for authorization prior to returning equipment.

INSTRUCTION MANUALS. Do not install, maintain or operate this equipment without reading, understanding and following the proper ABB Instrumentation 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

Equipment powered by an AC line voltage presents 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 or service. (pg. 4-2)

Do not inspect electrodes unless pipe is de-pressurized and drained. (pg. 4-3)

Do not attempt electrode inpection or replacement with a filled or pressurized pipeline. Personal injury may result from such practice. (pg. 4-4)

SPECIFIC CAUTIONS

Never allow support for the Magnetic Flowmeter to bear upon the inner surface of the meter pipe section inasmuch as the liner may become damaged. Do not lift the meter by the electrode bosses. (pg. 2-2)

Excercise extreme care when withdrawing electrode from its seat so that little or no tension is exerted on the connecting electode wire. If this wire should break within the meter pipe, the meter is not repairable. (pg. 4-6)

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 ABB Instrumentation 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 ABB Instrumentation 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 ABB Instrumentation, 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

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. (pg. 4-2)

Ne pas inspecter les électrodes sans avoir vidé et dépressurisé la tuyauterie. (pg. 4-3)

Ne pas effectuer d'inspection ou de remplacement d'électrode lorsque la tuyauterie est pleine ou sous pression. Des blessures de personne peuvent résulter d'une telle pratique. (pg. 4-4)

SPÉCIFIQUES ATTENTIONS

Ne pas laisser un support de débitmètre forcer sur la surface interne de celui-ci, il pourrait en résulter un dommage sur le revêtement interne. Ne jamais soulever le débitmètre par les bossages de protection des électrodes. (pg. 2-2)

Faire très attention en enlevant l'électrode de son emplacement de manière à n'exercer aucune tension mécanique trop forte afin de ne pas casser le fil de raccordement de l'électrode. Si ce fil est cassé le débitmètre est irréparable. (pg. 4-6)

READ FIRST

WARNING

INSTRUCTION MANUALS
Do not install, maintain, or operate this equipment without reading, understanding and following the proper ABB Instrumentation instructions and manuals, otherwise injury or damage may result.

RETURN OF EQUIPMENT
All Flowmeters and/or Signal Converters being returned to ABB Instrumentation 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 ABB Instrumentation 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 ABB Instrumentation representative to obtain the correct touch-up paint.

1.0 INTRODUCTION

1.1 General

1.1.1 Description

The ABB Instrumentation Model 10DX3111 Magnetic Flowmeter is a volumetric liquid flow rate detector that uses as the process transducing method the characteristic of a conductive fluid 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 fluid.

Being a completely obstructionless metering instrument, the ABB Instrumentation Model 10DX3111 Magnetic Flowmeter can be used to meter liquids without regard to heterogeneous consistency and is as independent of the tendency to plug or foul as the pipeline in which it is mounted. 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 non-corrosive wetted parts and a variety of meter lining materials permit metering of most corrosive and reactant fluids.

Factors such as fluid 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 fluid being metered. The degree of fluid conductivity has no effect upon metering accuracy as long as it is greater than this minimum level. Fluid temperature is limited only to the extent that it may affect fluid conductivity and, like fluid pressure, to the extent that it can not exceed the meter material specification limits.

1.1.2 Construction

The ABB Instrumentation Model 10DX3111 Magnetic Flowmeter, as shown in Figure 1-1, Cut-Away View, consists of a flanged, carbon steel pipe spool which serves as a meter body. A pair of arched, oval magnet coils fit on opposite sides of the meter body inner surface. This permeable metal pipe spool acts as a core or return path for the magnetic field generated by the coils.

The coils are potted within an epoxy-base compound. An insulating interior liner of NEOPRENE or polyurethane is inserted and turned-out against the flange faces. 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 standard electrodes are virtually flush with the inner surface of the insulating liner and come into contact with the fluid to be metered. Bullet nosed electrodes are mounted in a similar way; however, these electrodes protrude slightly beyond the inner surface of the liner. Standard or bullet nosed electrodes are available. The electrodes are replaceable without removing the meter from the pipeline.

The meter is available in three versions: splashproof, accidental submergence and continuous submergence.

All outer surfaces of the standard meter, with the exception of flange faces, are sprayed with a rust prohibitive paint. At special option, these surfaces may be treated with corrosion-resistant epoxy paint.

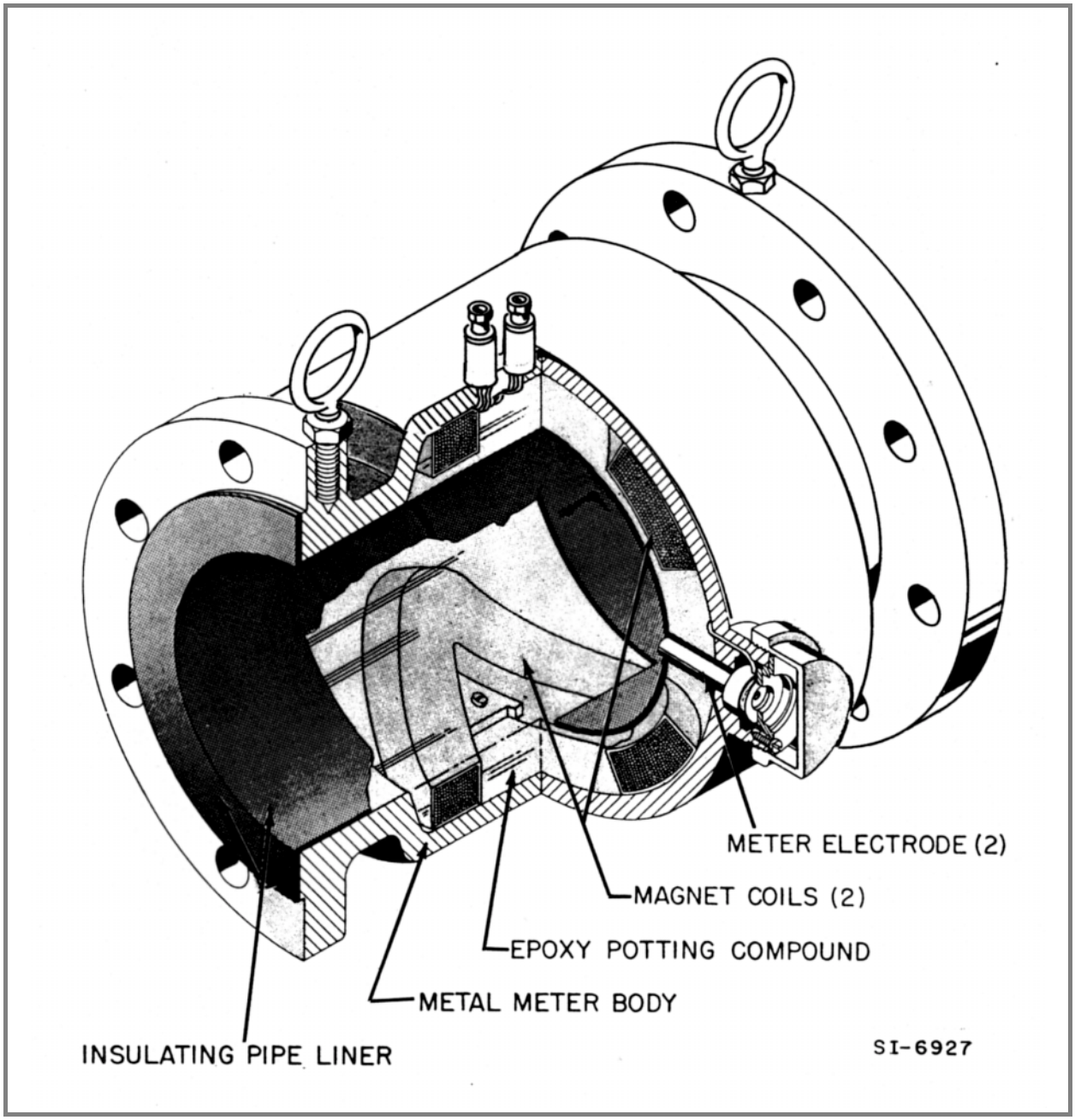


FIGURE 1-1. CUT-AWAY VIEW OF MAGNETIC FLOWMETER

1.2 Model Number Breakdown

Refer to the ABB Instrumentation data sheet or data tag on the equipment for the model number of the instrument furnished. The details of a specific number are shown on the following pages.

1.2.1 Model 10DX3111G Model Number Breakdown

	10DX3111	G	E	_	__	_	1	A	_	A	_	_	_	_	2	_
Model																
Design Level		G														
Meter Lay Length																
Replacement for 10D1435 & 10D1465			E													
Liner Material																
Hard Rubber				A												
Soft Rubber				B												
Polyurethane				D												
Neoprene				L												
Linatex				P												
Size (Inches / mm)																
28 / 700					25											
30 / 750					43											
32 / 800					26											
36 / 900					27											
40 / 1000					28											
42 / 1050					29											
44 / 1100					44											
48 / 1200					30											
54 / 1400					31											
60 / 1500					41											
64 / 1600					32											
66 / 1650					42											
72 / 1800					33											
78 / 2000					34											
Flange Standard/Pressure Rating																
AWWA C207 CL B						3										
AWWA C207 CL D						4										
DIN PN10						C										
ANSI CL150						P										
Flange Material																
Carbon Steel							1									
Protector Plates																
None Required								A								
Electrode Type																
Flush									2							
Bullet Nose									3							

1.2.1 Model 10DX3111G Model Number Breakdown (Cont.)

10DX3111	G	E	_	__	_	1	A	_	_	A	_	_	_	2	_

Electrode Material

316 Stainless Steel	B
Hastelloy B	C
Hastelloy C	D
Titanium	E
K-Monel	G
Nickel	P
Alloy 20	Q

Certification

Standard (None)	A

Enclosure Classification

IEC 529 IP65, NEMA 4X	1
Accidental Submergence. 33 ft H_2O/48 H (10m H_2O/48 H NEMA 4X IEC 529 IP67)	2
Continuous Submergence, IEC529 IP68 33 ft H_2O (10 m H_2O), Signal Cable Permanently Installed	5

Fluid Temperature Range

Hard Rubber, Linatex 170°F (77°C) Max.	1
Rubber, Neoprene, Polyurethane 190°F (88°C) Max.	4

Line/ Excitation Frequency

50 Hz / 6 1/4 Hz	1
60 Hz / 7 1/2 Hz	3

Customer Information Language

English w/ Riveted SST Tag	2

Converter Type (Remote Only)

M2	1
50SD1000	4
None	X

1.3 Specifications

Electrical Source Requirements: As specified with Converter/Driver

Power Consumption 25 watts maximum

Operating Characteristics:

Minimum Allowable Fluid Conductivity: 5 microsiemens per centimeter, (See Figure 1-2, Conductivity Graph)

Metering Range - Adjustable: 0-1.5 through 0-37.5 feet per second (standard preset range of Flow Converter)

Meter Capacity: See Standard Volumetric Capacity Table

Reference Voltage: 140 millivolts peak-to-peak

Maximum Temperature Limits

NEOPRENE Liner: 190°F (88°C)

Polyurethane Liner: 190°F (88°C)

Dimensions: See Figures 2-3 through 2-6

Weights(Approximate)

Meter Size (Inches)	Approx. Weight (Pounds)
30	1400
36	2000
42	2800
48	3900
54	6000
60	7000
66	8600
72	10600
78	13600

Pressure-Temperature Limits: psi (kPa)

Meter Size (Inches)	Flange Rating (ANSI)*	NEOPRENE & Polyurethane	
		100°F (38°C) psi (kPa)	190°F (88°C) psi (kPa)
30	CL150	145 (1000)	135 (931)
36	CL150	125 (862)	120 (827)
42	CL150	140 (965)	130 (896)
48	CL150	120 (827)	110 (758)
54	CL150	110 (758)	105 (724)
60	CL150	100 (690)	95 (650)
66	CL150	100 (690)	95 (650
72	CL150	95 (650)	90 (620)
78	CL150	95 (620)	90 (620)

NOTE: Values given in parenthesis are for SI equivalent units, eg.,
Temperature = °F (38°C)
Pressure = psig (kPA)

*OD and drilling only.

Materials of Construction

Meter Liner	NEOPRENE or Polyurethane
Meter Body	carbon steel w/Class 150 flanges (OD & drilling only)
Flanges	carbon steel
Electrodes	standard or bullet nose type, 316 stainless steel+

+ Also optionally available in HASTELLOY "C", MONEL, Alloy 20, tantalum, titanium, HASTELLOY "B" and nickel

CAPACITY TABLE

SIZE		FLOW RANGES 0 TO VALUE TABULATED				CAPACITY SETTINGS (IF NOT SPECIFIED BY CUSTOMER)	
		MINIMUM		MAXIMUM			
Inches	mm	gpm	m^3/h	gpm	m^3/h	gpm	m^3/h
30	750	3630	810	81000	16200	22000	5000
36	900	5370	1200	120000	24000	32000	7000
42	1100	7400	1650	165000	33000	45000	10000
48	1200	9400	2100	210000	42000	60000	12000
54	1400	12100	2700	270000	54000	70000	16000
60	1500	14800	3300	330000	66000	90000	20000
66	1700	17900	4000	400000	80000	110000	24000
72	1800	20200	4500	450000	90000	120000	27000
78	2000	25600	5700	570000	114000	150000	35000

METER CAPACITY (10m/sec)

Each 10DX3111 meter in sizes 30" through 78" is calibrated at the factory and the meter capacity unique to the individual meter is indicated on a tag attached to the side of the meter body. See the instructions for the converter in the Converter/Driver for details on programming the converter to use this meter capacity. Note that this is truly a PROGRAMMABLE factor; do NOT follow converter instructions for using a "constant meter factor".

The range requested by the customer is also marked on the tag attached to the meter.

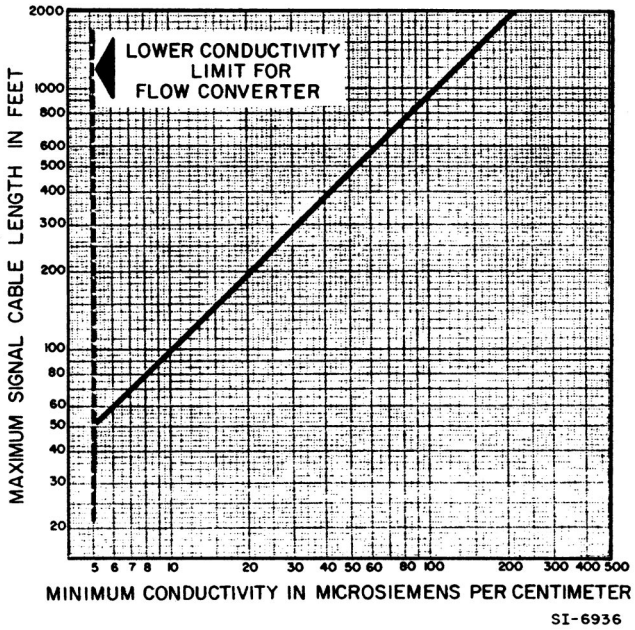


FIGURE 1-2 . CONDUCTIVITY GRAPH

2.0 INSTALLATION

2.1 Inspection

The Magnetic Flowmeter should be inspected before installation for indications of damage which may have occurred during shipment. All damage claims should be reported to the shipping agent involved for equipment shipped F.O.B. job site before installation or operation is attempted. If damage is such that faulty operation is likely to result, it should be brought to the attention of the ABB Instrumentation Service Department.

2.2 Uncrating & Handling

All ABB Instrumentation Magnetic Flowmeters are shipped with the flanges protected. Lift the Magnetic Flowmeter using a winch or block and tackle attached to the lifting lugs as shown in Figure 2-1. (Meter sizes 54" and smaller have two lifting lugs. Sizes 60" and larger have four lifting lugs.)The rig must be able to support weights as shown in the Specifications sub-section of the INTRODUCTION and must be long enough to produce an angle of 45° or greater between the sling line and the metal pipe axis.

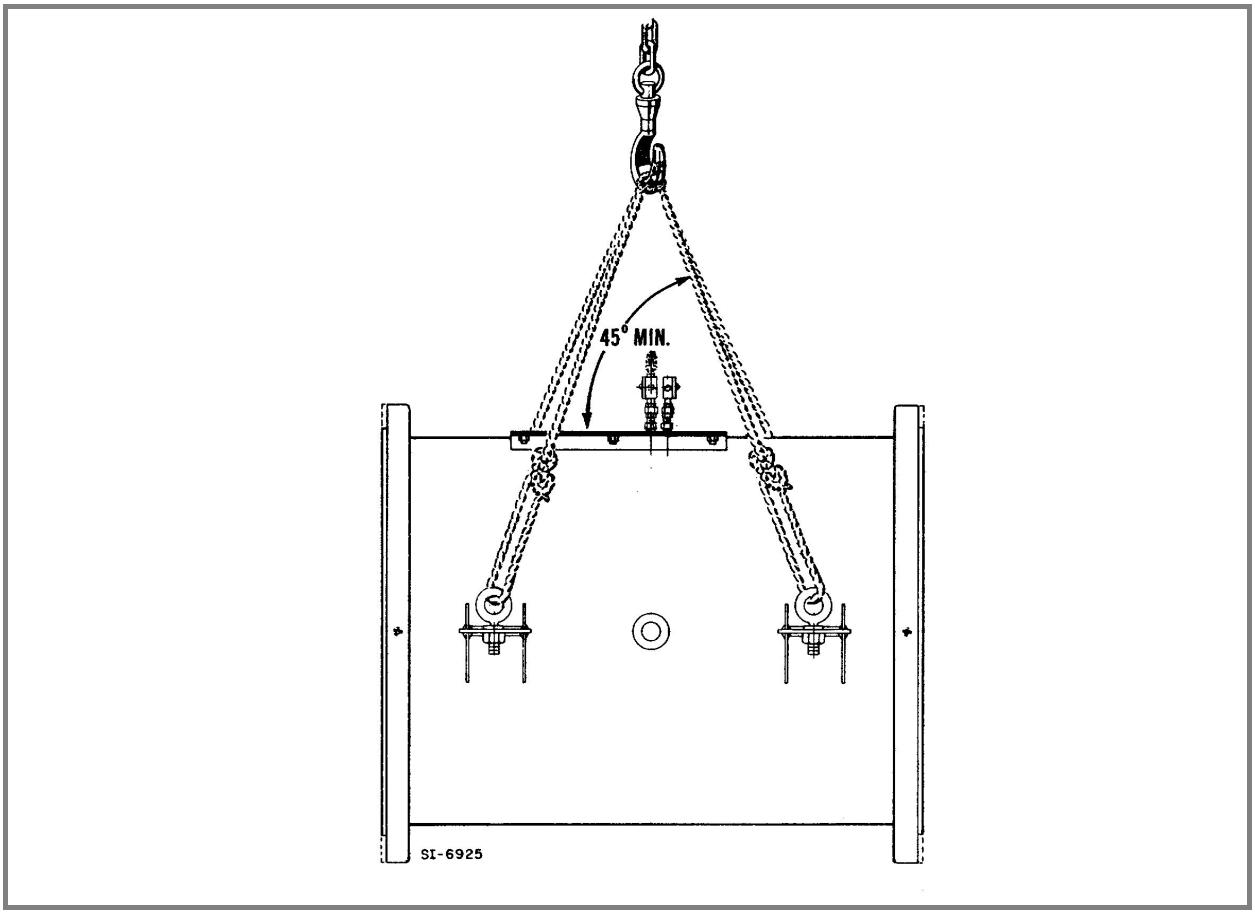


FIGURE 2-1. PROPER HOISTING TECHNIQUE

The exposed liner material on the meter flange faces is susceptible to damage if mishandled. Do not walk the meter on its ends. Always use the protective end covers when the meter is transported.

CAUTION
Never allow any support for the Magnetic Flowmeter to bear upon the inner surface of the meter pipe section inasmuch as the liner may become damaged. Do not lift the meter by the electrode bosses.

The protective wooden flange covers or paper guard caps must be removed for inspection and before mounting in the pipeline.

2.3 Location

Stray electromagnetic and electrostatic fields normally encountered in most industrial areas will have no effect upon the operating characteristics of the ABB Instrumentation Magnetic Flowmeter. It is recommended, however, that the meter not be installed within the immediate proximity of heavy induction equipment.

In-the-line meter maintenance is minimized with this instrument. Further, as no operating adjustments are required in the ABB Instrumentation Magnetic Flowmeter, servicing accessibility is of secondary importance unless greasy sludges or liquids bearing insulating materials which tend to coat pipe walls are to be metered. However, sufficient access room should be allocated to facilitate electrical interconnection and permit field replacement of electrodes should the need arise.

The installation site must be provided with a convenient source of power as specified with the Converter/Driver. The line should have a disconnect switch and a suitable fuse or circuit breaker as given on the interconnection diagram of the receiving instrument instruction bulletin. Further, if the pipeline is not in itself a good ground, a suitable earth ground must be made available in proximity to the installation site.

2.4 Mounting

2.4.1 Orientation

The ABB Instrumentation Model 10DX3111 Magnetic Flowmeter may be oriented at any angle in the pipeline. However, precautions must be taken to assure that the metering tube is **filled at all times** during measurement. A vertical installation of the metering tube in a pipeline carrying fluid upwards assures a filled hydraulic line under low flow rate conditions and also minimizes uneven wear on the meter lining by abrasive grit. Horizontal installations should be made in a lower segment of the pipeline to assure a filled meter condition. Further, for horizontal or sloping installations, the meter should be placed so that the connection bosses are on top to 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 may be mounted in the pipeline without regard to flow direction. If greasy sludges or insulating materials which tend to coat pipe walls are to be metered, it is recommended that in addition to standard block valves and bypass line, a clean-out tee be installed as shown in Figure 2-2 to facilitate meter cleaning without removal or interruption of the process.

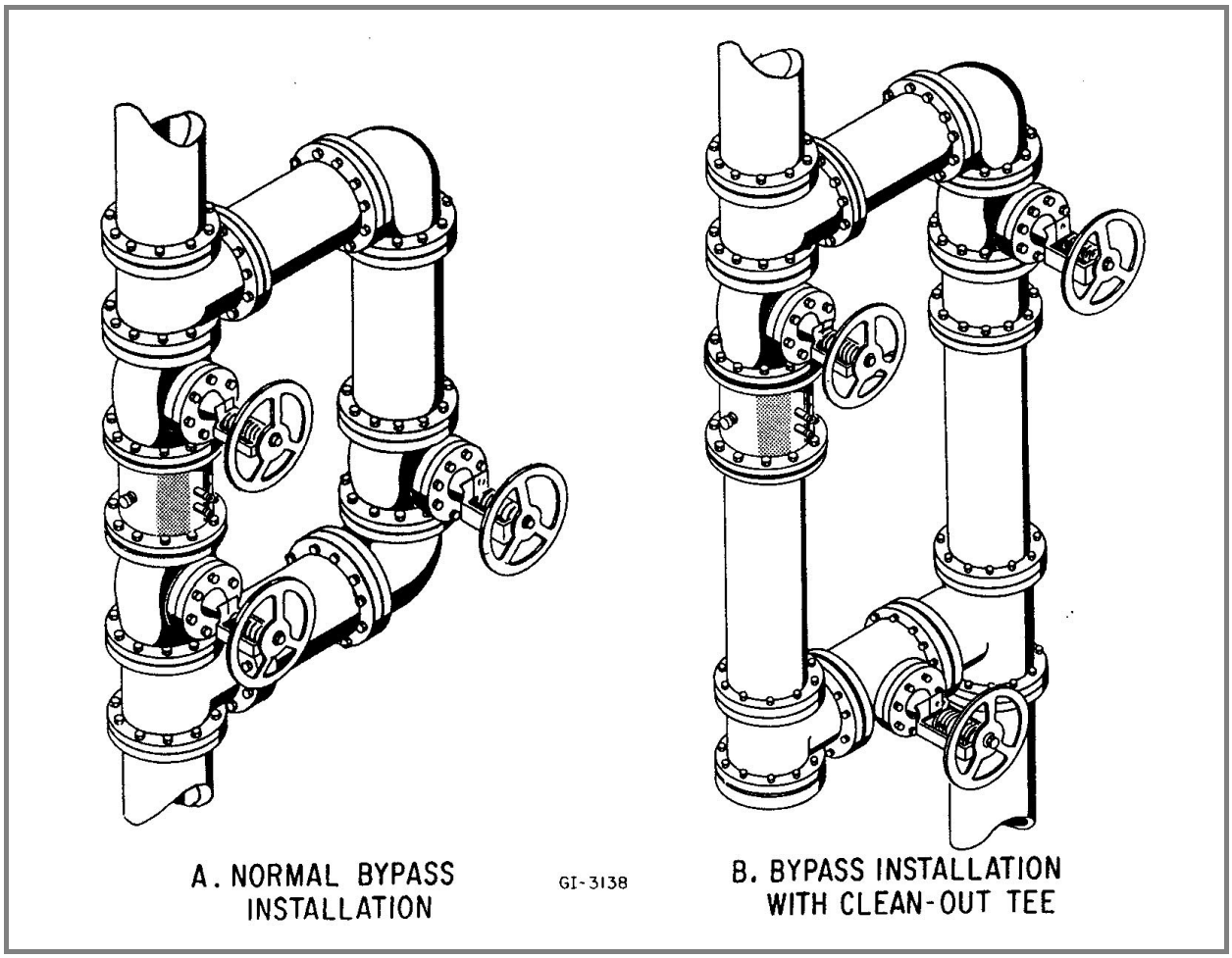


FIGURE 2-2. RECOMMENDED PIPING CONNECTIONS

Note that the flowmeter shown in this illustraton is not the meter described in this instruction bulletin.

2.4.2 Pipe Connections

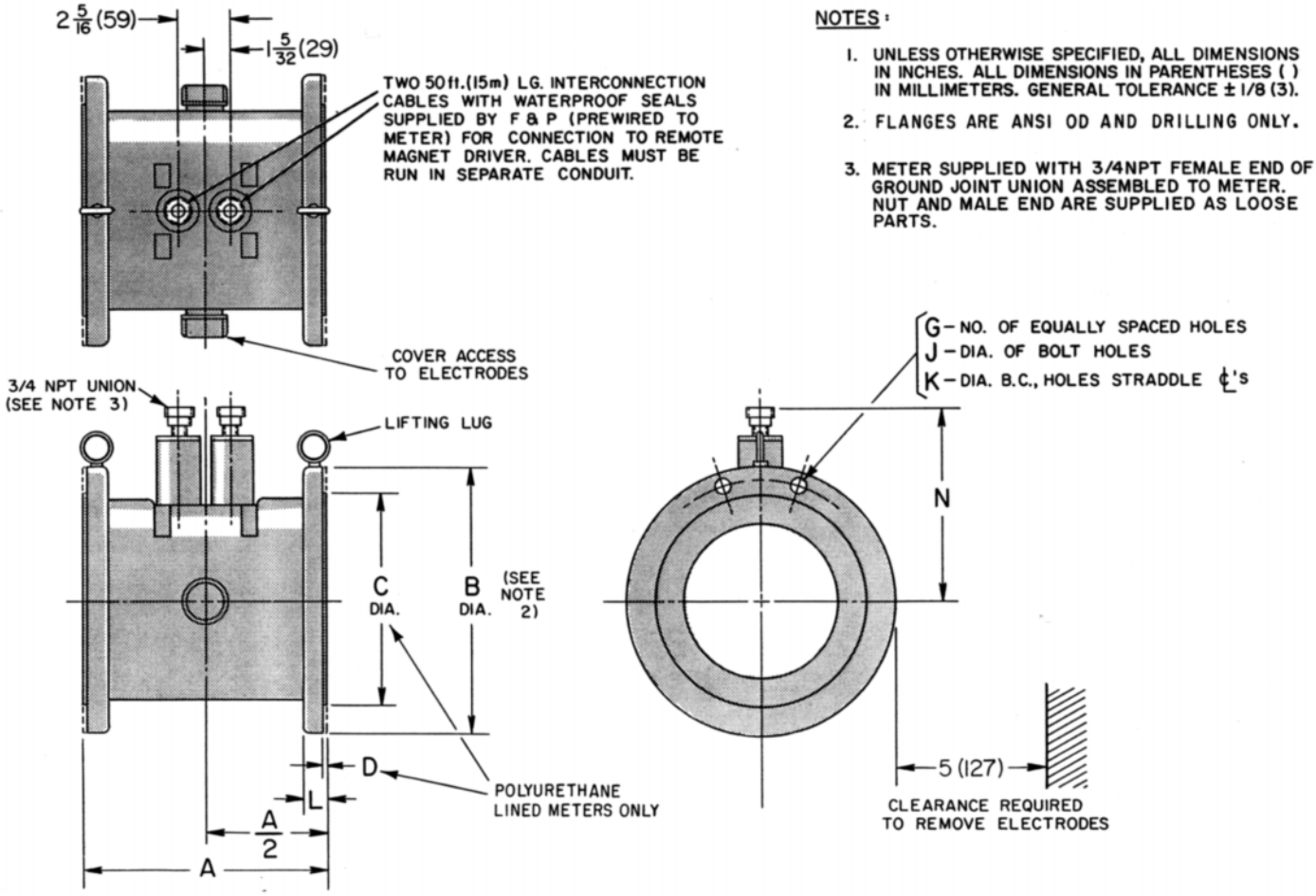
Standard meter piping connections are made by means of flanges that conform to ANSI standards in outside diameter and bolt circle. The bearing surfaces of the flanges are insulated with the meter pipe liner. Outline and mounting dimensions for meters specified for continuously submerged applications are given in Figures 2-3 and 2-4. Figures 2-5 and 2-6 provide outline and mounting dimensions for meters used in accidental submergence applications.

It is generally recommended that two pipe spools be installed, one on each end fitting of the Magnetic Flowmeter, while it is out of the pipeline in order to minimize the possibility of damage to the meter pipe and flange liner during mounting.

A pair of the proper gaskets to suit the particular lining option of the meter supplied is included within the installation kit which accompanies the Magnetic Flowmeter. Before connections are made, the bearing surfaces of NEOPRENE- or polyurethane-lined meter flanges, their NEOPRENE gaskets and adjacent pipeline flanges should be thoroughly dusted with talc gasket powder. This is done to prevent possible damage to the meter lining or gaskets, should the meter be removed from the line.

If the Magnetic Flowmeter is to be mounted in a non-conductive pipeline or a metal pipeline with an insulating liner, the user must provide a pair of suitable gaskets between the customer-supplied annular meter grounding rings (discussed under Grounding Procedure, Case 2, below) and the adjacent pipeline flange surfaces.

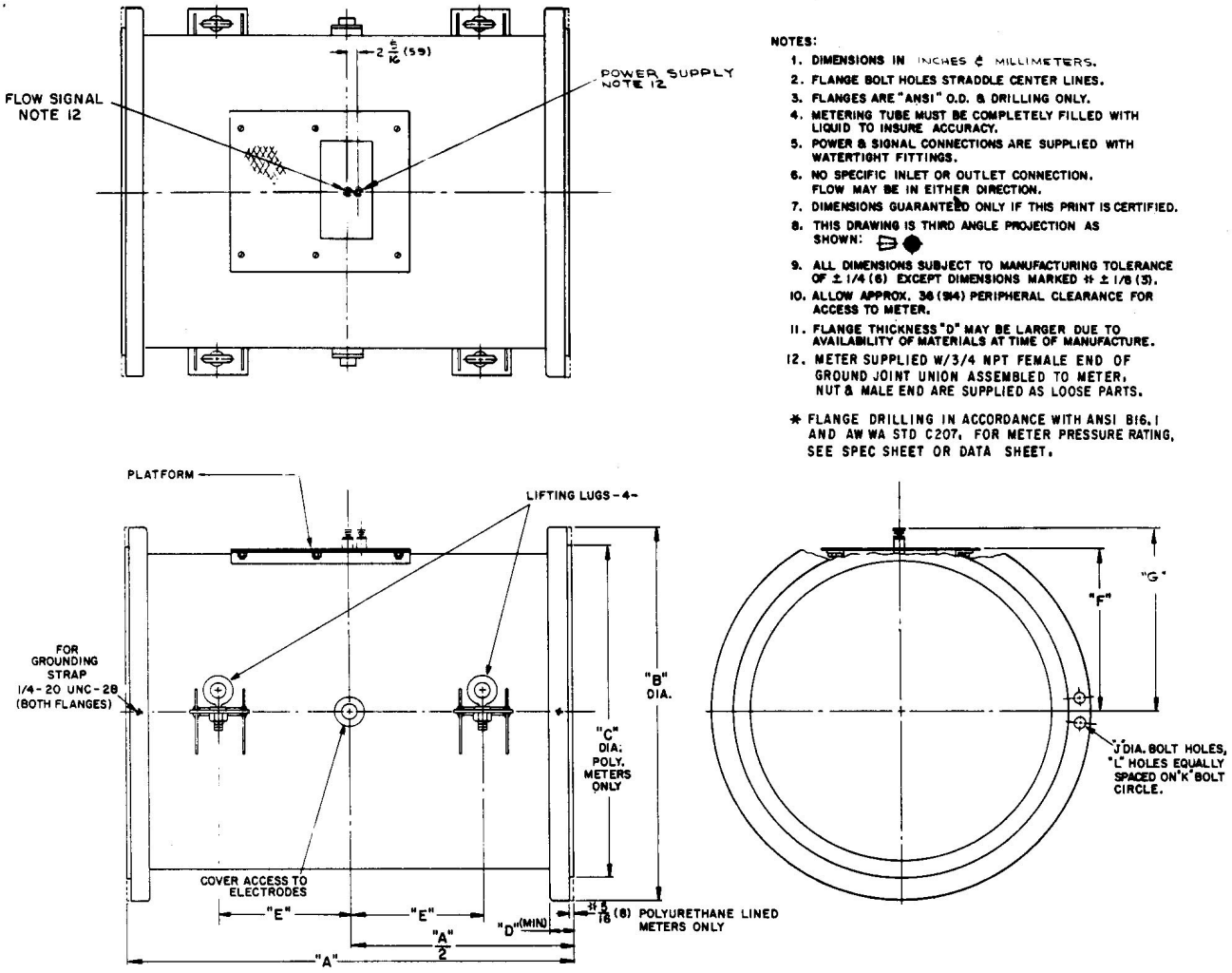
The standard coarse thread flange bolts supplied by the user must be well lubricated and tightened in even increments around the flange surface. Bolt torque should be limited to that which will produce a positive seal for the application.



METER SIZE	ANSI CLASS	A		B		C		D		G	J		K		L		N	
		INCH	mm	INCH	mm	INCH	mm	INCH	mm		INCH	mm	INCH	mm	INCH	mm	INCH	mm
30"	125	45	1143	38 3/4	984	33 3/4	857	5/16	8	28	1 3/8	35	36	914	2 3/8	60	21 1/2	546
36"	125	54	1372	46	1168	40 1/4	1022	5/16	8	32	1 5/8	41	42 3/4	1086	2 5/8	67	26 11/16	678
42"	125	63	1600	53	1346	47	1194	5/16	8	36	1 5/8	41	49 1/2	1257	2 7/8	73	29 11/16	754
48"	125	72	1829	59 1/2	1511	53 1/2	1359	5/16	8	44	1 5/8	41	56	1422	3	76	30 1/2	775
54"	125	81	2057	66 1/4	1683	59 3/4	1518	5/16	8	44	1 7/8	48	62 3/4	1594	3 1/4	83	34 1/8	867

BI-2562 (REF: BI-1812-1, OD-10D-3916 R3)

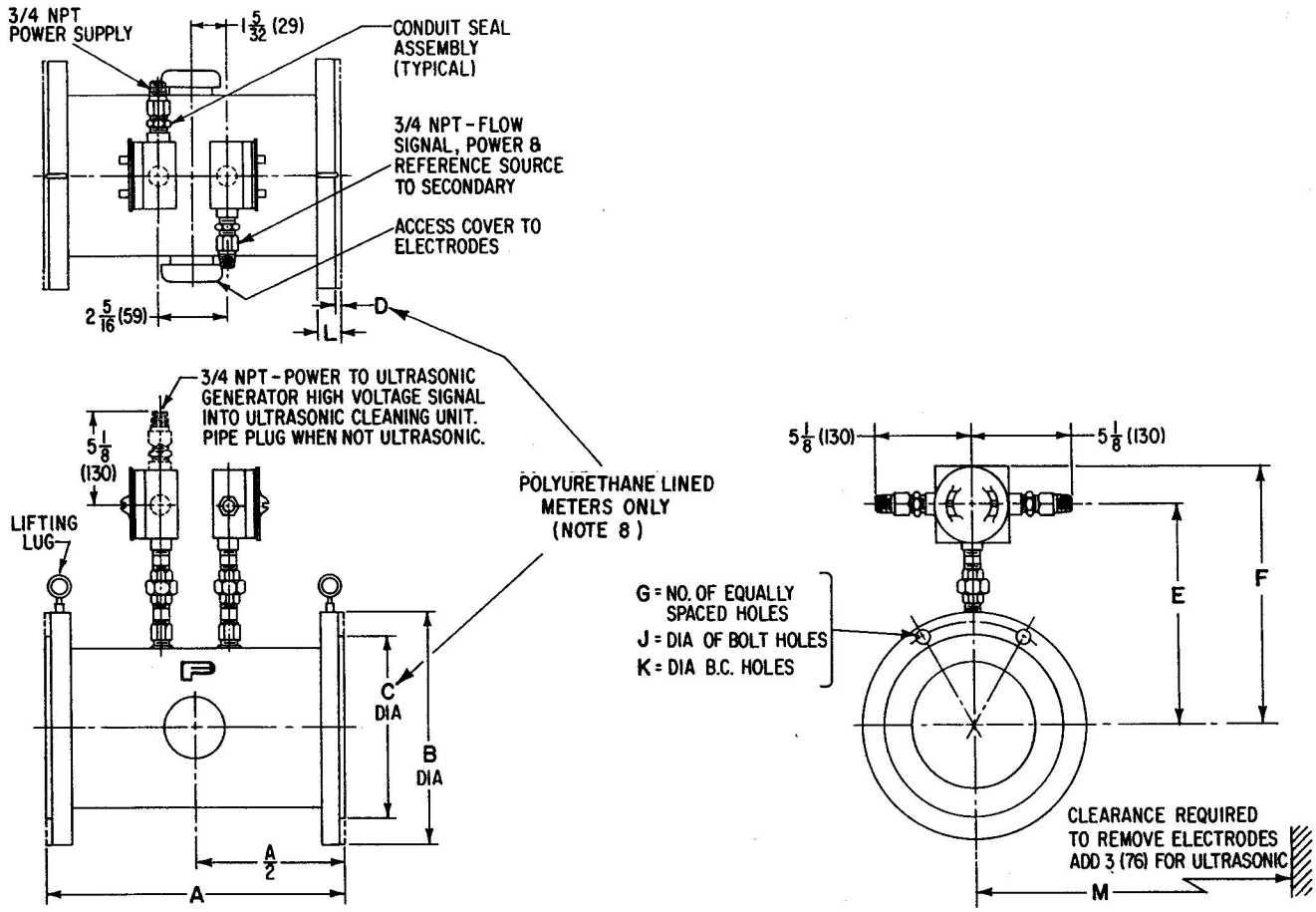
FIGURE 2-3. OUTLINE DIMENSIONS, ACCIDENTAL & CONTINUOUSLY SUBMERSIBLE METERS (IP67 & IP68), SIZES 30" THROUGH 54"



	METER SIZE							
	60"		66"		72"		78"	
	INCH	mm	INCH	mm	INCH	mm	INCH	mm
"A"	90	2286	99	2515	108	2743	117	2972
"B"	73	1854	80	2032	86-1/2	2197	99-3/4	2407
"C"	66	1676	73	1854	79-1/2	2019	85-3/4	2178
"D"	3-3/8	86	3-5/8	92	3-3/4	95	4-3/4	121
"E"	32	813	37	940	40	1016	43	1092
"F"	31-7/8	810	35	889	38-1/2	978	41-5/8	1057
"G"	37-3/8	949	40-1/4	1022	43-5/8	1108	46-5/8	1184
"J"	1-7/8	48	1-7/8	48	1-7/8	48	2-1/8	54
"K"	69-1/4	1759	76	1930	82-1/2	2096	89	2261
"L" HOLES	52		52		60		64	
WEIGHT (TONS) APPROXIMATELY								
U.S.	3.5		4.3		5.3		6.8	
S.I.	3.2		3.9		4.8		6.2	

BI- 2564 (OD-IOD-4072 RO)

FIGURE 2-4. OUTLINE DIMENSIONS, ACCIDENTAL & CONTINUOUSLY SUBMERSIBLE METERS (IP67 & IP68), SIZES 60" THROUGH 78"



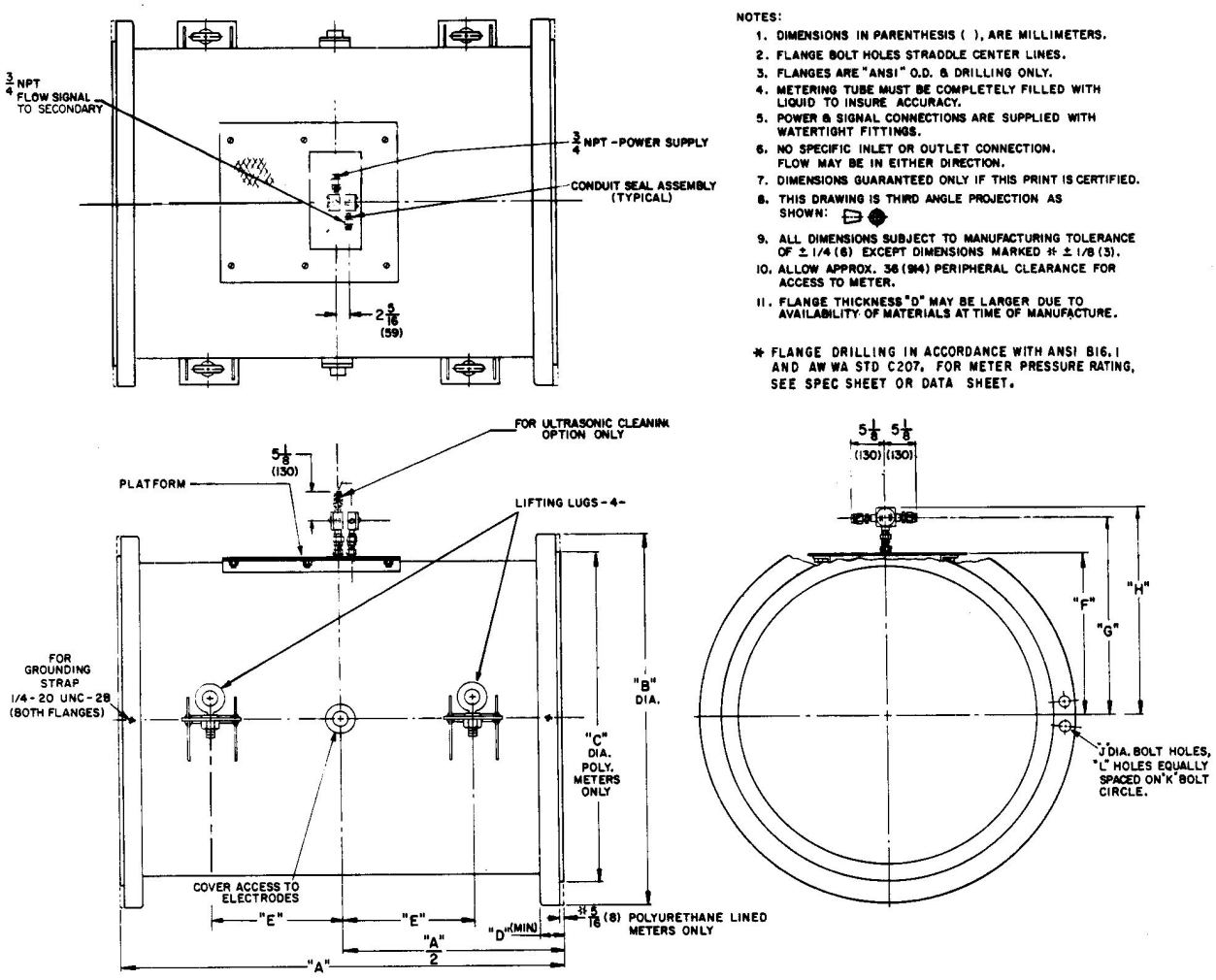
METER SIZE	ANSI CLASS	A		B		C		D		E		F		G	J		K		L		M	
		INCH	mm	INCH	mm	INCH	mm	INCH	mm	INCH	mm	INCH	mm		INCH	mm	INCH	mm	INCH	mm	INCH	mm
30"	125	45	1143	38 3/4	984	33 3/4	857	5/16	8	23 3/8	594	25 7/16	646	28	1 3/8	35	36	914	2 3/8	60	24	610
36"	125	54	1372	46	1168	40 1/4	1022	5/16	8	26 7/16	671	28 1/2	724	32	1 5/8	41	42 3/4	1086	2 5/8	67	27 1/4	692
42"	125	63	1600	53	1346	47	1194	5/16	8	29 9/16	751	31 5/8	803	36	1 5/8	41	49 1/2	1257	2 7/8	73	30 1/4	768
48"	125	72	1829	59 1/2	1511	53 1/2	1359	5/16	8	32 9/16	827	34 5/8	879	44	1 5/8	41	56	1422	3	76	33	838
54"	125	81	2057	66 1/4	1683	59 3/4	1518	5/16	8	35 7/8	911	37 15/16	964	44	1 7/8	48	62 3/4	1594	3 1/4	83	35	889

NOTES

1. UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS IN INCHES. ALL DIMENSIONS IN PARENTHESES ( ) IN MILLIMETERS. GENERAL TOLERANCE ± 1/8 (3).
2. BOLT FLANGE HOLES STRADDLE CENTER LINES.
3. FLANGES ARE ANSI OD AND DRILLING ONLY.
4. METERING TUBE MUST BE COMPLETELY FILLED WITH LIQUID TO INSURE ACCURACY.
5. POWER AND SIGNAL CONNECTIONS ARE SUPPLIED WITH WATERTIGHT FITTINGS.
6. NO SPECIFIC INLET OR OUTLET CONNECTION. FLOW MAY BE IN EITHER DIRECTION.
7. DIMENSIONS GUARANTEED ONLY IF THIS PRINT IS CERTIFIED.
8. POLYURETHANE LINER FORMS RAISED FACE ON FLANGE. NEOPRENE LINER FORMS FLAT FACE ON FLANGE.

BI-2561 (REF: BI-2224, OD-IOD-3987)

FIGURE 2-5. OUTLINE & MOUNTING DIMENSIONS, SPLASHPROOF METERS (IP65), SIZES 30" THROUGH 54"



	METER SIZE							
	60"		66"		72"		78"	
	INCH	mm	INCH	mm	INCH	mm	INCH	mm
"A"	90	2286	99	2515	108	2743	117	2972
"B"	73	1854	80	2032	86-1/2	2197	99-3/4	2407
"C"	66	1676	73	1854	79-1/2	2019	85-3/4	2178
"D"	3-3/8	86	3-5/8	92	3-3/4	95	4-3/4	121
"E"	32	813	37	940	40	1016	43	1092
"F"	31-7/8	810	35	889	38-1/2	978	41-5/8	1057
"G"	38-5/8	981	41-1/2	1054	44-7/8	1140	47-7/8	1216
"H"	40-11/16	1033	43-9/16	1106	46-15/16	1192	49-15/16	1268
"J"	1-7/8	48	1-7/8	48	1-7/8	48	2-1/8	54
"K"	69-1/4	1759	76	1930	82-1/2	2096	89	2261
"L" HOLES	52		52		60		64	
WEIGHT (TONS) APPROXIMATELY								
U.S.	3.5		4.3		5.3		6.8	
S.I.	3.2		3.9		4.8		6.2	

BI-2563 (REF: OD-10D-4073 RO)

FIGURE 2-6. OUTLINE & MOUNTING DIMENSIONS, SPLASHPROOF METERS (IP65), SIZES 60" THROUGH 78"

2.5 Electrical Connections

2.5.1 Grounding Procedure

Satisfactory operation of ABB Instrumentation 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.

One of two similar, but distinct, grounding procedures applies to the Model 10DX3111 Magnetic Flowmeter supplied. The selection of the applicable procedure is based upon the type of pipeline in which the meter is to be mounted, as follows:

Case 1: Electrically conductive adjacent pipeline where the liquid to be metered comes in contact with this conductive pipeline.

-or-

Case 2: Adjacent pipeline which is insulated from the fluid to be metered, such as ceramic-lined iron pipe, plastic pipe or bituminous-coated cast iron pipe.

Perform the proper grounding procedure for the case which applies to your pipeline.

Grounding Procedure - Case 1

For the ABB Instrumentation Magnetic Flowmeter mounted in an adjacent **conductive pipeline** which is **not insulated** from the fluid to be metered, the following grounding procedure must be performed:

1) Drill and tap a blind hole on the peripheral surface of each of the two adjacent pipeline flanges to accept a 1/4-inch hex head bolt. These tapped holes should be placed at that point on the pipeline flanges that aligns with the 1/4" hex head bolts which clamp the 1/2" wide, 6" long copper braid to the periphery of each meter flange. Obtain a bright metal surface around the edges of each taped hole with a file or burnishing tool.

2) Securely clamp the lug on the end of each meter flange ground strap on the respective pipeline flange surface with a pair of mating hex head bolts and external tooth lockwashers, as shown in Figure 2-7.

3) If the pipeline is in itself not a suitable ground, interconnect the shortest practical length of 1/2" wide copper braid from a meter flange ground strap bolt to a good ground as shown in Figure 2-7. Copper wire #12 AWG or heavier, may be substituted for this ground connection if braid is not available.

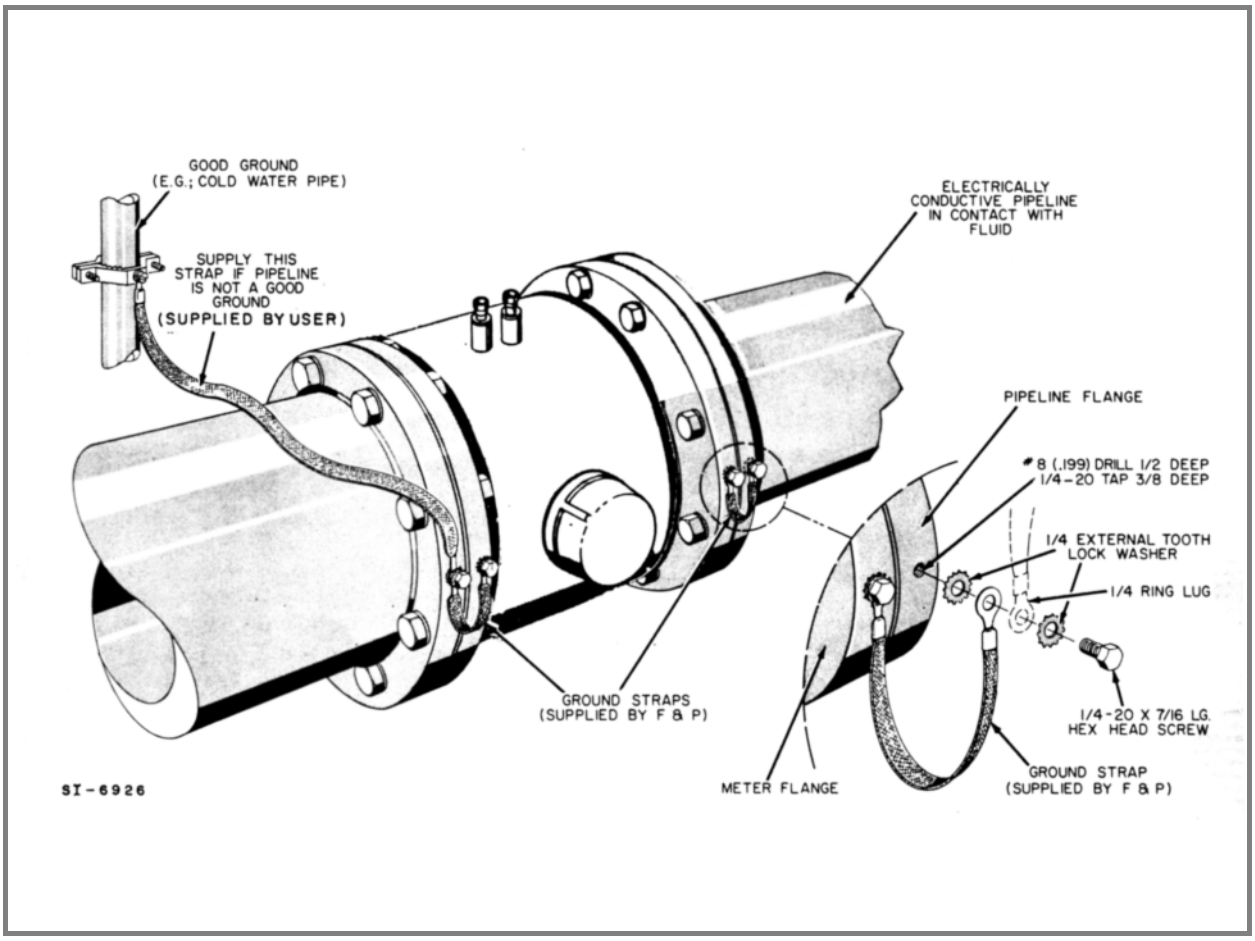


FIGURE 2-7. GROUNDING PROCEDURE: NON-INSULATED PIPELINE

Grounding Procedure - Case 2

For the ABB Instrumentation Magnetic Flowmeter mounted in a **non-conductive** or **fluid insulated pipeline,** perform the following grounding procedure:

1) Obtain a pair of grounding rings. Grounding rings (with NEOPRENE gaskets) for sizes 30" through 54" meter sizes are available from ABB Instrumentation. The part numbers are shown in Table 2-1. The grounding rings available from ABB Instrumentation resemble orifice plates which have been modified to facilitate connection of a grounding lead as shown typically in Figure 2-8. When installed, these rings are centered by the flange bolts. The grounding ring material selected must not react with the metered fluid.

TABLE 1. 304 SST GROUNDING RING PART NUMBERS

Flange Size	Part Number
30"	644B009U19
36"	644B009U20
42"	644B009U21
48"	644B009U22
54"	644B009U31

2) When installing the meter in the pipeline, bolt the grounding rings between each primary meter flange and its adjacent pipeline flange as shown in Figure 2-9. Provide standard gasketing between the rings and the adjacent pipeline flange (when gasketed ring not specified).

3) Clamp the lug on the free end of each meter flange ground strap down securely on each of the metal ground rings by means of the user provided hex head bolts and external tooth lockwashers as shown in Figures 2-8 and 2-9.

4) Connect a ground jumper from one of the grounding ring terminals to a good earth ground using 1/2" copper braid or #12 AWG copper wire.

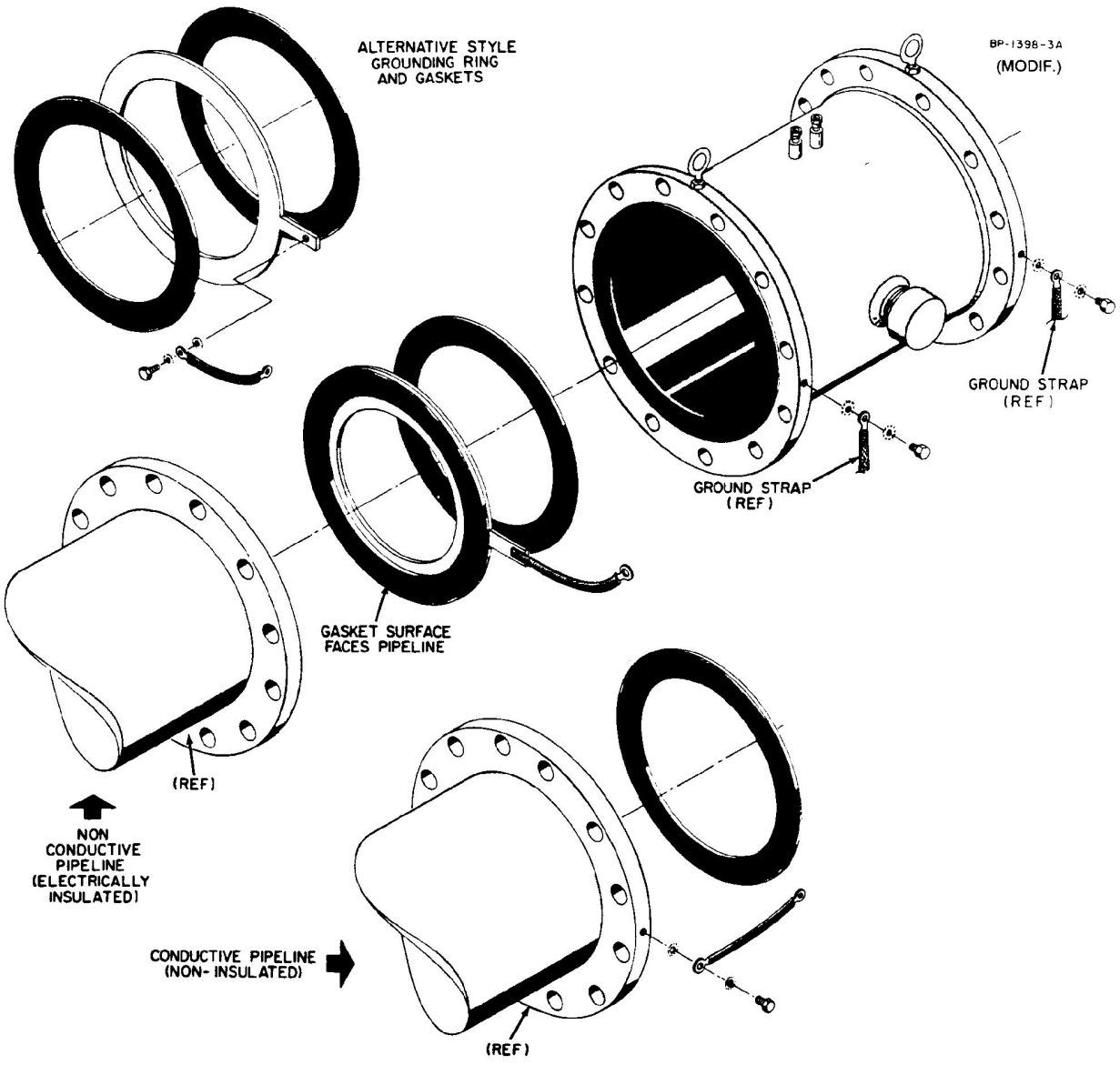


FIGURE 2-8. USE OF GROUNDING RINGS & GASKETS

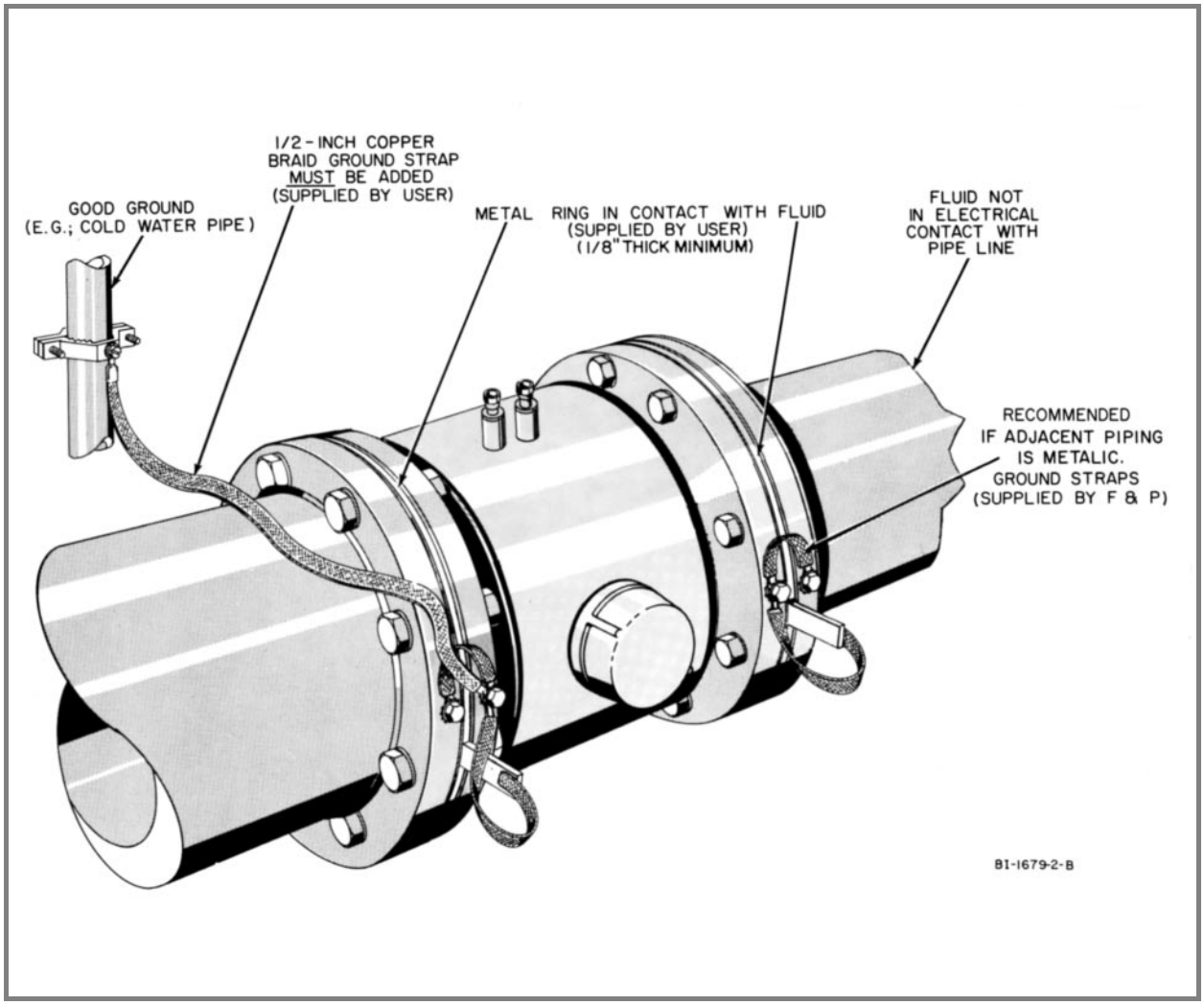


FIGURE 2-9. GROUNDING PROCEDURE: INSULATED PIPELINE

2.5.2 Interconnections

Meters designed for accidental and continuous submersion have cables for interconnection to the Converter/Drive already attached to the primary. The wires are identified as shown in Figure 2-10.

Meters designed for accidental submergence must be wired between the conduit boxes and the Converter/Driver by the user. The terminals in the conduit boxes are identified in Figure 2-11. A specific electrical interconnection diagram and procedure which defines wiring to be installed between your ABB Instrumentation Magnetic Flowmeter and the Converter/Driver is provided in the Converter/Driver instruction bulletin.

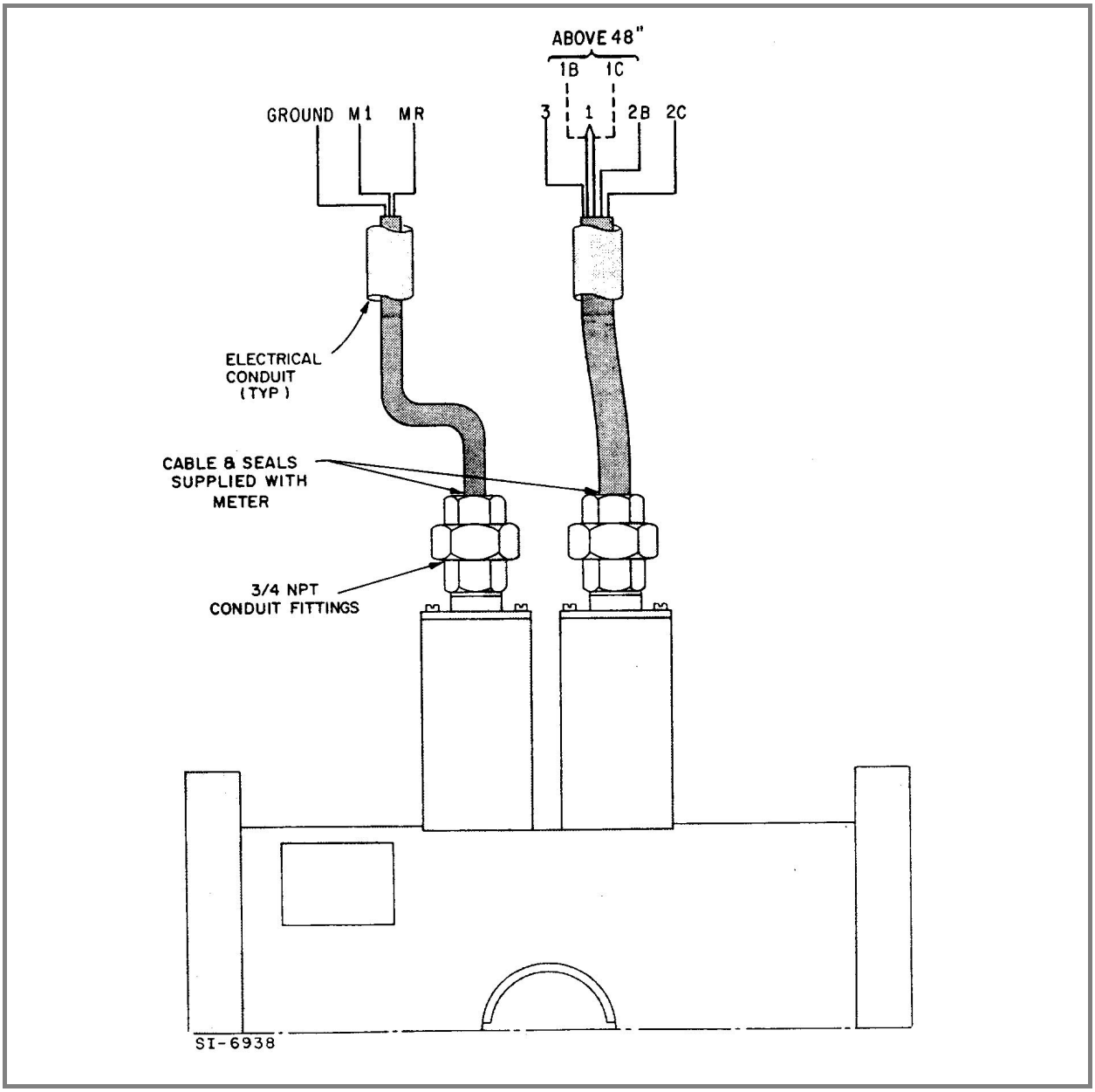


FIGURE 2-10. WIRE IDENTIFICATION FOR ACCIDENTAL & CONTINUOUS SUBMERGENCE METERS

NOTE

The interconnect cable shield connected to the MR terminal carries active signals and is not at ground potential. Be certain to insulate this shield to prevent it from contacting other shields or ground.

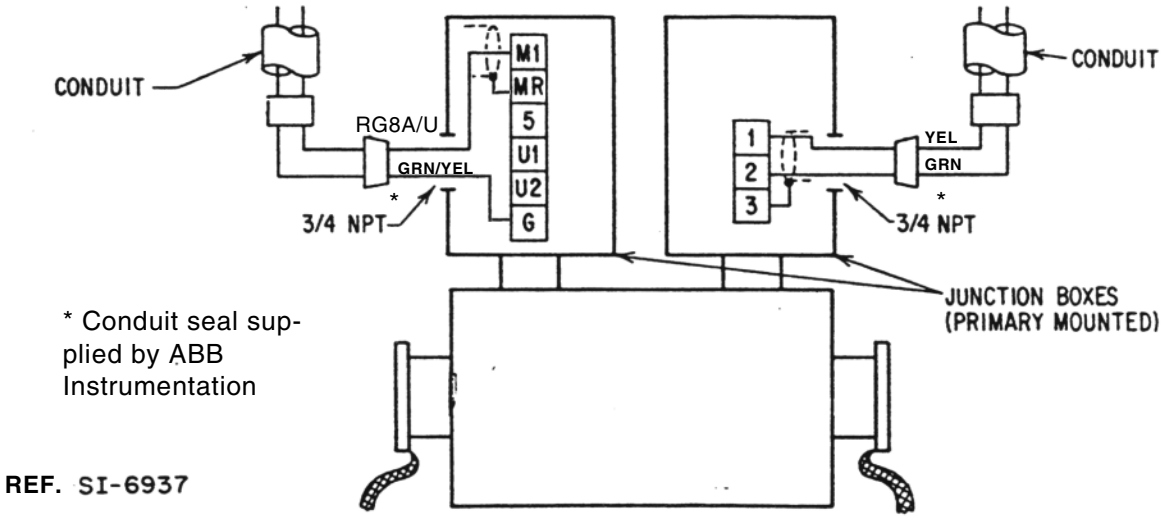


FIGURE 2-11. TERMINAL IDENTIFICATION FOR SPLASHPROOF METERS

3.0 PRINCIPLE OF OPERATION

3.1 Basic Operating Principle

3.1.1 Signal Voltage Generation

The operating principle of the ABB Instrumentation Model 10DX3111 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 ABB Instrumentation Magnetic Flowmeter constitutes a modified form of an ac generator.

Figure 3-1 graphically illustrates the basic operating principle. A magnetic field, "B", being generated in a plane which is perpendicular to the axis of the meter pipe. A disk of the metered fluid can be considered as a conductor. The transverse length "D" is equal to the meter pipe diameter. Since the velocity "V" of the fluid disk is directed along the axis of the meter pipe, a voltage, "E_s", will be induced within this fluid and is mutually perpendicular to the direction of the fluid 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 fluid particle that passes under the influence of the magnetic field.

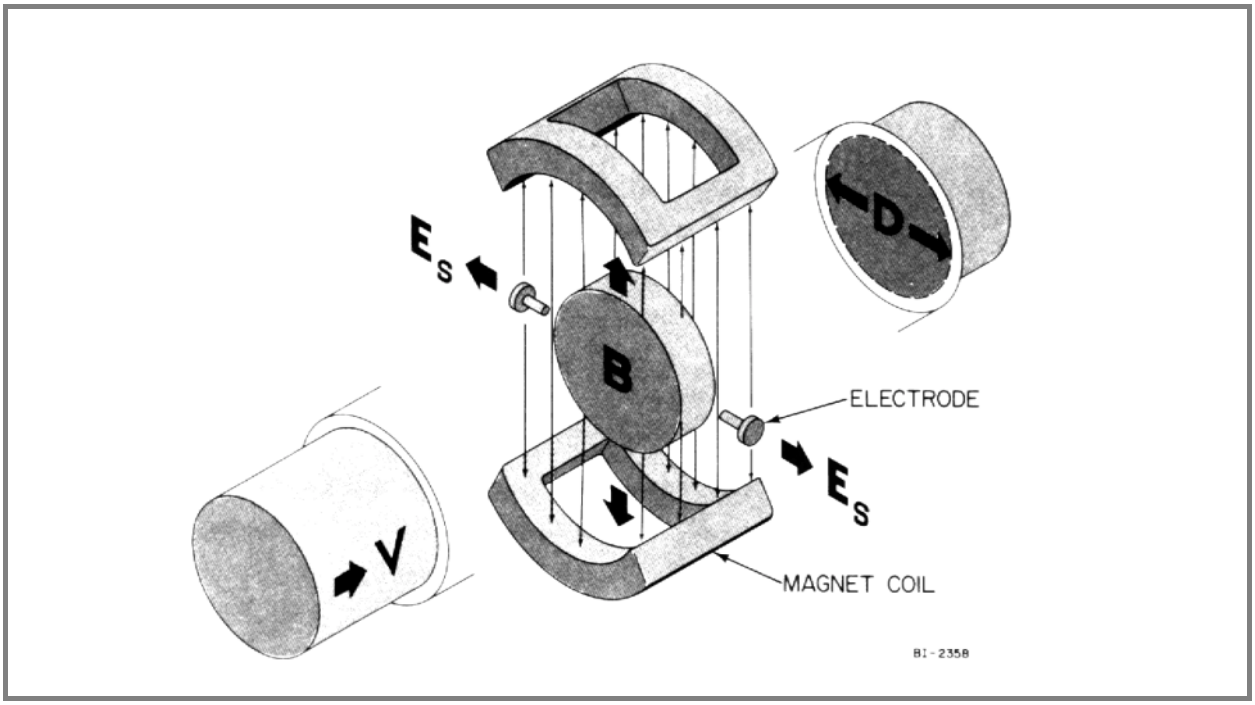


FIGURE 3-1. BASIC OPERATING PRINCIPLE

This may be expressed mathematically as -

(Equation #1)

$$E_s = \frac{1}{\propto} BDV$$

where:

E_s = induced electrode voltage
B = magnetic field strength
D = meter pipe diameter
$\propto$ = dimensionless constant
V = fluid velocity

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

3.1.2 Magnet Coil Drive Circuits

In most 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 ABB Instrumentation Series 10DX3111 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.

3.1.3 Volumetric Flow Rate Measurement

The ABB Instrumentation Magnetic Flow Rate Measurement is a volumetric flow rate measuring instrument. This can be shown by substituting the physical equivalent of fluid velocity into equation #1 as follows:

(Equation #2)

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

Substituting for V in equation #1

$$E_s = \frac{1}{\propto} BD \frac{4Q}{\pi D^2}$$

and solving for Q:

$$\therefore \quad Q = \frac{\pi \propto D}{4} \bullet \frac{E_s}{B}$$

Since $B = \beta E_r$

and since $\propto$, D and β' 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
$\propto$ = dimensionless constant
β & γ = dimensional constant
V = fluid velocity

Therefore, volumetric flow rate is directly proportional to the induced signal voltage as measured by the ABB Instrumentation Magnetic Flowmeter.

3.2 Operating Characteristics

3.2.1 Fluid Variables

3.2.1.1 Fluid Conductivity

The Magnetic Flowmeter described in this manual requires a fluid conductivity of 5 microsiemens per centimeter, or greater, for operation with the accuracies specified. This minimum fluid conductivity requirement is also dependent upon the length of the signal transmission cable employed in a given installation; the longer the cable, the higher the minimum fluid conductivity requirement becomes. The precise relationship between minimum allowable fluid conductivity and signal transmission cable length for all Model 10DX3111 Magnetic Flowmeters is shown in Figure 1-2. Changes of conductivity above the threshold level for a given installation have no effect upon metering accuracy as long as the proper installation and interconnection procedures are observed.

3.2.1.2 Fluid Temperature

Having established the minimum fluid conductivity requirements for a given application, any fluid which exhibits equal or higher conductivity may be metered without concern for any system compensating adjustments. However, due regard for the effect of the fluid conductivity should be considered.

Most fluids exhibit a positive temperature coefficient of conductivity. It is possible for certain marginal fluids to become sufficiently non-conductive at lower temperatures so as to hamper accurate metering; whereas, the same fluid at higher or normal environmental temperatures may be metered with optimum results. The possibility of an adverse temperature conductivity characteristic should be investigated before attempting to meter such a fluid. Fluid or ambient temperatures are also limited by the meter materials specification.

Other normal effects of temperature, such as influence upon fluid viscosity and density, the size of the metering area, and the flux density of the magnetic field, have negligible or no effect upon metering accuracy.

3.2.1.3 Other Fluid Variables

Other fluid variables such as viscosity, density and fluid pressure have no direct influence on metering accuracy. Fluid density has no effect on volumetric flow rate since only the area of the meter pipe and liquid velocity are required to determine the rate of flow. Viscosity and metering pressure are restricted to physical limitations alone, such as the leakage pressure of the meter pipe flange connections.

3.2.2 Metering Characteristics

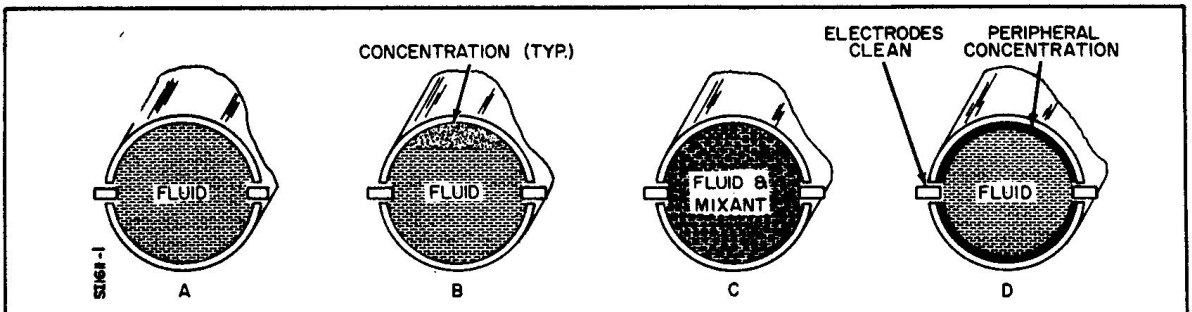
The metering pipe must be completely filled at all times for accurate results. Where there is possibility of operation with a partially filled horizontal pipeline, it is recommended that the Magnetic Flowmeter be installed in a vertical section of that pipeline such that fluid flow moves upward.

A vertical installation also offers the advantage of an even distribution of liner wear in the event that solid abrasives are being carried along in the fluid stream.

The ABB Instrumentation Magnetic Flowmeter will measure the total amount of material passing in the fluid stream. The meter will not, for instance, differentiate between the amount of liquid and the amount of entrained gases. Also, in the case of a slurry, it will not differentiate the amount of liquid from solids. If the liquid to mixant ratio is of importance to process control, then separate

measurements of the concentration of the desired medium must be made and appropriate correction factors must be applied to the Magnetic Flowmeter output. The table of Figure 3 illustrates various metering and fluid conditions which may be encountered and provides a qualitative analysis of the effects of these conditions upon the meter signal output.

In applications involving variable quantities of uniformly dispersed, non-conductive mixing agents, it must be ascertained that the higher concentrations of mixant will not drive the average conductivity of the liquid mixture below the minimum conductivity level for the given installation.



PRIME FLUID CONDITION	MIXANT OR CONCENTRATION NATURE	METER PIPE CONDITION	REF. FIG.	INDICATED VOLUMETRIC FLOW RATE	
				MIXTURE	FLUID ONLY
Homogeneous	Conductive	Full	A	—	Accurate
	Non-conductive, e.g., air	Full	B	High	—
With Uniformly Dispersed Mixant	Conductive Particles (solid, emulsion or slurry)	Full	C	Accurate	—
	Magnetic Particles (solid or slurry)	Full	C	High	—
With solid Concentration — Peripherally Distributed (clean electrodes)	Non-conductive	Full	D	—	Not Predictable
With Solid Concentration — Peripherally Distributed (clean electrodes)	The coating the same conductivity as the fluid	Full	D	—	Accurate
With Solid Concentration Peripherally Distributed (clean electrodes)	The coating very highly conductive compared to the fluid	Full	D	—	Low
With Liquid or Solid Concentration (top or bottom)	Non-Conductive (solid)	Full	B	Accurate	—
	Highly Conductive (liquid or solid)	Full	B	Partially Compensated Errors, not predictable	
	Magnetic Particles	Full	B	High	—

SI-6934

FIGURE 3-2. FLUID AND METERING CONDITIONS

4.0 MAINTENANCE

4.1 General

Although the Series 10DX3111 Magnetic Flowmeter is of inherently rugged design, normal care used in the handling, installation and maintenance of the meter will contribute substantially toward trouble-free operation. As the Magnetic Flowmeter has no moving parts, the necessity for specifying or requiring replacement parts is limited.

Electrodes can be replaced in NEOPRENE and Polyurethane-lined meters without removal of the meter from the pipeline.

Contact ABB Instrumentation for part numbers of field replaceable parts.

4.2 Routine Maintenance

No routine maintenance procedures should be required for the normal application.

For those applications where the fluid being metered consists of sludge, unusually greasy mixants, or other insulating mixants which normally tend to coat pipe walls, it is advisable to visually inspect the inner meter walls periodically. This procedure is facilitated by use of a plugged pipe tee in a by-pass piping configuration, as shown in Figure 2-2. The pipe tee also provides easy access for cleaning polyurethane-lined meters with a wire brush or cleaning NEOPRENE-lined meters with a ball bristle brush.

4.3 Trouble-Shooting

Localization of electrical malfunction in the 10DX3111 Magnetic Flowmeter can best be accomplished by making static and dynamic measurements on the meter in question and comparing rhe results with the proper resistance and voltage measurements given in Table 4-1. Only qualified electronic technicians should be permitted to service the meter.

WARNING
Equipment powered by an AC line voltage presents 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 or service.

4.3.1 Magnet Coils

To check the magnetic coils follow this procedure:

1) Power down the converter/driver. Remove the coil wiring from terminals M1 and MR in the converter/driver. (See converter/driver instruction bulletin for location of terminals.)

2) Measure the resistance; the cable resistance should be as indicated in Table 4-1 (or more depending on the length of the interconnecting cable).

3) Check for short circuit between either of these wires and terminal 3 on the converter/driver. Continuity indicates a shorted magnetic coil. If a shorted coil is detected, the meter must be replaced.

4) Reattach coil wiring.

TABLE 4-1. MAGNET COIL RESISTANCE

METER SIZE (INCHES)	RESISTANCE IN OHMS
30	22
36	13.2
42	8.4
48	4.8
54	4
60	3
66	*
72	*
78	8

*Consult ABB Instrumentation

4.3.2 Electrodes

To check for problems with the electrodes do the following:

1) Power down.

WARNING
Do not inspect electrodes unless pipe is de-pressurized and drained.

2) With an empty and **dry** meter pipe, remove the electrode connections from the terminal board in the Converter/Driver or from the terminals in the conduit box (accidental submergence meters only). Check for possible continuity first from terminal "1" to the meter housing and then from terminal "2" to the meter housing. No continuity whatsoever should be detected for proper operation.

3) If continuity is detected, check for stranding shorts about terminals "1", "2" and "3" in the conduit box of accidentally submersible meters, or about terminals 1, 2B and 2C in the Converter/Driver for continuously submersible meters. Also check the possibility of a short in either electrode assembly (the standard electrode assembly is shown in Figure 4-1). Condensate in an electrode assembly may cause a high resistance ground which can be remedied by partial disassembly and exposure with infra-red bulb or by packing with a desiccant. (The procedure for electrode disassembly is described in 4.3.4.) If the electrode short cannot be eliminated (either in the area of the terminal boards or wiring), the meter must be replaced.

4) If all components prove reliable, restore internal wiring interconnections. If the meter does not function properly after reconnection, contact your local ABB Instrumentation Field Representative.

4.3.3 Electrode Disassembly, Inspection and Replacement

Standard and bullet-nosed electrodes may be inspected and replaced in Model 10DX3111 Magnetic Flowmeters without removal of the meter from the pipeline.

WARNING
Do not attempt electrode inspection or replacement with a filled or pressurized pipeline. Personal injury may result from such practice.

Unless specified otherwise at the time of purchase, meters are equipped with stainless steel electrodes.

4.3.3.1 Electrode Inspection

Perform the following procedure for seated electrode inspection (see Figure 4-1):

1) Empty the meter pipe.

2) Unscrew and remove the 2-inch pipe cap from the electrode boss.

3) Remove the three #10-32 x 1/2" fillister head cap screws which clamp the electrode cover on the assembly.

4) Remove the electrode cover and its 'O'-ring.

5) Remove the insulator disc. The seated electrode and wiring are open for inspection.

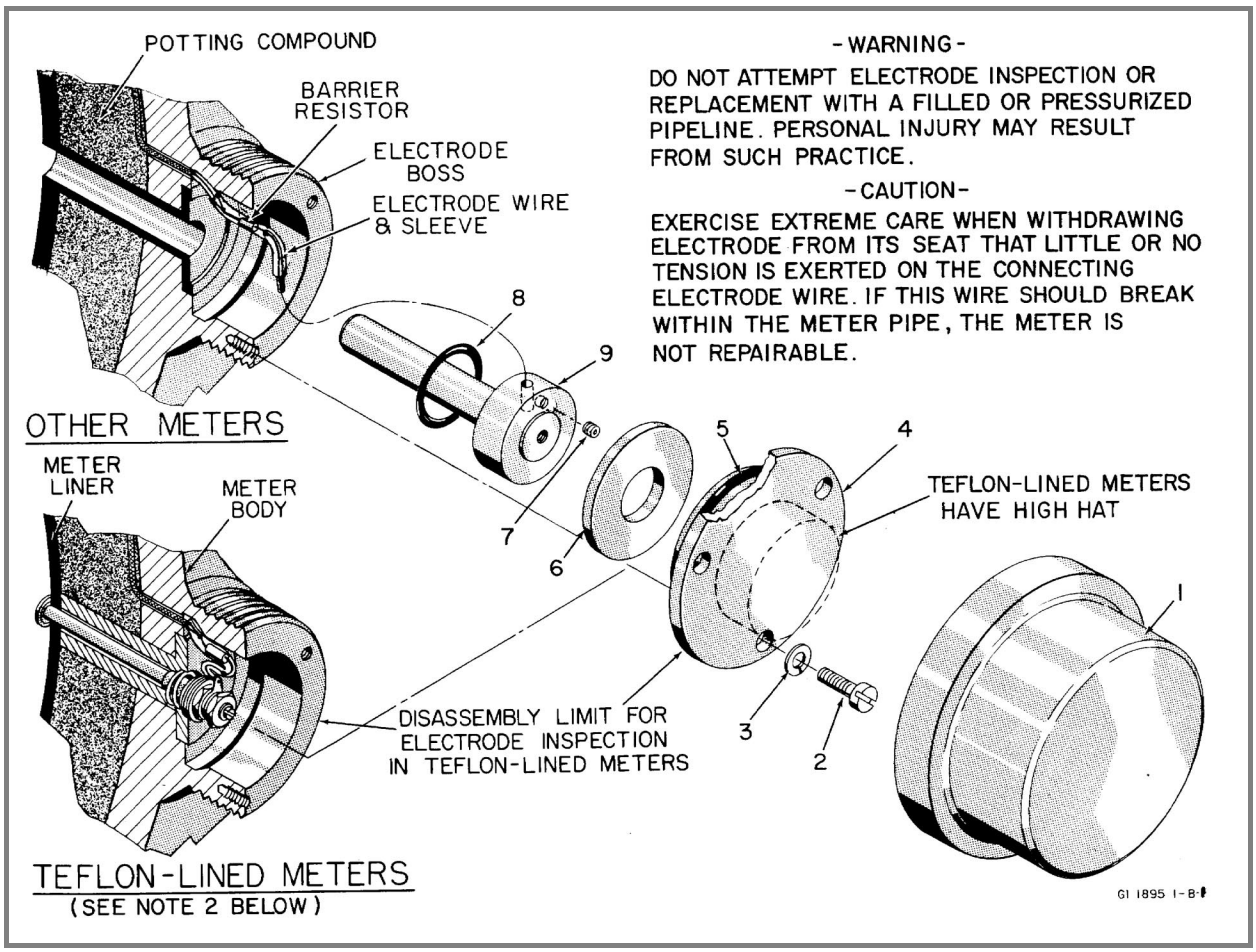


FIGURE 4-1. DISASSEMBLY OF ELECTRODE ASSEMBLIES

4.3.3.2 Electrode Replacement

1) Pull the electrode from its seat in the side of the meter spool and liner. This is facilitated by partially running one of the removed #10-32 cap screws that held the electrode cover in place into the tapped hole in the electrode head and using this as a grip for electrode withdrawal. In polyurethane-lined meters an 'O'-ring on the underside of the electrode head also must be withdrawn.

CAUTION

Exercise extreme care when withdrawing electrode from its seat so that little or no tension is exerted on the connecting electrode wire. If this wire should break within the meter pipe, the meter is not repairable.

2) Loosen the #4-40 x 1/8" hex socket set screw in the head of the electrode. Withdraw the electrode wire with its sleeve tip from its electrical connection seat in the side of the electrode head.

3) Insert and reseat replacement electrode. For polyurethane-lined meters, be certain the new 'O'-ring which accompanies the new electrode is seated in the groove under the head of the electrode.

4) Reassemble by reversing the procedure given in steps #2) through 5) in subsection 4.3.3.1. Use pipe dope on the threads of the 2-inch cap when replacing on the electrode boss.

NOTE

It is possible to interchange simple electrodes and electrode-transducer assemblies in NEOPRENE- and polyurethane-lined meters, **if** the meter body was manufactured with ultrasonic transducer leads installed and if proper accessory parts such as electrode and dust covers, insulators, etc., are obtained.

CUT ALONG LINE, FOLD, STAPLE

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