INSTRUCTION MANUAL

MAGNETIC FLOWMETERS
10D1475 Design Levels J & S
Sizes 1/10 through 4 Inches

MINI-MAG® MAGNETIC FLOWMETER

PN25006A

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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.

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 ABB 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 for authorization prior to returning equipment.

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

All flowmeters and/or signal converters being returned to ABB 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 for authorization prior to returning equipment. (pg. V, 4-1)

ELECTRICAL SHOCK HAZARD. Equipment powered by 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. (pg. 2-16

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. (pg. 3-2, 4-2)

ELECTRICAL SHOCK HAZARD. Equipment that operates from ac line voltage constitutes a potential electric shock hazard to the user. Make certain that the system power is disconnected before making the following ohmmeter checks. (pg. 4-3)

SPECIFIC CAUTIONS

Do not use graphite gaskets. Under certain conditions they may cause an electrically conductive layer to form on the inside wall of the meter, causing meter operation to degrade. (pg. 2-8)

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. 4-1)

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 ABB 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 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, 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

Tout débitmètre et(ou) convertisseur retourné à ABB 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 pour autorisation avant renvoi du matériel. (pg. V, 4-1)

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. (pg. 2-16)

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. 3-2, 4-2)

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 4-3)

SPÉCIFIQUES ATTENTIONS

N'utilisez pas les garnitures de graphite. Dans certaines conditions elles peuvent causer une couche électriquement conductrice à la forme sur le mur intérieur du mètre, faisant dégrader l'exécution de mètre. (pg. 2-8)

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. 4-1)

READ FIRST

WARNING

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

RETURN OF EQUIPMENT
All Flowmeters and/or Signal Converters being returned to the manufacturer 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 the manufacturer for authorization prior to returning equipment.

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

Contacting the factory

Should assistance be required with any of the manufacturer's products, contact the following:

Telephone:

Automation Services Call Center
1-800-HELP-365

E-Mail:

ins.techsupport@us.abb.com

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 factory representative to obtain the correct touch-up paint.

1.0 INTRODUCTION

1.1 General

The Series 10D1475 MINI-MAG® Magnetic Flowmeter is an electromagnetic liquid flow rate detector. The meter uses the characteristics of a conductive liquid to generate an induced voltage, directly proportional to flow rate, as the liquid passes internal electrodes. The resultant voltage is applied to a solid state electronics package that conditions it to an output signal compatible with conventional receiving equipment.

The meter's design provides a compact, very low power, obstructionless primary metering element that bolts between flanges in a process pipeline. Pressure losses in this type of meter are reduced to levels occurring in equivalent lengths of equal diameter pipeline, thus reducing or conserving pressure source requirements as compared to other metering methods. The compact size of the meter results in a light-weight unit that requires no additional support other than that used normally on pipe runs.

This Flowmeter can be used to meter either clean or dirty liquids. The meter may be used with many non-homogeneous liquids and is as independent of the tendency to plug or foul as the pipeline in which it is mounted. By design, only the liner and electrodes are wetted parts and will accommodate most acids, bases, water and aqueous solutions.

Viscosity and density of the metered liquid have no effect on the measurement accuracy of the meter and, therefore, signal compensation is not required. 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 the metering accuracy (as long as it is greater than the minimum level). The liquid temperature and pressure are limited only to the meter material specification limit.

With the exception of the primary board, the meter body is a sealed section that bolts between the customer's pipe line flanges. The body has a TEFZEL® (ETFE) liner which is turned out against the flange faces. The measuring electrodes that contact the process liquid have their ends flush with the inside of the liner. For accurate results, the meter bore diameter must be centered in the pipeline. For the larger size meters, spacer sleeves are slipped over the flange mounting bolts. The smaller size meters use a unique centering device (called a flange adaptor) to center the meter.

FIGURE 1-1. INTEGRAL 10D1475J FLOWMETER

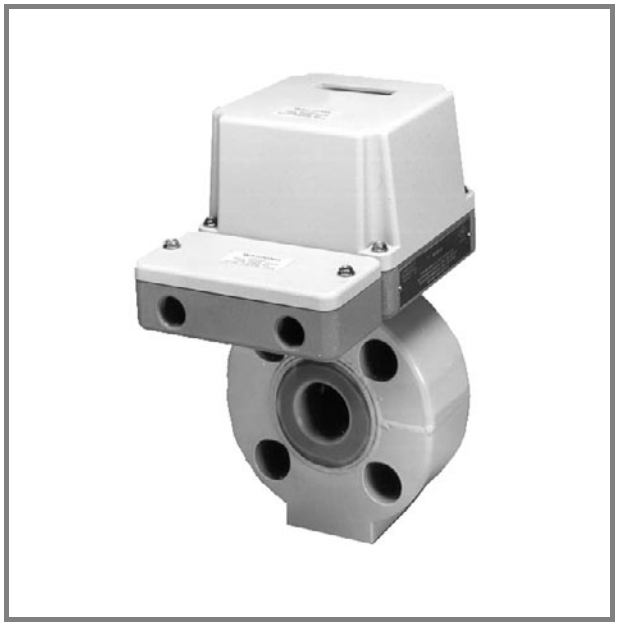


FIGURE 1-2. INTEGRAL/REMOTE 10D1475S FLOWMETER

The associated electronics package is called the signal converter and may be either integrally or remotely mounted. Typical integral MINI-MAG Magnetic Flowmeters are shown in Figures 1-1 & 1-2. The integral housing shown contains a 50XM1000 electronics module. Remote models 10D1475J & 10D1475S are furnished with remote 50XM1000 electronics. Refer to the separate 50XM1000 converter instruction manual for additional information.

The flowmeter without the electronics package is used with a remote signal converter. A remote mounted signal converter is recommended if:

- The integral model vibration specification is exceeded and/or
- The process liquid temperature exceeds the value given for that ambient temperature listed in the integral model's specifications.

Figure 1-3 shows a remote Primary used for general purpose and FM Class I, Div.2 applications. A 2-piece box with cable seal and pressure-relief fitting is shown. Figure 1-4 shows the remote Primary with cable seal used for FM Class I, Div.1 applications.

FIGURE 1-3. 10D1475J REM. PRIMARY w/ GEN. PURPOSE BOX

FIGURE 1-4. 10D1475J REMOTE w/ EXPLOSION PROOF BOX

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

For additional details and a basic functional description, refer to Chapter 4.0.

1.2 Model Number Breakdown

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

Order Number 10D1475	_	N	__	_	_	2	_	_	_
Design Level									
1/10 - 3/8 Inches	S								
1/2 - 4 Inches	J								
Liner Material									
Tefzel (ETFE)		N							
Meter Size - inches (mm)									
1/10 (3)			01						
5/32 (4)			02						
1/4 (6)			04						
3/8 (10)			06						
1/2 (15)			07						
1 (25)			09						
1 1/2 (40)			11						
2 (50)			12						
3 (80)			14						
4 (100)			15						
Pressure Rating									
ANSI Class 150				P					
ANSI Class 300				Q					
BS 10 Table D				S					
BS 10 Table E				T					
BS 10 Table F				U					
DIN PN16				D					
DIN PN40				F					
Electrode Material									
Hastelloy-C					D				
Tantalum					F				
Zirconium					L				
Platinum					M				
Electrode Type									
Flush						2			
Flange Material									
Flangeless Design w/ Self-adhesive Tag							8		
Flangeless Design w/ Riveted SS Tag							9		
Safety Classification									
w/o FM Approval (General Purpose)								A	
FM Approved - Nonincendive for Class I, Div 2, Gp A, B, C & D: Electrodes Intrinsically Safe for Class I, Div 1, Gp A, B, C & D: Outdoor Hazardous Locations, NEMA 4X. Integral Signal Converter enclosure additionally approved: Dust-Ignitionproof Class II & III, Div 1, Gp E, F & G: Accidental Submergence, 30 ft H_20/48 hr (9 m H_2O/48 hr)								K	
FM Approved - Explosionproof for Class I, Div 1, Gp B, C & D; Dust-Ignitionproof Class II & III, Div 1, Gp E, F & G: Electrodes Intrinsically Safe for Class I, Div 1, Gp A, B, C & D: Outdoor Hazardous Location, NEMA 4X. (Remote version only)								L	
Power Requirements (*Integral Signal Converter*)									
220/230/240 VAC, 50/60 Hz									A
110/115/120 VAC, 50/60 Hz									C
24 VDC									H
Remote Converter w/ Separate Model Number									Y

Order Number 10D1475 _ N __ _ _ 2 _ _ _ _ _ _ _ _ _ _ _

Enclosure Classification
IEC 529, IP65, NEMA 4X — 1

Continuous Submergence: IEC 529, IP68, NEMA 4X, 33 ft H_20 (10 m H_2O) Continuous Duty. Signal cable permanently installed (Remote only). — 4

Accidental Submersion, IEC 529, IP67, 30 ft H_20/48 h (9 m H_2O/48 h) (NEMA 4X) — 5

Fluid Temperature Range
Integral Converter to 65°C (149°F) — 1
Remote Converter to 121°C (250°F) — 2

[Refer to operating conditions curve in Specifications section for allowable combinations of fluid & ambient temperatures]

Output Current
No Output Signal Required — A
0-20 mA DC — B
4-20 mA DC — C

Output Options
No Scaled Output Required — 1
Active Scaled Pulse Forward & Zero Return — 2
Active Scaled Pulse Forward & Reverse — 4
Data Link RS232C — 5
Data Link RS485 — 6

Communication Mode
Not applicable — 1
ASCII — 2
HART Protocol — 4

Coil Drive Frequency
7-1/2 Hz (60 Hz line frequency) — 1
15 Hz (60 Hz line frequency) — 2
15 Hz (DC power, in vicinity of 60 Hz line) — 3
6-1/4 Hz (50 Hz line frequency) — 4
12-1/2 Hz (50 Hz line frequency) — 5
6-1/4 Hz (DC power, in vicinity of 50 Hz line) — 6
12-1/2 Hz (DC power in vicinity of 50 Hz line) — 7
7-1/2 Hz (DC power, in vicinity of 60 Hz line) — 8

Additional Options
Empty Pipe Detector — 1
None — 2
HART Protocol & Empty Pipe Detector — 3
HART Protocol — 4

Mounting Hardware Kit
Standard Kit: Steel Bolts & Nuts, Centering Device, Klinger Sil C-4401 Gaskets — C
Optional Kit: Steel Bolts & Nuts, Centering Device, Teflon Gaskets — E
Standard Kit Not Required — X

Converter
Required — 1
Not Required (Primary only) — 2

1.3 Specifications

Power Requirements — See Section 1.2 Model Number Breakdown

Power Consumption — Refer to signal converter instruction manual

Flowmeter Characteristics

Meter Size/Flow Capacity

TABLE 1-1. METER CAPACITY

			Flow Ranges 0 to value tabulated			
Meter Size		METER CAPACITY*	Minimum		Maximum	
inch	mm	gpm	gpm	lpm	gpm	lpm
1/10	3	1.06	0.021	0.08	1.06	4.0
5/32	4	2.12	0.042	0.16	2.12	8.0
1/4	6	5.28	0.11	0.40	5.28	20
3/8	10	11.9	0.24	0.90	11.9	45
1/2	15	26.4	0.53	2.00	26.4	100
1	25	52.8	1.06	4.00	52.8	200
1 1/2	40	158.5	3.17	12.0	158	600
				m^3/h		m^3/h
2	50	264.2	5.28	1.2	264	60
3	80	792.5	15.85	3.6	792	180
4	100	1057	21.14	4.8	1057	240

* Flow Velocity (ft/s) = (Operating GPM x 32.81)/METER CAPACITY

Span — Factory set at specified range between extremes listed in table above; can be field adjusted.

Rangeability — 50:1

Minimum Liquid Conductivity — 5 μS/cm

System Accuracy
(At Reference Conditions)

	Flowrate	Accuracy
Frequency Output	< 2% Meter Capacity	± 0.01% Meter Capacity
	≥ 2% Meter Capacity	± 0.5% of rate

RFI Protection — Class 3-abc-0.5% (30 V/m-27 to 446 MHz) Per SAMA Standard PMC 33.1-1978.

Environmental Limits

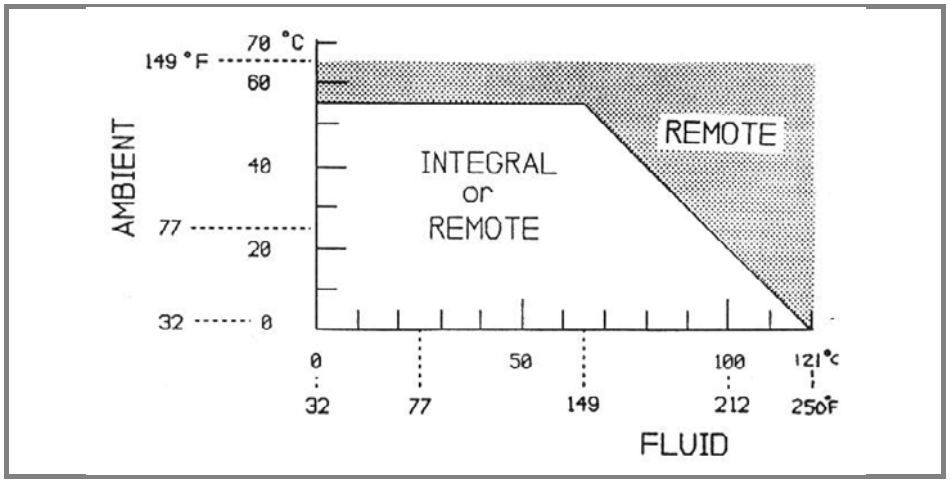
Enclosure Classification with or without Signal Converter	NEMA 4X, IEC 529 IP65
Accidental Submergence	IEC 529 IP67, 33 feet H_2O/48 h (10 m H_2O /48 h)
Continuous Submergence	IEC 529 IP68, 33 feet H_2O (10 m H_2O)

Ambient Temperature Limits

MODEL	LIMITS
10D1475 w/ Integral Converter	-4 to 131° F (-20 to 55° C)
10D1475 w/ Remote Converter	-40 to 150° F) (-40 to 65° C)

Process Limits

Temperature Limits



NOTE
Signal converter must be remote mounted if liquid temperature exceeds value listed for a given ambient temperature. Liquid temperature must not exceed 250°F (121°C) in any event.

Pressure

Temperature		Pressure	
oF	°C	psi	MPa
100	40	740	5.11
150	65	720	4.96
250	120	650	4.50

Vacuum — full vacuum at 212° F (100° C) for 1/10 - 3 in. (3 - 80 mm) sizes
full vacuum at 176° F (80° C) for 4 in. (100 mm) size

Meter Capacity — specified on Flowmeter data tag (equal to max flow capacity in engineering units). This factor is equivalent to a flow velocity of 32.81 ft/s in the metering tube.

> NOTE
> Any maximum (range) between 0.02 x Meter Capacity & 1.0 x Meter Capacity is available with HART or standard software.

Physical Characteristics

Outline Dimensions

- Magnetic Flowmeter with integral Signal Converter — Refer to Figure 2-1
- Remote w/ General Purpose or FM Class I, Div.2 Box — Refer to Figure 2-2
- Remote w/ Explosion-Proof Box — Refer to Figure 2-3
- Remotely Mounted Signal Converter — Refer to signal converter instruction manual

Conduit Connections — two 1/2 inch NPT internally threaded entrances in Flowmeter junction box

Cable Length, Remote Converter — NEMA 4X & Accidental Submersion - 250 ft. Continuous Submergence - 100 ft.

Meter Weight

TABLE 1-2. METER WEIGHTS

METER SIZE		**INTEGRAL**		**REMOTE**		EXPLOSION PROOF REMOTE	
in.	**mm**	**lbs.**	**kg**	**lbs.**	**kg**	**lbs.**	**kg**
1/10	3	9	4.1	4	1.8	5	2.3
5/32	4	9	4.1	4	1.8	5	2.3
1/4	6	9	4.1	4	1.8	5	2.3
3/8	10	9	4.1	4	1.8	5	2.3
1/2	15	9	4.1	4	1.8	5	2.3
1	25	10	4.5	4	1.8	5	2.3
1 1/2	40	11	5	5	2.3	6	2.7
2	50	12	5.4	7	3.2	8	3.6
3	80	16	7.3	10	4.5	11	5
4	100	22	10	16	7.3	17	7.7

- Remotely Mounted Signal Converter — Refer to signal converter instruction manual

Vibration Limit	
Integrally Mounted	*5 to 14 Hz, 0.10 inch, 14 to 2000 Hz, 1 g * Signal converter must be remotely mounted if these limits are exceeded.
Remotely Mounted	5 to 14 Hz, 0.20 inch 14 to 2000 Hz, 1.5 g
Materials of Construction	
Meter Liner	TEFZEL (ETFE)
Electrode Assemblies	Hastelloy-C, Tantalum, Zirconium or Platinum materials as specified (ref: Application Guide PMI IV.C.10)
Meter Housing	carbon steel, all welded construction, epoxy finish
Electronics Housing	die cast aluminum, epoxy finish, 316 sst attachment screws, 1/2 in. NPT conduit connections; gasketed covers
Installation Kit	includes 2 gaskets, mounting studs and nuts, flange adaptor device when required.
Safety Classification	Refer to Section 1.2

2.0 INSTALLATION

2.1 Inspection

All Model 10D1475 Magnetic Flowmeters are shipped in heavy duty containers. An itemized list of all items included in the shipment is attached to the shipping container.

Depending upon the particular model specified, the shipment will generally consist of:

- Magnetic Flowmeter with integrally mounted signal converter and appropriate mounting hardware kit

or

- Magnetic Flowmeter and appropriate mounting hardware kit, and a remotely mounted signal converter with mounting hardware and a 30 feet (9m) interconnection cable.

The mounting hardware kit for the Flowmeter includes:

- 4 (or 8) threaded studs and nuts
- 2 gaskets
- appropriate flange adaptor components, if specified.

NOTE
The centering device (Refer to Figure 2-6) or adaptor sleeves (Refer to Figure 2-7) required for the particular meter installation are supplied by the factory with all U.S. orders.

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 the equipment.

The proper use of the items included in the mounting hardware kit, as described subsequently, and the proper employment of them during installation is necessary to maintain a valid instrument warranty. An installation and warranty tag is furnished with the mounting hardware kit that provides the basic information essential for proper meter installation.

Following inspection of the shipment contents, it is suggested that all items be carefully replaced in the shipping container for transit to the installation site. The use of normal care in the handling and installation of this equipment will contribute substantially toward satisfactory performance.

2.2 Location

The Flowmeter is suitable for either indoor or outdoor installation. When selecting the installation site, consideration should be given to the ambient and process temperature limits, as stated in the Specifications. Consideration should be given to access for servicing the meter. The standard meter is rated NEMA 4X, watertight, and will withstand rain and hose down. If flooding is a problem, the optional "Accidental Submersible" flowmeter is suited for 33 feet (of water) depths for up to 48 hours or a "Continuous Submergence" suitable for use under 33 feet (10 meters) of water is available.

The integrally mounted signal converter includes RFI filters that provide excellent protection against radiated RFI/EMI. Therefore, stray electromagnetic and electrostatic fields, low power radio transmissions, etc. will have no effect upon the operating characteristics of the electronic package of the Magnetic Flowmeter system. It is recommended, however, that the meter not be installed within the immediate proximity of heavy induction equipment.

Outline dimensions of the magnetic flowmeters are given in Figures 2-1 through 2-3. When applicable, provide access for occasional servicing of the integrally mounted signal converters. At least five inches of overhead clearance is required for cover removal as shown in Figure 2-1. Observe the various clearances given on the drawings. If the cover is removable from the front for servicing of the electronics, provide adequate working space. When a remote mounted signal converter is specified, Converter outline and mounting dimensions are provided in the Instruction Bulletin supplied for the particular Converter.

The installation site must be provided with a source of power for the meter's electronics (refer to the ratings in Sections 1-2 & 1-3 and to the meter's data tag. The power source must have an external disconnect and suitable fuse (or circuit breaker), as shown on the interconnection diagram.

2.3 Mounting

2.3.1 Meter Orientation

The Model 10D1475 MINI-MAG Magnetic Flowmeter may be installed in horizontal, vertical or sloping pipe runs. However, precautions must be taken to assure that the meter 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.

The electronic housing of the meter should be **top** oriented for horizontal or sloping installations. If the electronic housing must be **bottom** oriented, vibration must be limited to be within the specifications shown in Section 1.4. Orienting the electronic housing top or bottom aligns the meter electrodes in a lateral plane which eliminates the possibility of entrained air acting as an electrode insulator. An electrode must not be on "top" when the meter is horizontally mounted.

The Magnetic Flowmeter must be oriented in accordance with the direction of process flow, as indicated by the **FLOW** arrow on the meter data tag. Elbows should be located a minimum of three pipe diameters upstream from the meter. Control valves should be located on the downstream side of the meter. Control valves upstream of the meter can create turbulence that result in air pockets and may effect the meter's accuracy or cause its output to be noisy. If for some reason the control valve cannot be located downstream from the meter, a minimum of ten pipe diameters upstream are required between the meter and the control valve. The requirements for control valves also applies to pumps. Pipe diameters are measured from the centerline of the meter to the nearest edge of the device, as shown in Figure 2-4. For higher accuracy requirements, use twice the number of pipe diameters referenced. See Figure 2-4 for recommended piping arrangement.

When the process liquid contains abrasive grit, avoid disturbance upstream of the meter so that the liquid passes smoothly through the meter; elbows and tees can distort the flow pattern causing uneven liner wear.

2.3.2 Meter Handling

The TEFZEL liner of the Flowmeter must be protected at all times. The liner can be damaged by sharp objects or cut by undue pressure. Do not pass any rope or wire sling through the meter liner.

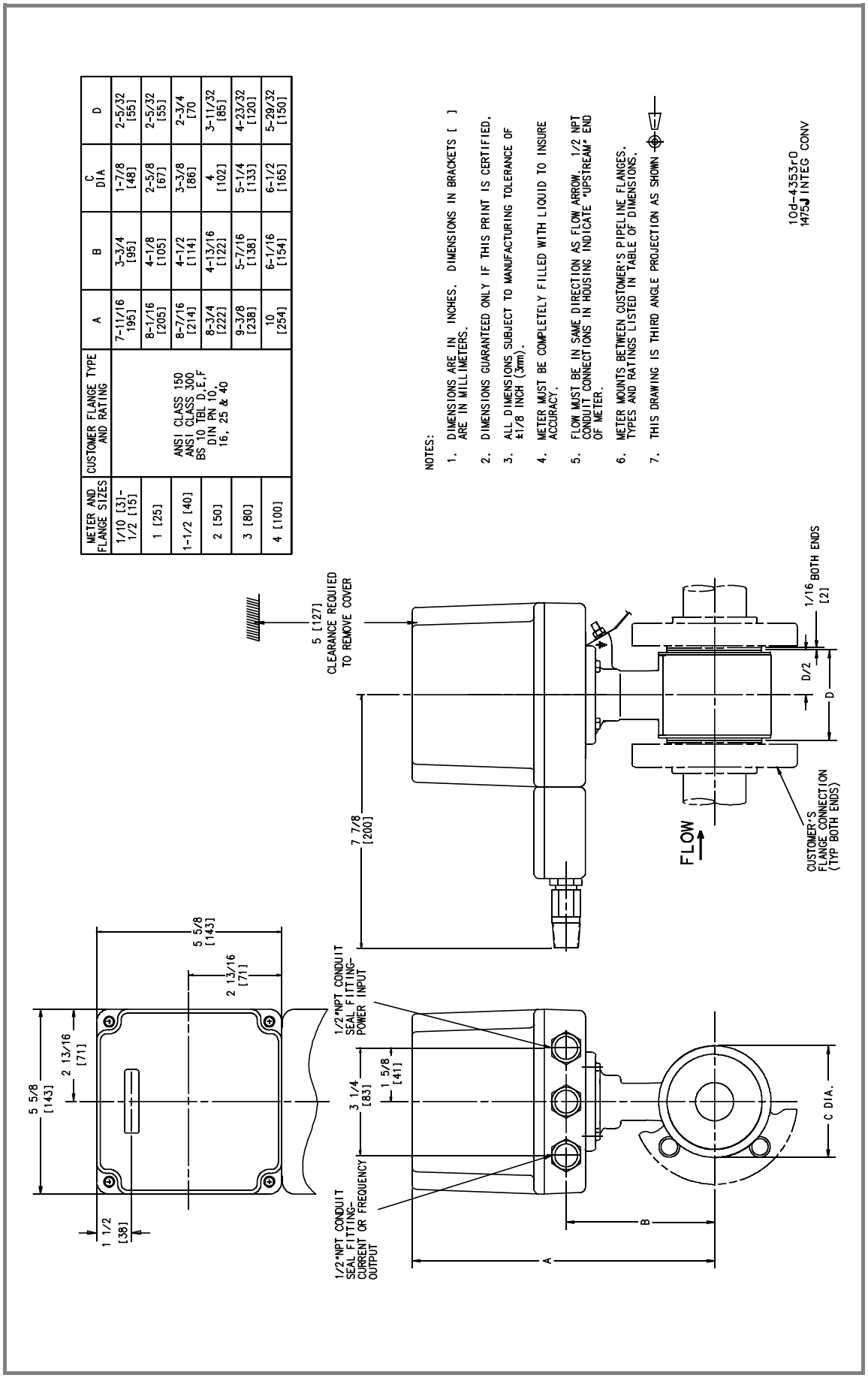


FIGURE 2-1. OUTLINE DIMENSIONS OF FLOWMETER WITH INTEGRAL SIGNAL CONVERTER

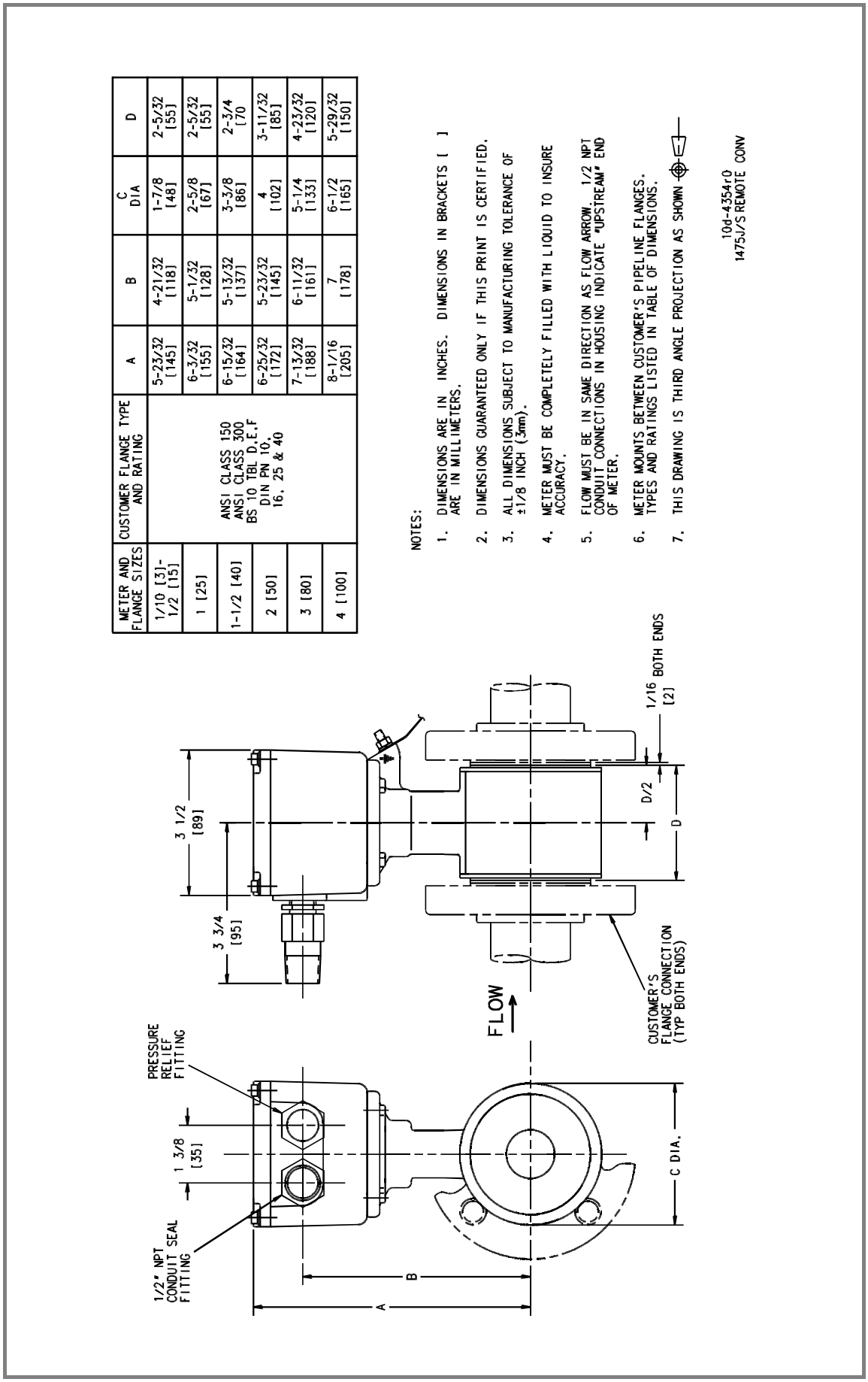


FIGURE 2-2. OUTLINE DIMENSIONS OF REMOTE FLOWMETER WITH 2-PIECE BOX

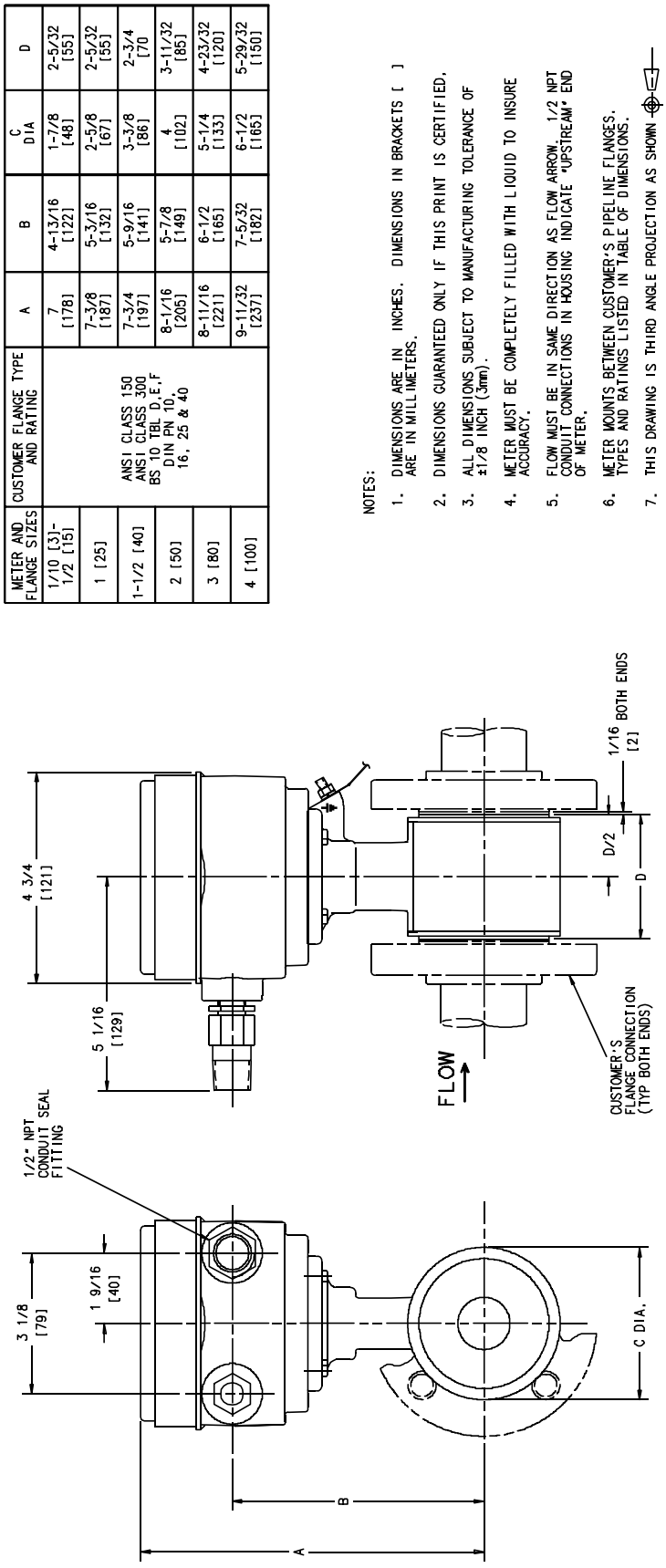


FIGURE 2-3. OUTLINE DIMENSIONS OF REMOTE FLOWMETER WITH EXPLOSION-PROOF BOX

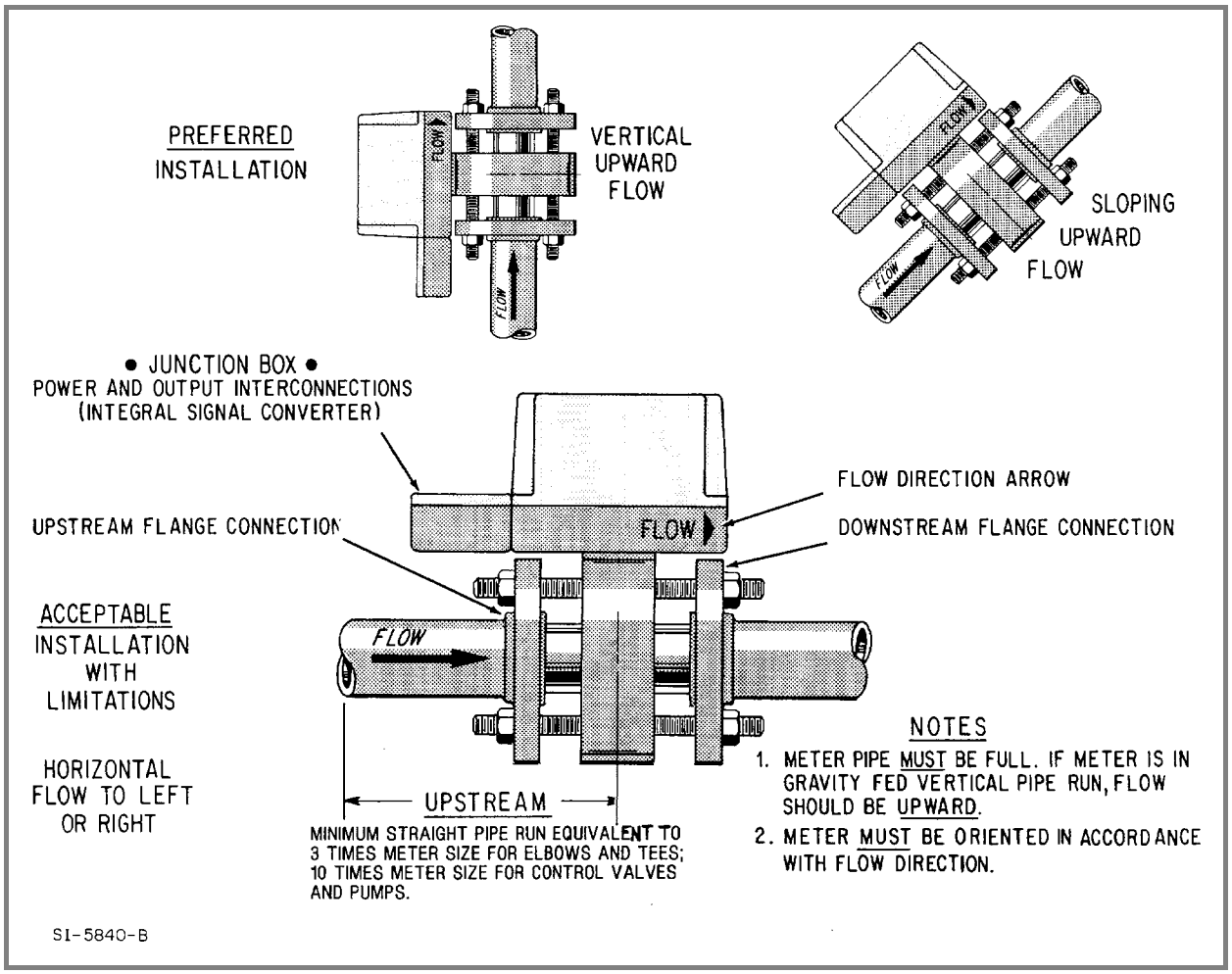


FIGURE 2-4. RECOMMENDED PIPING ARRANGEMENT

2.3.3 Pipe Connections

The Model 10D1475 Magnetic Flowmeter has a wafer type body designed for mounting between adjacent pipe flanges. Most commonly used ANSI, BS and DIN type flanges can be accommodated.

Mounting hardware (studs, nuts, gaskets and the flange adaptor device(s) for the particular flange type and rating specified) is supplied for use with common ANSI flanges. Line schedule 80 or lighter pipe is recommended for system piping.

When the Magnetic Flowmeter is to be mounted in an electrically non-conductive pipeline such as totally plastic pipe, or a metal pipeline with an insulating liner, the user must obtain a pair of meter grounding rings (discussed in Section 2.4 Grounding Procedure) to facilitate grounding of the process. Good grounding is effected by bonding the meter body to the process liquid both upstream (inlet end) and downstream (outlet end) of the meter; thereby preventing any stray electrical currents that may be carried by the pipeline, or by the process, from passing through the Magnetic Flowmeter. Improper grounding often results in unsatisfactory meter performance, therefore particular attention should be paid to the meter grounding procedure.

The threaded mounting studs and nuts supplied in the meter installation kit should be well lubricated before use. When the meter has been installed in the pipeline, tighten the nuts in even increments around the flange surface. It is recommended that the nuts be tightened using a torque wrench or an open end wrench with a handle length no greater than 8 inches. Recommended mounting-bolt torque values are shown in Table 2-1and should not be exceeded.

For 4-bolt and 8-bolt flanges, tighten the flange bolts in a "star" pattern as shown in Figure 2-5 to avoid localized stresses on the gaskets. The bolts and nuts should be tightened approximately 50% during the first pass, approximately 80% during the second pass and to full tightness during the third pass.

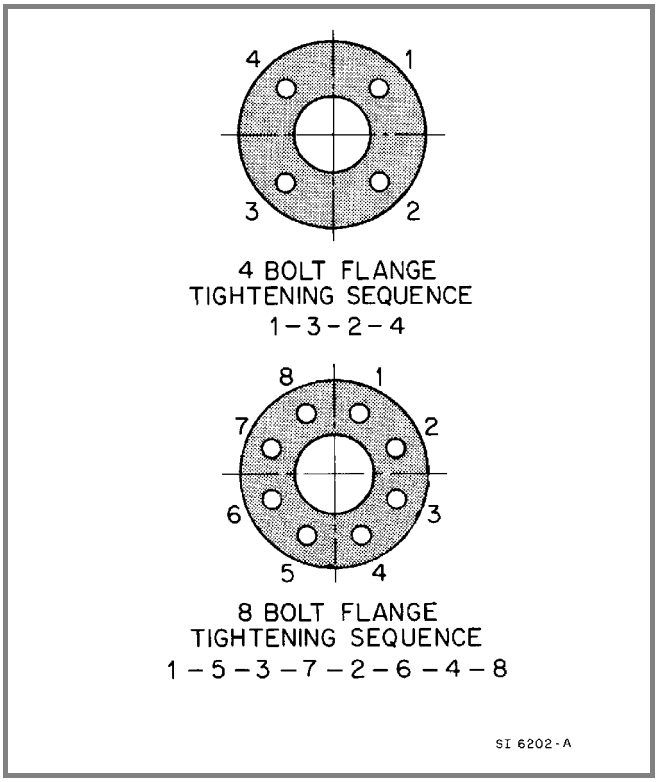


FIGURE 2-5. BOLT TIGHTENING SEQUENCE

NOTE
All 1/10 - 1/2 inch (3 - 15 mm) size Magnetic Flowmeters are supplied for use with 1/2 inch (15 mm) pipe flange.

TABLE 2-1. RECOMMENDED MOUNTING-BOLT TORQUES

Meter Size	ANSI Class 150			ANSI Class 300		
	# of Holes	ft. lbs.	Nm	# of Holes	ft. lbs.	Nm
≤1/2	4	10	15	4	15	20
3/4	4	10	15	4	15	20
1	4	10	15	4	15	20
1 1/4	4	15	20	4	20	25
1 1/2	4	15	20	4	25	35
2	4	25	35	8	15	20
2 1/2	4	30	40	8	20	25
3	4	40	55	8	30	40
4	8	30	40	8	45	60

2.3.4 Gaskets

Use only the gaskets supplied with the instrument. The gaskets supplied with the meter are the proper size for the meter size and type specified. When installing the meter it is important that the correct size gaskets be utilized. Use of the wrong size gaskets could allow the inner diameter of the gasket to protrude into the flow stream, thereby altering the flow profile within the meter. This condition could affect meter accuracy significantly and must be avoided. Using the proper gaskets and installing them correctly will also avoid any possibility of leakage. Observe parts information given in Section 6.0.

CAUTION
Do not use graphite gaskets.
Under certain conditions they may cause an electrically conductive layer to form on the inside wall of the meter, causing meter operation to degrade.

2.3.5 Basic Mounting Procedure

Refer to Figure 2-6 to supplement the following procedure.

1. Insert both of the two lower mounting studs through the clearance holes in the pipe flange, so that approximately half the stud length extends past the flange face. (Start with either the upstream or downstream flange, as convenient.)

3. Install a gasket next to the flange face.

4. Slip an adaptor sleeve* on both of the mounting studs, and then install the other gasket required. The two mounting studs can now be guided through the clearance holes in the downstream (typical) gasket and its associated flange.

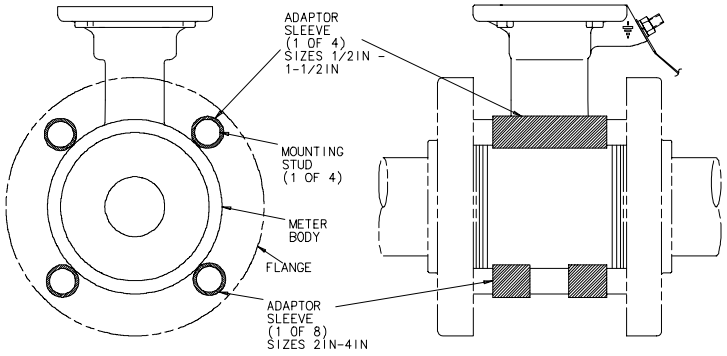
*Exception: Adaptor sleeves are not required for size 1/10 to 3/8 in. meters placed between ANSI pipeline flanges.

5. Place the MINI-MAG Magnetic Flowmeter between the two flange gaskets, with the meter resting on the two adaptor sleeves. **The meter must be oriented in accordance with the flow direction arrow.**

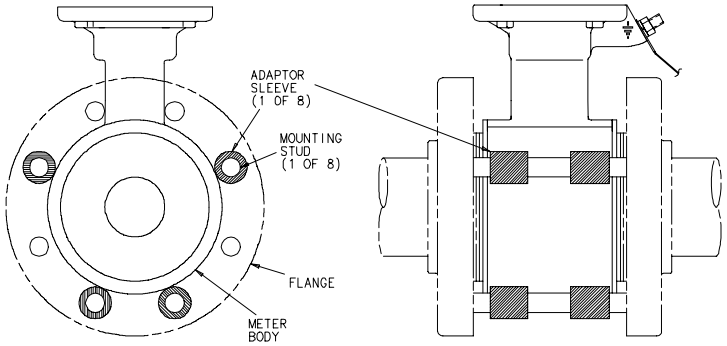
6. Install the two upper mounting studs and adaptor sleeves as shown in Figure 2-6. Note that when the sleeves are properly located, only four adaptor sleeves are needed for positioning the meter. In systems with an 8-bolt flange pattern, insert the four remaining mounting studs through the clearance holes in the upstream and downstream flanges.

7. Thread nuts on both ends of the 4 (or 8) mounting studs, finger-tight.

8. As the meter body is positioned properly by the adaptor sleeves, it is only necessary to tighten the stud nuts to complete the mounting procedure. Tighten the nuts in a "star" pattern as shown in Figure 2-5 and in even increments; to produce an even pressure distribution around the flange faces. Bolt torque should be limited to the recommended values shown in Table 2-1.



SIZES 2IN - 4IN CLASS 150
SIZES 1/10IN -1-1/2IN CLASS 300



SIZES 2IN - 4IN CLASS 300

ADAPTER SLEEVE PART NUMBERS

METER SIZE	FLANGE RATING ANSI CLASS	* P/N
2 INCH (50 mm)	150	U04
3 INCH (80 mm)		U04
4 INCH (100 mm)		U05
1/2 INCH (15 mm)	300	U01
1 INCH (25 mm)		U02
1-1/2 INCH (80 mm)		U03
2 INCH (50 mm)		U06
3 INCH (80 mm)		U07
4 INCH (100 mm)		U07

* PART NO. 430E020___ (ADD U0_ FROM TABLE TO COMPLETE PART NO.

SD-10-3602

FIGURE 2-6. METER MOUNTING DIAGRAM

2.4 Grounding Procedure

2.4.1 General

Satisfactory operation of the Magnetic Flowmeter system requires that careful attention be paid to proper grounding techniques. Meter grounding requirements are a combination of standard grounding methods and grounding of the meter body to the process liquid. The grounding of the process liquid places an electrical short circuit through the meter body, thereby routing any stray current around the process liquid rather than through it.

There are two basic types of piping systems:

- One type is an electrically conducting pipeline in which the process liquid comes in contact with the conductive pipe. This piping requires only that the grounding wires be attached to the adjacent pipe flanges.
- In the other case, the pipeline may be lined with a non-conductive material. These lined pipelines require the use of metal grounding rings to ground the process liquid and the conductive exterior of the pipe/meter to ground.

A good ground is one that is in contact with the earth over a large conductive area. An excellent example of this is an iron cold water pipe that is buried in the earth for a considerable distance in its distribution system. The water pipe laterals form a large conductive area of contact, that in turn provides a low resistance connection to earth. Plastic pipe does not provide an adequate ground system.

Select the grounding procedure applicable from Sections 2.4.2 or 2.4.3 that follow. **Proper grounding of the Magnetic Flowmeter is required for optimum system performance**.

2.4.2 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 2-7 to supplement the text.

1. Drill and tap a blind hole on the peripheral surface of each of the two adjacent pipeline flanges (see Figure 2-7 inset). These tapped holes should be placed so that they are within easy reach of the bonding straps (2 supplied) attached to the ground lug on the meter housing.

2. Obtain a bright metal surface around the edges of both tapped holes with a file or emery cloth.

3. Clamp the end of each bonding strap to the adjacent pipe flange, using a pair of hex head bolts and external tooth lockwashers (supplied by user).

4. The user must supply a sufficient length of grounding wire for connecting the meter grounding post (ring lug supplied) to a good electrical ground. (Number 12 AWG, or heavier, copper wire may be used for this grounding wire.)

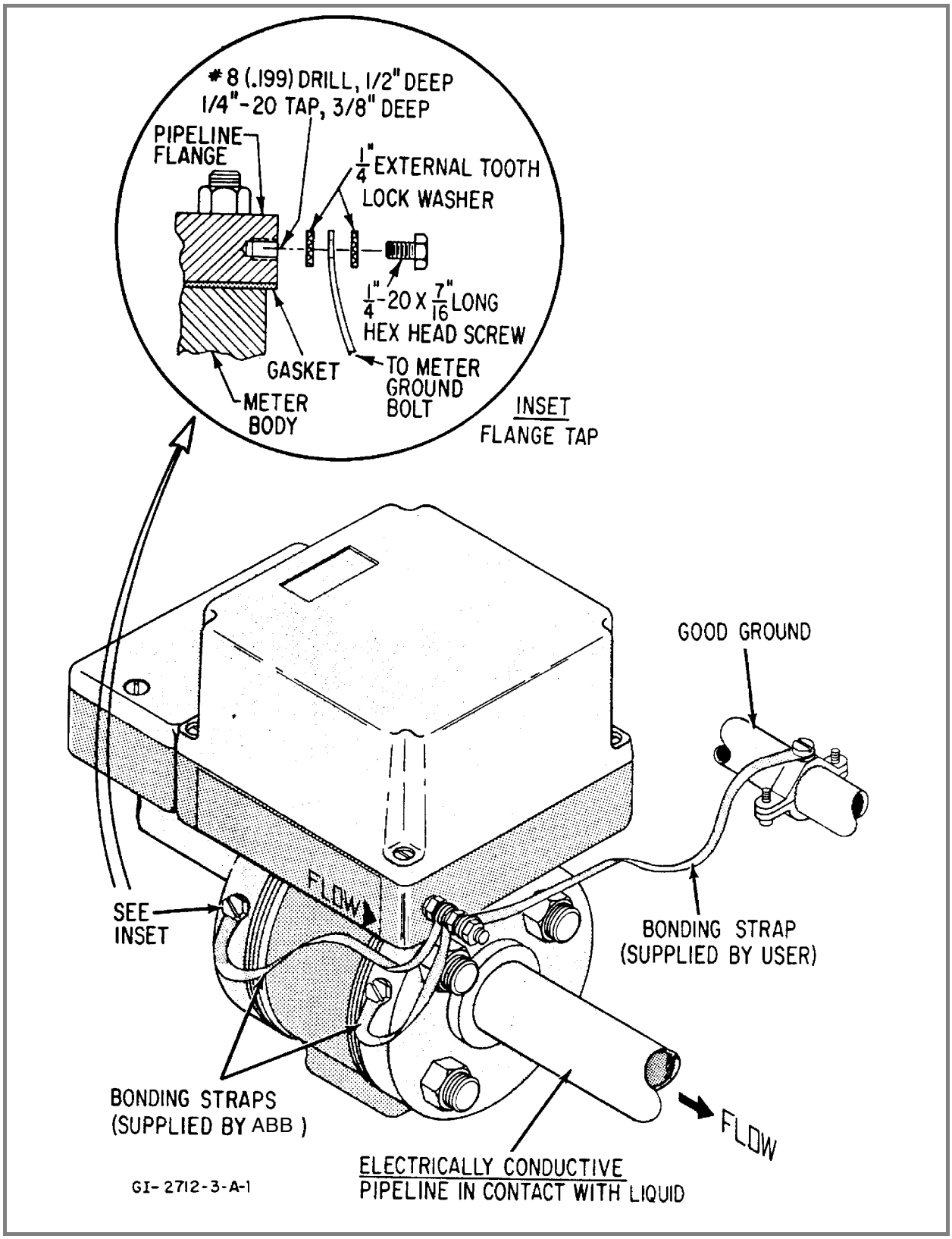


FIGURE 2-7. GROUNDING PROCEDURE, CONDUCTIVE PIPE

2.4.3 Non-Conductive or Insulated Pipeline

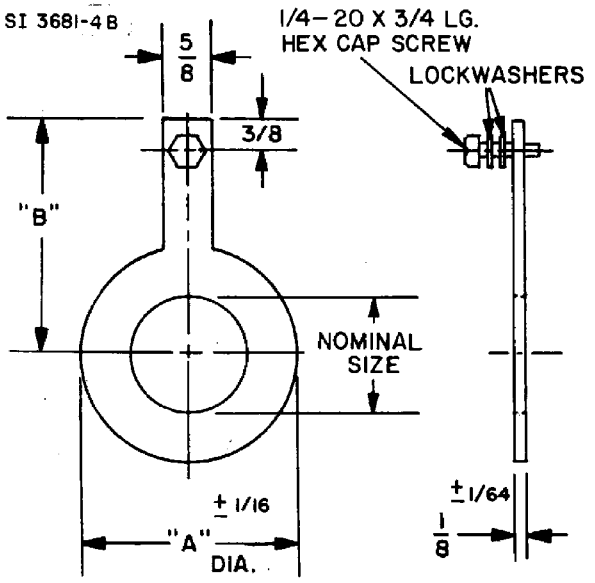
For the Magnetic Flowmeter mounted in a non-conductive or liquid insulated pipeline (such as totally plastic pipe, ceramic lined iron pipe, or cast pipe with internal bitumastic coating), perform the grounding procedure outlined below. Refer to Figures 2-8 and 2-9 to supplement this discussion.

1. Grounding rings are required if the meter is installed in non-conductive or insulated pipe. If grounding rings and gaskets were not specified at the time the meter was ordered, they can be ordered from Tables 6-1 and 6-2. Grounding rings are available in various corrosion resistant materials and should be selected to be compatible with the process liquid. When installed, these rings are centered by the flange bolts and therefore must be selected according to the flange rating.

2. When installing the meter in the pipeline, place a grounding ring at both the inlet and outlet connections of the Magnetic Flowmeter. Provide standard gasketing between the face of the meter liner and the grounding ring and the adjacent pipe flange; i.e., four gaskets required. Position the grounding rings in the pipeline so that the meter grounding straps (2) attached to the meter ground post will easily reach the ground strap connection bolt on the respective grounding ring.

3. Clamp the free end of the two bonding straps (shortest strap to downstream grounding ring) to the applicable grounding ring; using hex head bolt and external tooth lockwasher (supplied with the grounding rings when rings are ordered from the manufacturer).

4. The user must supply a sufficient length of grounding wire for connecting the meter grounding post (ring nut supplied) to a good electrical ground. Number 12 AWG, or heavier, copper wire may be used for this grounding wire.



NOMINAL SIZE		ANSI CLASS 150	
mm	(inch)	"A"	"B"
3-15	(1/2)	1 - 7/8	2 - 7/8
25	(1)	2 - 5/8	3 - 1/4
40	(1-1/2)	3 - 3/8	3 - 5/8
50	(2)	4 - 1/8	4
80	(3)	5 - 3/8	4 - 5/8
100	(4)	6 - 7/8	5 - 3/8

(Ref: CD-10D-3627R2)

NOTES:

1. ALL DIMENSIONS IN INCHES, EXCEPT AS NOTED.
2. GENERAL TOLERANCE = ± 1/8.
3. GROUNDING RING CENTERED BY FLANGE BOLTS.

FIGURE 2-8. OUTLINE DIMENSIONS, GROUNDING RINGS *

* For applications other than ANSI Class 150, contact the manufacturer.

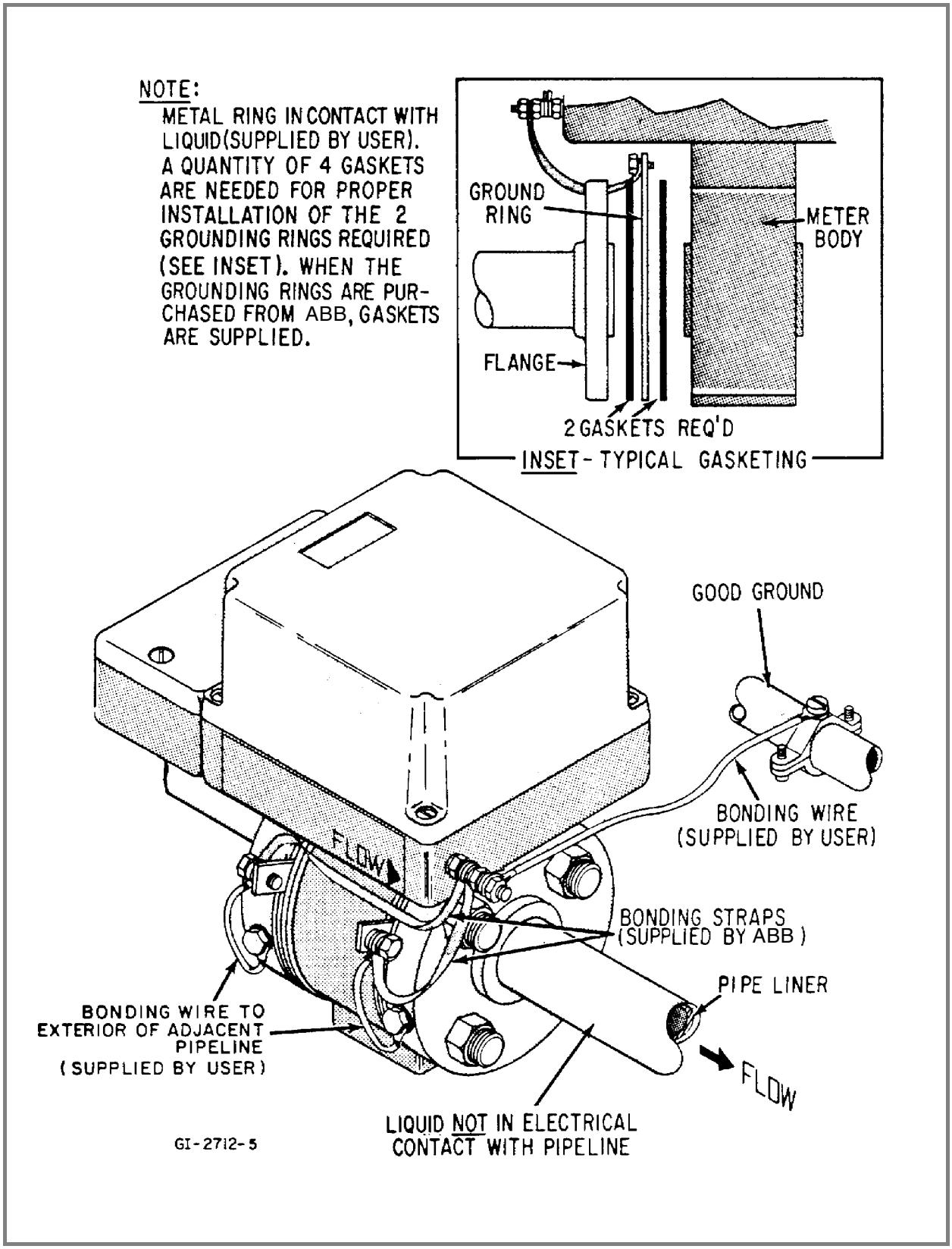
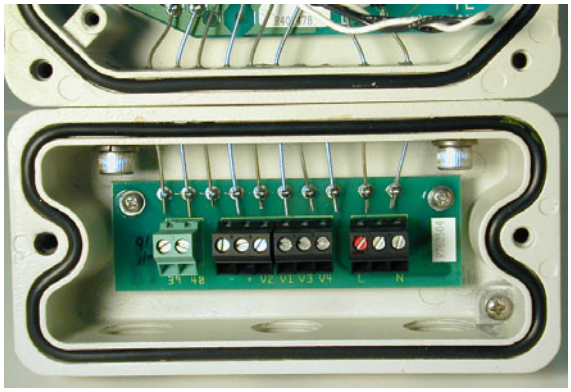


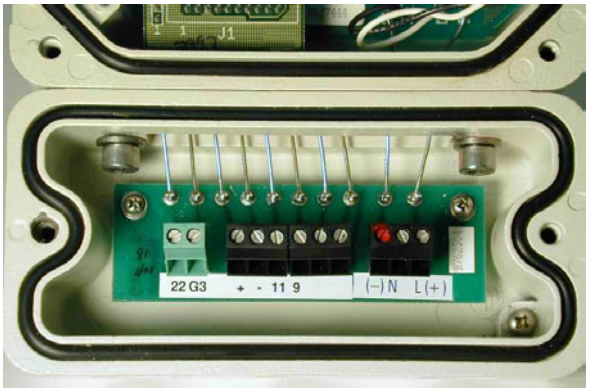
FIGURE 2-9. GROUNDING PROCEDURE, NON-CONDUCTIVE OR INSULATED PIPE

2.5 Electrical Interconnections

The Series 10D1475 Magnetic Flowmeter may be furnished with either an integrally or remotely mounted signal converter. Interconnection wiring is arranged differently for the two systems and is done in the customer connection boxes shown below for the 10D1475J integral & 10D1475Sintegral/remote meters. Refer to interconnection diagrams provided in the instruction manual supplied with the appropriate signal converter for wiring details.



10D1475J REMOTE METER



10D1475S INTEGRAL/REMOTE METER

FIGURE 2-10. INTERCONNECTION WIRING BLOCKS

WARNING
ELECTRICAL SHOCK HAZARD. Equipment powered by 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.

Regardless of the interconnection procedure required, the grounding procedures given in Section 2.4 must be followed.

2.6 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 liquid from entering the electrical conduit system. These safety features consider the remote possibility of a primary seal failure between the meter and the electronic housing.

The **conduit entry seal is required** in order to prevent the process liquid from entering the electrical conduit system. This seal consists of a conduit entry cable seal on the meter junction box. The user must properly install the conduit entry cable seal fitting supplied with the signal converter interconnection cable. This will ensure proper performance of this safety feature. Refer to Figure 2-10. **Failure to install the conduit entry cable seal fitting may void the meter warranty.**

A **pressure relief** is provided in the electronics housing of the flowmeter. The pressure relief is located in the center of the cover joint on the side opposite from the conduit connection. If the primary seal should fail, the pressure relief will vent the process preventing an over pressurization and potentially dangerous failure of the electronics housing. It is the user's responsibility to be aware of this safety feature and to consider the unlikely event of its functioning. Based on knowledge of the process and meter application, the user should consider the use of deflectors to safely direct the vented process.

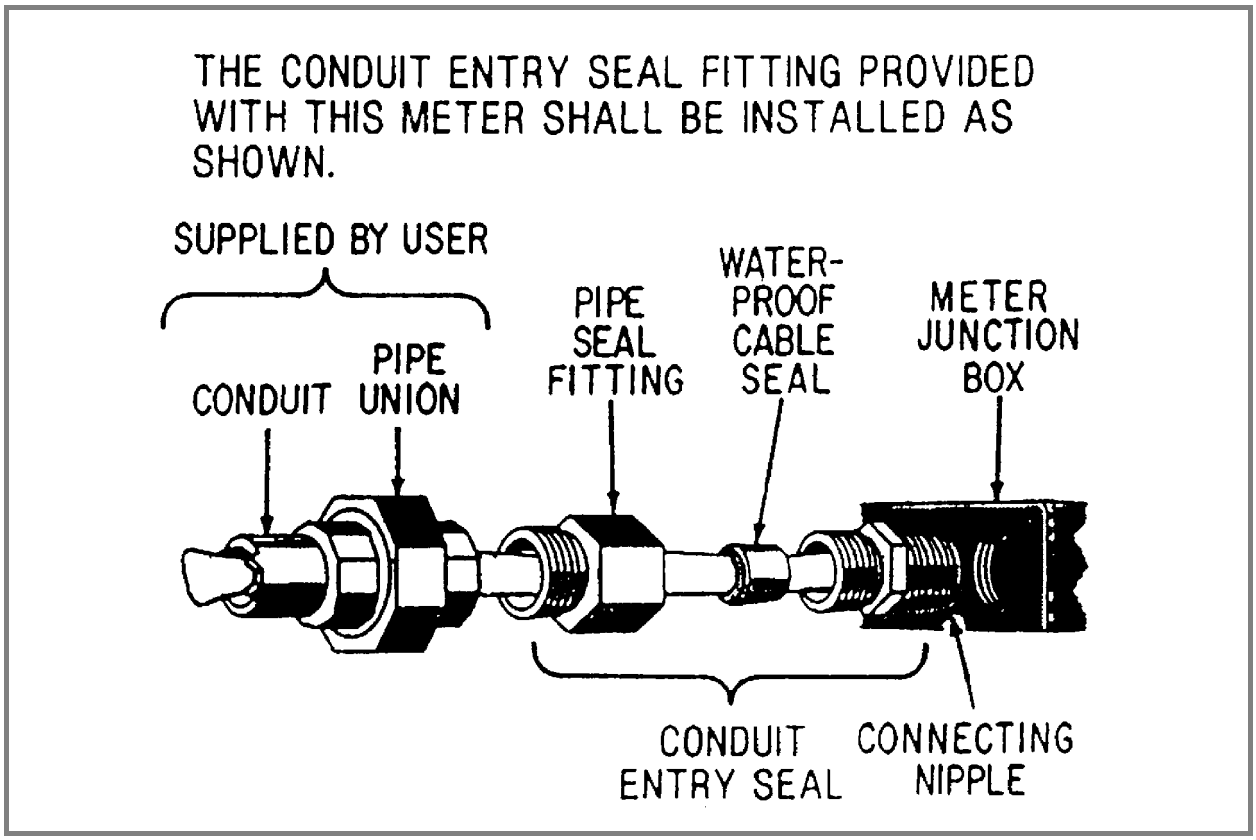


FIGURE 2-11. CONDUIT ENTRY SEAL INSTALLATION

3.0 START-UP

The Series 10D1475 MINI-MAG Magnetic Flowmeter (which includes the integral or remote Signal Converter) is precision calibrated at the factory for the values stated on the instrument tag. If specific values were not specified, the meter is calibrated at a nominal maximum flow rate and for a 4-20 mA current output span. Typical instrument data tags are shown in Figures 3-1 & 3-2.

There are no operating controls that require field adjustment unless the full scale range setting was not specified when the meter was ordered. If a change in the full scale range setting is required, refer to the Instruction Manual supplied with the 10D1475J & 10D1475S Signal Converters. If no change is required, the equipment is ready for operation as received.

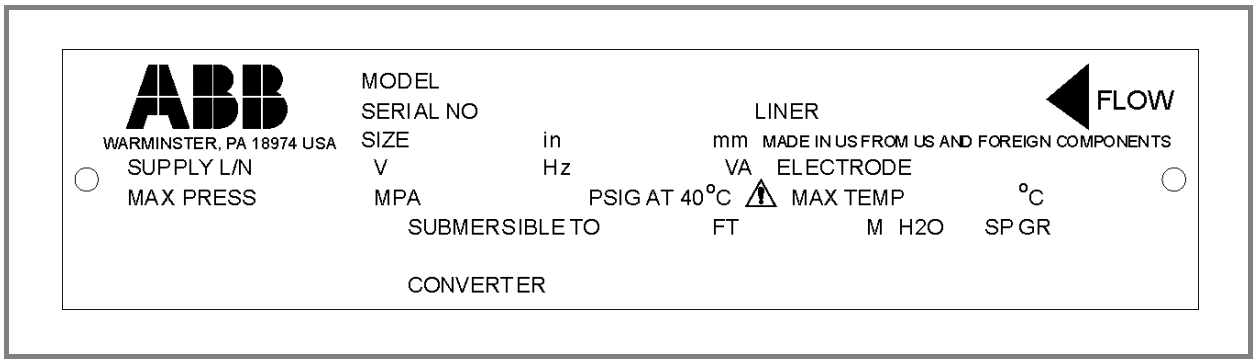


FIGURE 3-1. TYPICAL INTEGRAL PRIMARY 10D1475J DATA TAG

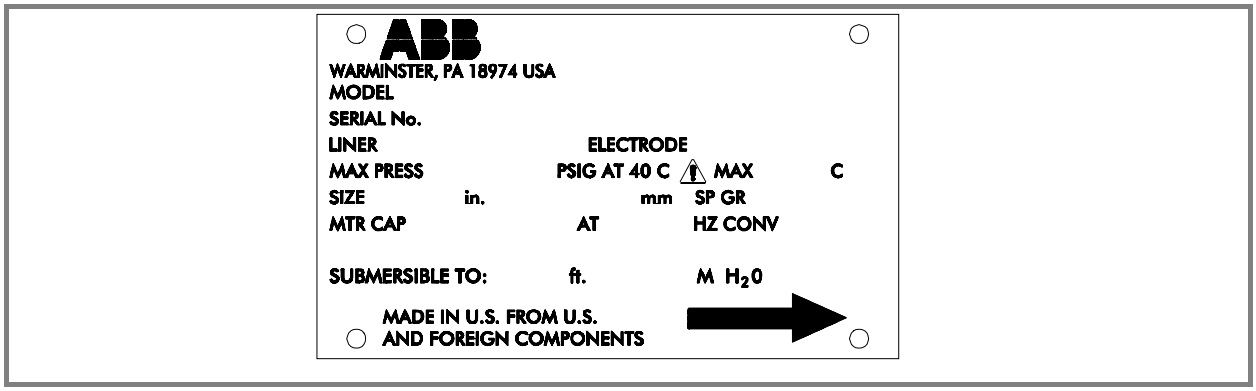


FIGURE 3-2. TYP. REMOTE PRIMARY 10D1475J & S DATA TAG

3.1 Preliminary Check List

Follow these start up instructions after completing the assembly and installation of the Primary and Converter:

- Check that the flow direction of the fluid agrees with the flow-direction arrow on the primary housing.
- Check that the flowmeter is properly grounded. See Section 2.4. Improper grounding may result in unsatisfactory performance.
- Check that the interconnections agree with the interconnection diagrams shown in the instruction manuals supplied with the Converter.
- Check that the power supply agrees with the specifications on the data tag.
- Check that the ambient conditions meet the conditions specified in Section 1.4 - Specifications.

3.2 Turn Power On

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.

Apply system power to the Series 10D1475 Magnetic Flowmeter by closing the external switch or circuit breaker (not supplied with the meter); there are no master power 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.

Once power is applied, the display should become active. Refer to the 50XM1000 Converter instruction manual for proper display indications and system adjustments.

If not already entered, some parameters must be entered for proper system operation (refer to the instruction manual supplied with the Converter):

- Verify the meter size stamped on the nameplate in the "Size" parameter.
- The range may have been factory-set to 10 m/s. Enter the desired maximum forward and reverse flow values in the appropriate units.
- Hydraulically ideal range end values are approximately 5-10 ft/sec (or 2-3 m/s).
- Select the desired output current range in the "Submenu Current Output".
- Set the number of pulses per unit, the pulse width and the totalizer mode from the Totalizer Submenu.

Check the system zero (Refer to Zero Check, Section 3.3).

3.3 Zero Check

The system zero must be set at the Converter. For this parameter, all flow activity through the flowmeter must be totally stopped. Make certain that the meter pipe of the primary is totally full of fluid. The zero can be set either manually or automatically at the Converter by accessing the parameter "System Zero". Refer to the instruction manual supplied with the Converter for the appropriate procedure.

3.4 Detector Empty Pipe (option)

The empty pipe module, when installed, should be adjusted at start up under actual conditions. Refer to instructions in the Converter instruction manual. **(Not available for integral configuration)**

3.5 Start Process Flow

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. Flow measurement, display and concurrent output signal transmission will commence with process flow through the meter.

3.6 Electronics

Refer to Figures 3-3 through 3-5 for illustrations of integral and remote-mounted electronics mounted on the Primary

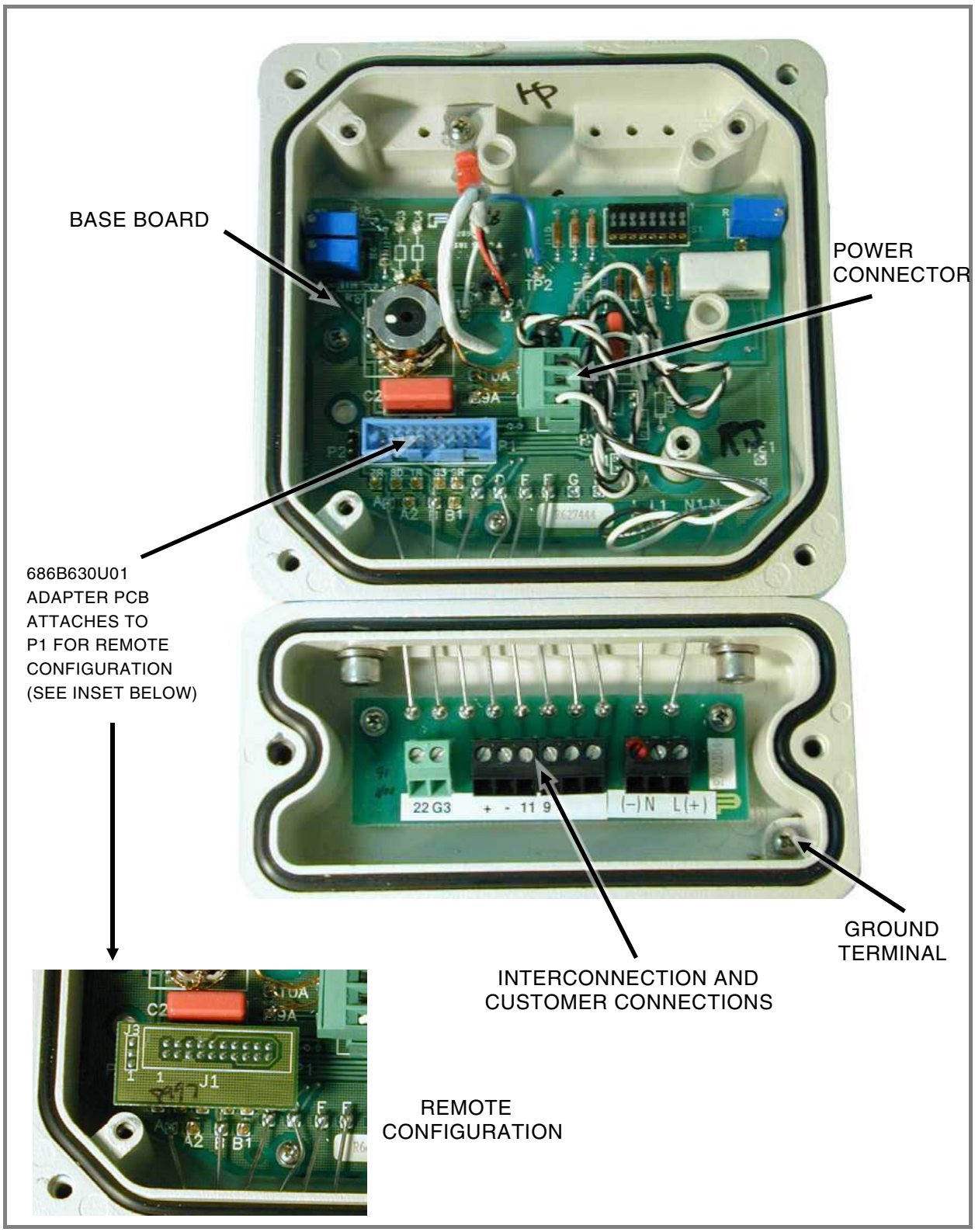


FIGURE 3-3. 1/10 through 3/8 INCH INTEGRAL/REMOTE ENCLOSURE [10D1475S]

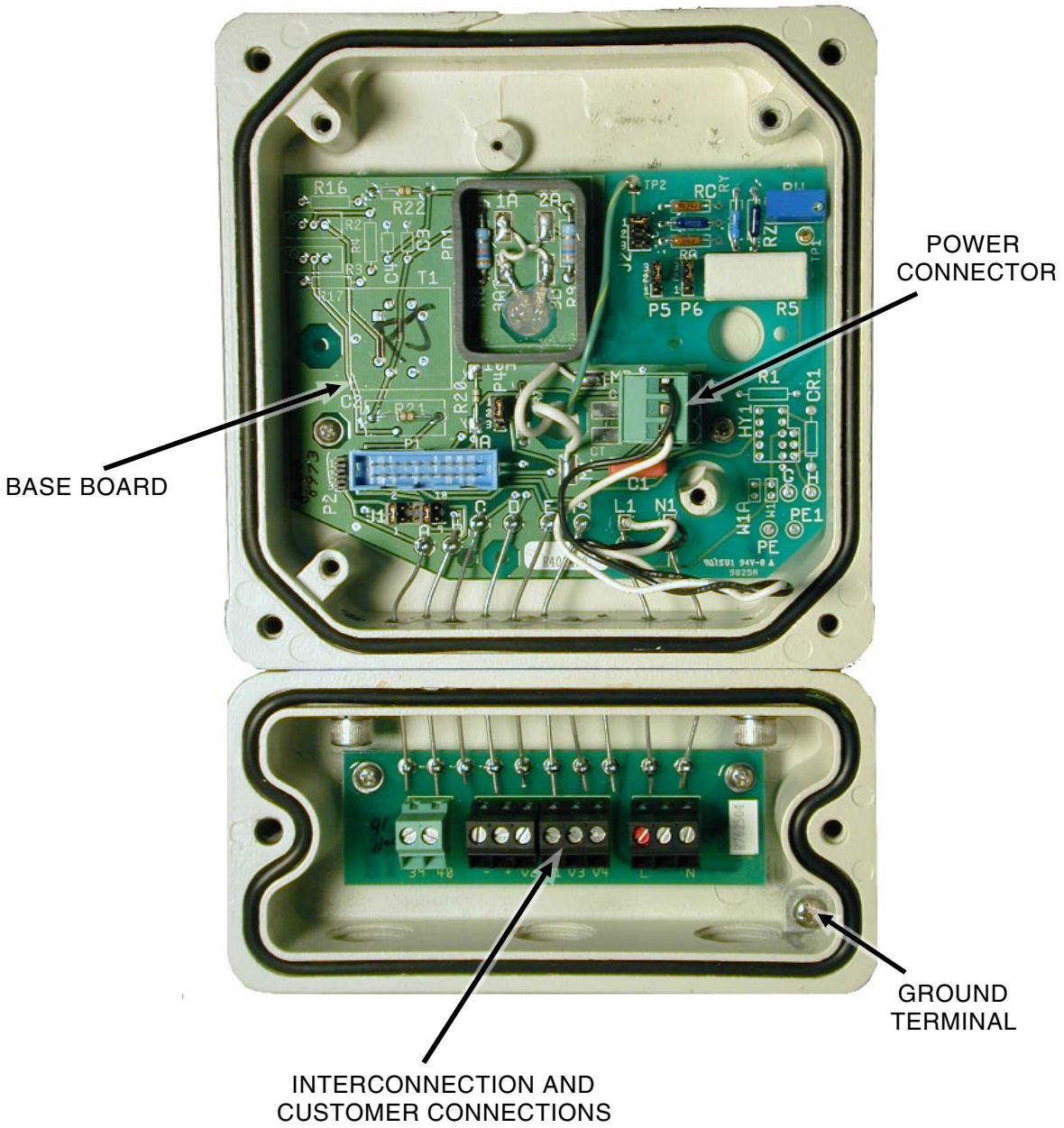


FIGURE 3-4. 1/2 through 4 INCH INTEGRALLY MOUNTED ENCLOSURE WITHOUT CONVERTER MODULE [10D1475J]

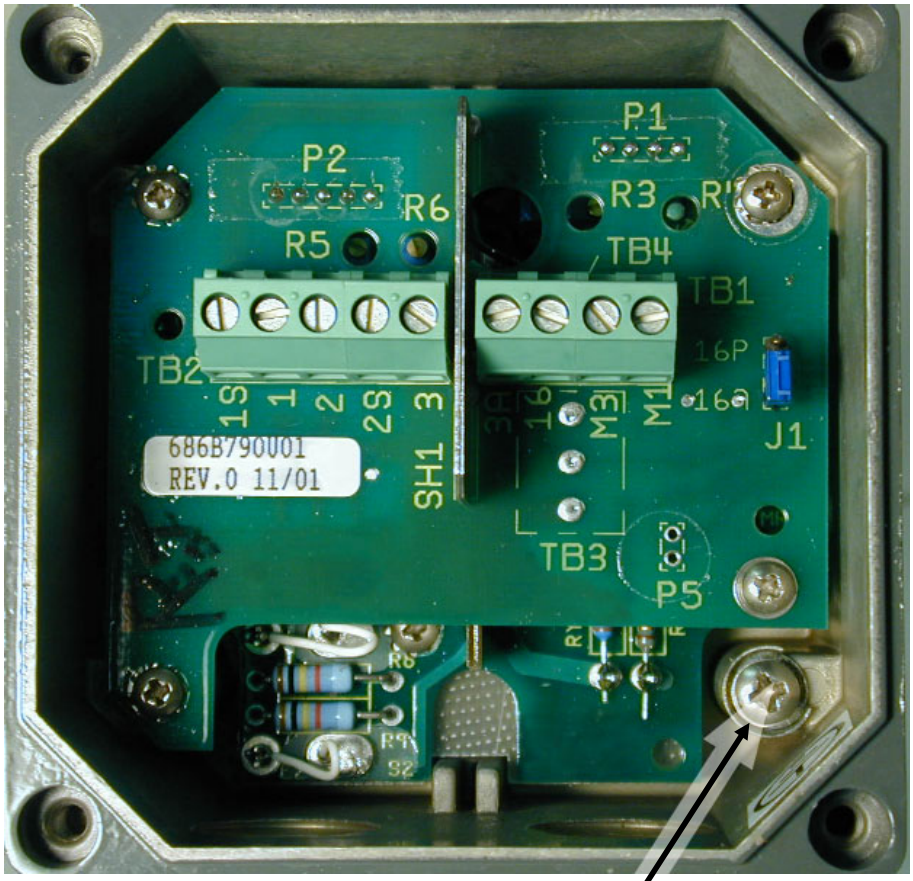
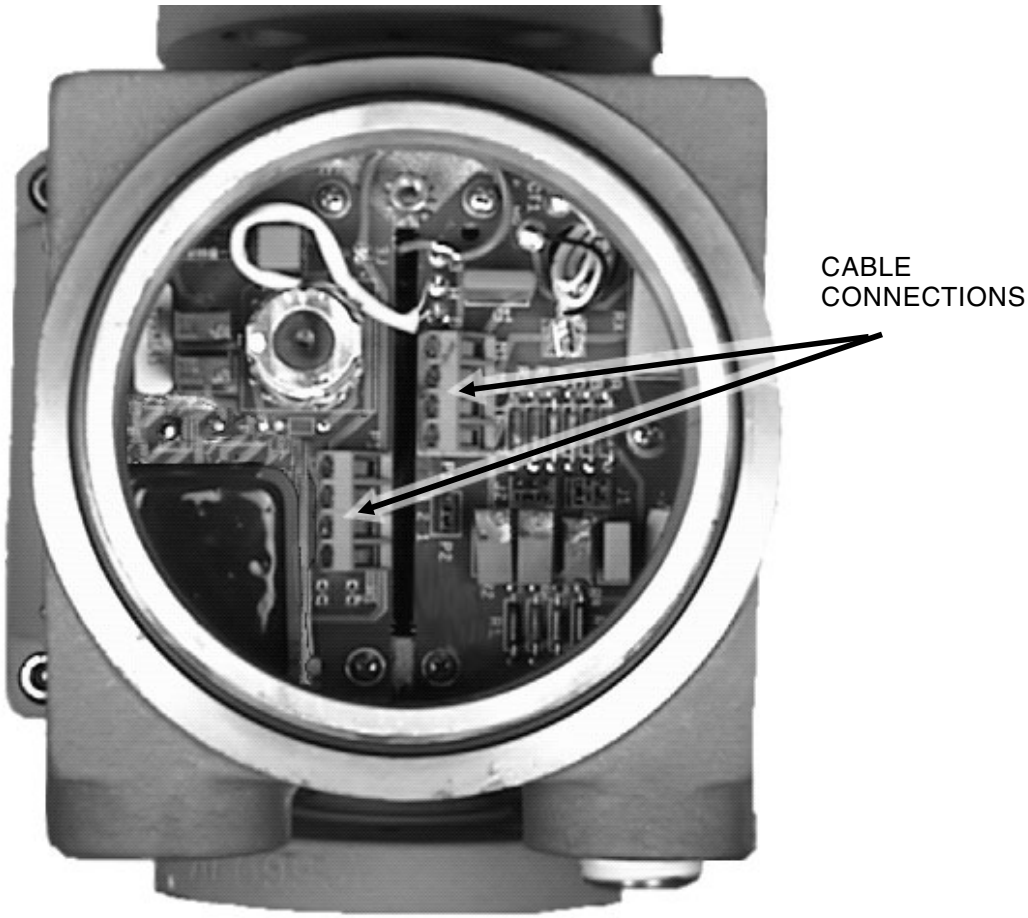


FIGURE 3-5. REMOTE PRIMARY PCB ASSEMBLY IN GENERAL PURPOSE OR FM CLASS I, DIV.2 HOUSING [10D1475J]



NOTE
The figure shows electronics without encapsulation material.
Normally the housing is filled with a silicone rubber encapsulant.

FIGURE 3-5. TYPICAL EXPLOSION-PROOF OR CONTINUOUS SUBMERGENCE PRIMARY FOR REMOTE MOUNTED SIGNAL CONVERTER

4.0 FUNCTIONAL DESCRIPTION

The magnetic flowmeter body houses two signal electrodes and the 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 of the meter housing.

The Flowmeter provides two output signals to the associated signal converter:

- an electrode signal that contains the flow rate information
- the reference signal which is proportional to the magnet excitation current (theoretically, this reference signal is proportional to the flux density in the metering section).

The reference voltage is derived across a precision "constant meter factor" 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 circuitry will provide an exact ratio and thereby provide immunity to power supply variation. The magnet coil drive circuitry is contained in the signal converter.

4.1 Basic Operating Principle

4.1.1 Signal Voltage Generation

The operating principle of the Model 10D1475 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 magnetic flowmeter constitutes a modified form of a generator.

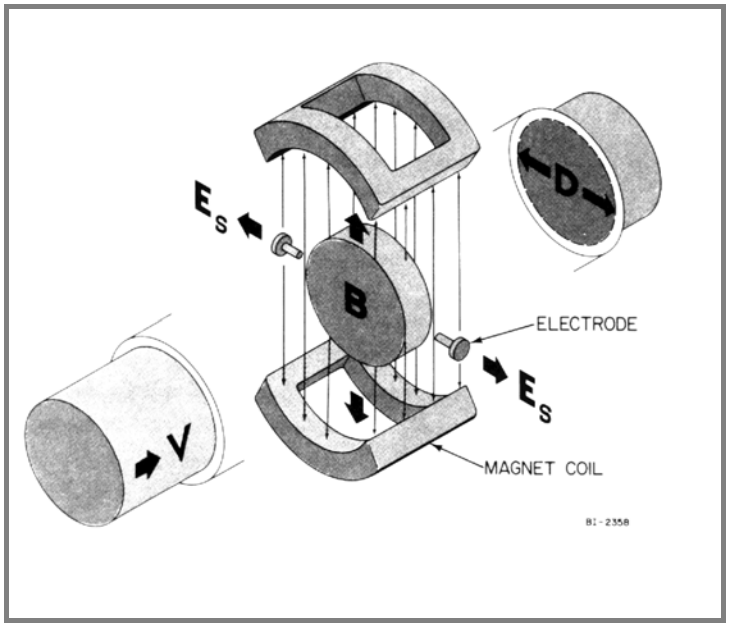


FIGURE 4-1. BASIC OPERATING PRINCIPLE

Figure 4-1 graphically illustrates the basic operating principle. A magnetic field, "B", is being generated in a plane which is 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 signal voltage, "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

Thus, 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 many conventional magnetic flowmeters the integral magnet coils are driven directly by the customer's 50/60 Hz power service. The design of the Series 10D1475 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.

4.1.3 Volumetric Flow Rate Measurement

The 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:

$$\therefore \quad Q = \frac{\pi \alpha D^2}{4} \bullet \frac{E_s}{B}$$

Since $B = \beta E_r$

and since α, 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
α = dimensionless constant
β & γ = dimensional constant
V = liquid velocity

Therefore, volumetric flow rate is directly proportional to the induced signal voltage as measured by the magnetic flowmeter.

4.2 Operating Characteristics

4.2.1 Liquid Variables

4.2.1.1 Liquid Conductivity

The 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 factory-supplied interconnection cable (with driven shields) is utilized. The nominal maximum transmission distance is limited to 30 meters (100 feet), however longer distance can be accommodated (contact factory for details).

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

1) Remove the Converter housing cover. Disconnect the electrode signal interconnection leads from terminals "1" and "2" of the signal converter. (These leads should be identified so that they will be properly reconnected.)

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.

The conductivity of the process liquid (in microsiemens/cm) may be determined from the electrode ac resistance measurement (in megohms) by substitution of values in the following equation.

$$\sigma = \frac{1}{(R_{ac} - 0.072) \times \text{Electrode Dia, in cm}}$$

where,

0.072 is the electrode barrier resistance in megohms; i.e., 36 k x $2/10^6$

Electrode diameters vary with meter size, however, the values given in Table 4-1 will serve as typical.

For example, assuming the measured ac electrode resistance (full pipe and zero flow) is 192,000 ohms and electrode diameter is 7.92 mm (0.792 cm), then

$$\sigma = \frac{1}{(0.192 - 0.072) \times 0.792} = 10.52\ \mu S/cm$$

This is above the threshold for specified measurement accuracy for the particular liquid, meter size and signal converter combination. Liquid conductivities at the operating temperature may also be determined from standard reference works for many pure liquids. Company Field Engineers are equipped to determine the conductivities of special liquids at the user's site as an engineering service.

TABLE 4-1. ELECTRODE DIAMETERS

Meter Size		Electrode Diameter	
inch	mm	inch	cm
1/10	3	0.048	0.122
5/32	4	0.079	0.202
1/4	6	0.142	0.361
3/8	10	0.236	0.600
1/2	15	0.250	0.635
1 - 4	25 - 100	0.312	0.792

4.2.1.2 Liquid Temperature

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

Most liquids exhibit a positive temperature coefficient of conductivity. It is possible for certain marginal liquids to become sufficiently non-conductive at lower temperatures so as to hamper accurate metering. However, the same liquid 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 liquid. Process or ambient temperatures are also limited by the meter materials specification.

Other normal effects of temperature, such as influence upon liquid 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.

4.2.1.3 Other Liquid Variables

Other liquid variables such as viscosity, density and liquid pressure have no direct influence on metering accuracy. Liquid 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.

4.2.2 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 liquid 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 liquid stream.

The magnetic flowmeter will measure the total amount of material passing in the liquid 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.

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.

4.3 Circuit Description

4.3.1 Primary Signals

The Model 10D1475J/S flowmeters use **integral or remote** 50XM1000 Converter electronics. As described in paragraph 4.1, the magnetic flowmeter body houses two signal electrodes and two flux producing magnet coils. Refer to the 50XM1000 Converter Instruction Manual for remote-configuration interconnection wiring diagrams. All Flowmeter intraconnection wiring is terminated at the CMC 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 and the reference signal which is proportional to the magnet excitation current (theoretically, the reference signal is proportional to the flux density in the metering section). The reference voltage is derived across a precision "constant meter factor" 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 circuitry will provide an exact ratio and thereby provide immunity to power supply variation. The magnet coil drive circuitry is contained in the signal converter.

The (gated) magnet driver operates at a frequency that permits magnetic flux in the Flowmeter to reach a steady state level during the last 25% of each half period of magnet excitation. 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. A thorough discussion of signal converter operation is provided in the Instruction Bulletin supplied with the particular signal converter.

4.3.2 Constant Meter Capacity (CMC) PC Assembly

The CMC PC Assembly provides several functions. These include:

1. Establishing interconnections between the Flowmeter internal wiring and the signal converter.

2. Permitting factory adjustment of meter capacity values to a fixed value for each nominal size Flowmeter.

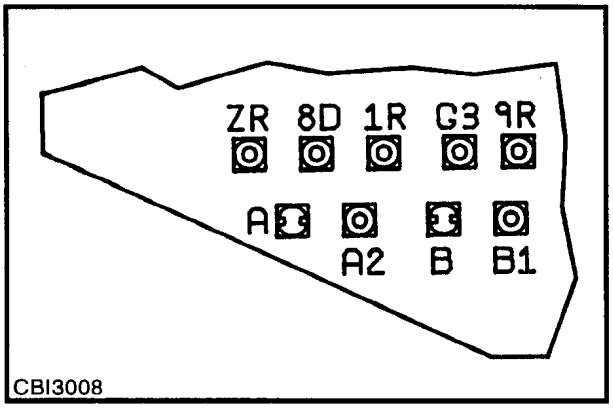
3. Establishing proper wiring connections for remotely mounted signal converters.

Meter coil current and, consequently, calibration factor are established by adjusting a precision current-sense network which is in series with the meter coils. The current-sense network consists of a low-resistance current-sensing resistor along with an adjustable resistive divider network placed across the current-sense resistor. A potentiometer is also used to provide fine-tuning of the meter capacity. Should this resistive network be damaged, repair and recalibration are only possible by using precision electronic calibration instruments.

4.4 Jumper Selections

4.4.1 Model 10D1475S

For the integral-mounted converters, zero return and functions associated with the 50XM1000 signal converter are established by the movable jumpers at terminals A2 and B1 located on the lower left corner of the **686B623U01 Primary Board** assembly. The following table and diagram correlates the zero return and functions with the jumper connections:

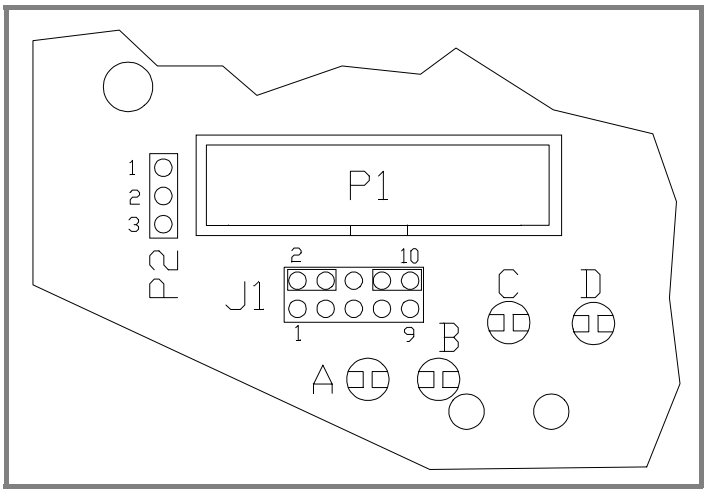


Jumpers		
Functions	**A2**	**B1**
Zero return	ZR	G3
10 kHz	8D	G3
Pulse reverse	1R	9R

4.4.2 Model 10D1475J

4.4.2.1 Integral

For the integral version of Model 10D1475J Converter, zero return and functions associated with the 50XM1000 signal converter are established by the movable jumpers on terminal-strip J1 located in the lower left corner of the **686B762U02 Primary Board** assembly. The following table and diagram correlates the zero return and functions with the jumper connections:



Jumpers	
Functions	**Jumper Position**
Zero return	1-2
10 kHz	3-4
Pulse reverse	5-6

The full view of the 686B762U02 Primary Board Assembly is shown in Figure 4-2 along with a table of selectable functions and their jumper settings.

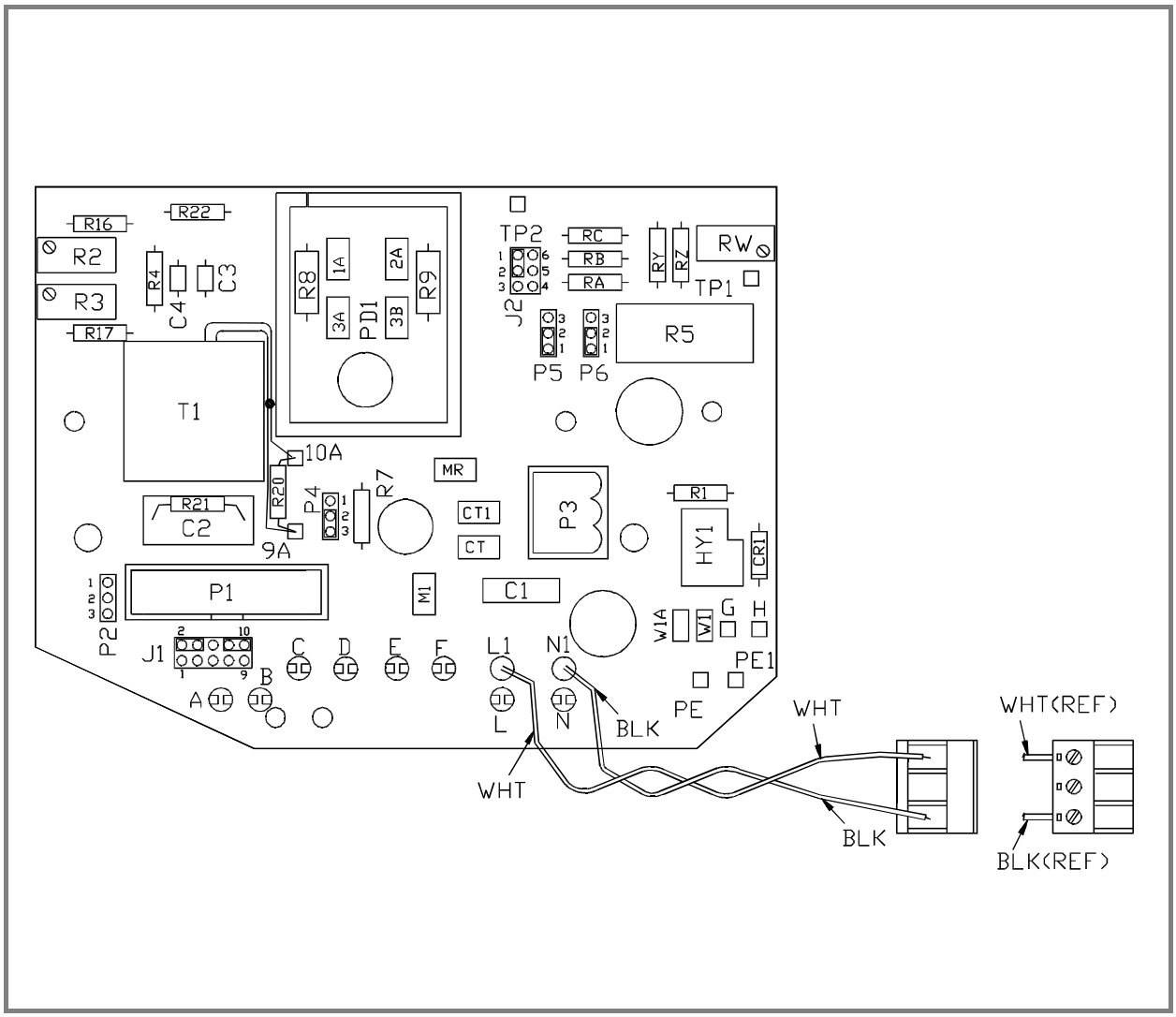


FIGURE 4-2. 686B762U02 PRIMARY BOARD ASSEMBLY

TABLE 4-2. 686B762U02 PCB JUMPER FUNCTIONS

JUMPER NO.	POSITION	FUNCTION
J1	1-2	Zero Return
	3-4	10 KHz Signal
	5-6	Reverse Pulse Signal
	7-8	GND for 10 KHz, Zero Return
	9-10	COMMON for Reverse Pulse
	2-4, 8-10	Remote Converter
P4	1-2	Integral Converter
	2-3	Remote Converter
P5, P6	2-3	CD-1, XM1000 Mode
J2	1-2	IEX = 85 to 141 mA
	1-6	IEX = 125 to 230 mA
	2-5	IEX = 210 to 350 mA
	3-4	IEX = 337 to 560 mA
P2	-	Not to be Jumpered

4.4.2.2 Remote

The remote version of Model 10D1475J Converter uses the smaller two-piece housing which contains two circuit board assemblies, the **686B789U01 CMF** PCB assembly and the **686B790U01 Customer Connection** PCB assembly. The **686B790U01** PCB interfaces to the remote 50XM1000 Converter via the supplied interconnection cable.

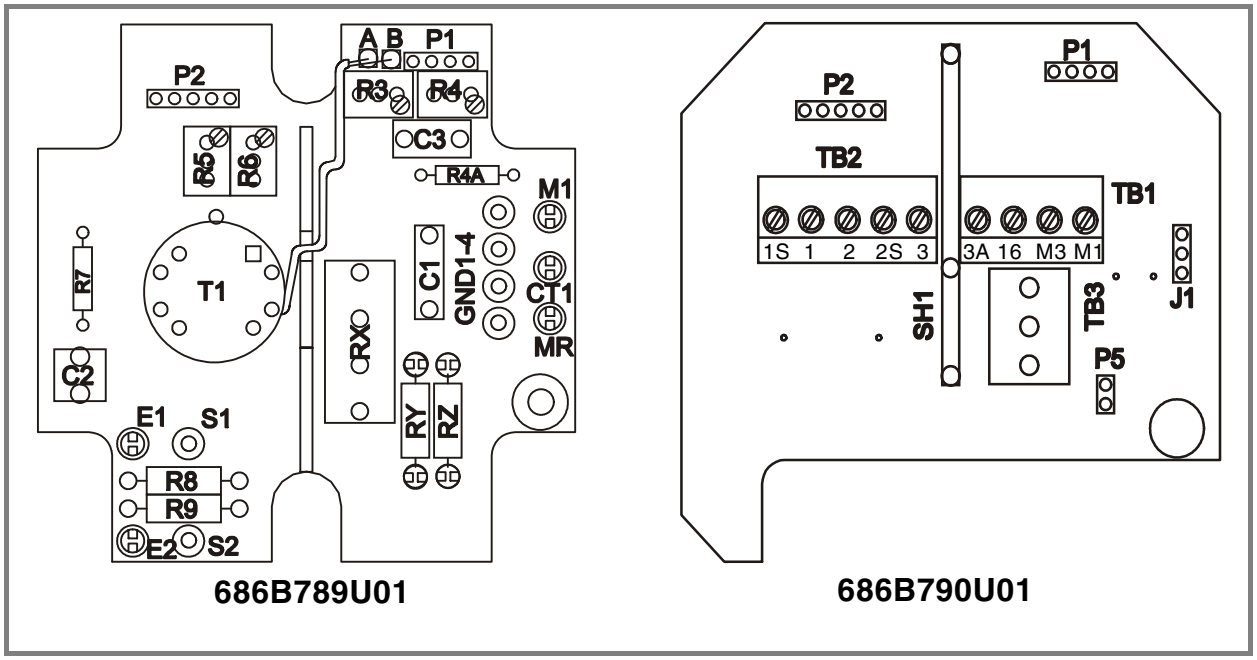


FIGURE 4-3. 10D1475J REMOTE PRIMARY PCB ASSEMBLIES

5.0 MAINTENANCE

5.1 General

Except for an occasional performance verification check, there is no required routine maintenance for the Model 10D1475 meters. The flowmeter body is of all welded construction. In the event a malfunction occurs in the primary, the meter body must be replaced. If supplied, the integrally mounted signal converter assembly is removable for maintenance or replacement purposes.

The manufacturer 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 the factory (charges prepaid). The equipment available under this program is as follows:

- the complete flowmeter with integrally mounted signal converter and installation hardware
- the flowmeter and primary board, without the signal converter
- the signal converter assembly

The signal converter uses complex electronic circuit components. Generally, due to the complexity of troubleshooting integrated circuit devices, maintenance beyond the assembly level is not recommended. Also, caution must be used when connecting test probes, as even a momentary accidental short circuit may damage or destroy an integrated circuit device. Therefore, only trained electronic technicians who are familiar with CMOS technology and have a background in logic and gating circuitry should be permitted to service this equipment.

In the event of a malfunction in the signal converter assembly, a replacement pc assembly can be quickly substituted for the defective assembly, thereby minimizing system down-time. Servicing by substitution of spare assemblies is generally more economical than stocking a large variety of IC chips, transistors, diodes, etc. Also, test equipment requirements and the level of technical expertise necessary are minimized. Should any doubt arise regarding the proper procedure for solving an existing problem, it is suggested that the user contact his local factory-service facility for technical assistance.

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.

WARNING

All flowmeters and/or signal converters being returned to the manufacturer for repair must be free of any hazardous materials (acids, alkalis, solvents, etc.). A Material Safety Data Sheet (MSDS) for <u>all process liquids</u> must accompany returned equipment. Contact the manufacturer for authorization prior to returning equipment.

NOTE
Operation and maintenance procedures for the 10D1475 signal converters are provided in the Instruction Manual supplied with the signal converter.

When communicating 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. The subject information is provided on the manufacturing specification sheet supplied with the magnetic flowmeter, and on the instrument data tags.

5.2 System Troubleshooting

In the event 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 flowmeter or the signal converter. A standard multimeter and an oscilloscope are suitable for making the test measurements.

To supplement the following discussion refer to the applicable signal converter instruction manual.

WARNING
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 junction box and converter housing.

If water entry is present, de-energize system at power source. Inspect conduit seals and cover gaskets for possible source of water entry. Replace the seals and/or gaskets if evidence of water entry is indicated. Allow interior of junction box and converter housing to dry completely before restoring system power.

2. The signal converter which is supplied with the Series 1475 meter is an integrally or remotely mounted microprocessor-based 50XM1000 signal converter.

Since signal wiring and operating procedures are dependent upon the mounting option selected, the user should refer to the instruction manual supplied with the 50XM1000 signal converter for system troubleshooting procedures. A static performance test for the flowmeter mounted components is discussed in Section 5.3.

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

5.3 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. A standard multimeter is suitable for making the resistance checks. These measurements can be made at the Connection board located in the base of the electronic housing.

WARNING
Equipment that operates from AC line voltage constitutes a potential electric shock hazard to the user. Make certain that the system power is disconnected before making the following ohmmeter checks.

5.3.1 Magnet Coil Check

There are two magnet coils in the meter that are connected in a series arrangement. The respective coil leads are brought up to lugs "M1" and "MR" (or "M3") on the Connection board in the meter electronics base.

Before making resistance measurements, verify that the system power service has been de-energized. Remove the electronics housing cover to obtain access to the Connection board.

If a remotely mounted signal converter was supplied, proceed to step 1. If the magnetic flowmeter is supplied with an integrally mounted signal converter, loosen and remove the four screws that hold the signal converter to the base. Disconnect the plugs supplying signal (P1) and power (P3) connections to the converter and set the converter aside. This will enable access to the Connection board.

1) Set the ohmmeter to its lowest range; e.g., R x 1.

2) Connect the Ohmmeter test leads to terminal lugs M1 and MR (or M3) on the Connection board. The value displayed should correspond to the coil-resistance value indicated in Table 5-1 (±20%).

3) Connect the Ohmmeter test leads to terminal lugs CT and MR (or M3). The value displayed should correspond to 1/2 the coil-resistance value indicated in Table 5-1 within ±20%.

4) Connect the Ohmmeter test leads to terminal lugs CT1 and M1. The value displayed should correspond to 1/2 the coil-resistance value indicated in Table 5-1 within ±20%.

TABLE 5-1. PRIMARY COIL RESISTANCE

Meter Size		Coil Resistance, M1 to MR/M3
inch	mm	Ohms (nominal)
1/10	3	18
5/32	4	18
1/4	6	18
3/8	10	18
1/2	15	45
1	25	54
1 1/2	40	48
2	50	48
3	80	54
4	100	62

5.3.2 Electrode Check

The electrode check is essentially a resistance measurement that can be made to establish that a short (or high resistance leakage path) does not exist between one, or both, electrodes and the meter body.

Before proceeding, verify that system power has been de-energized. To perform this test, the meter must be removed from the pipeline and the meter liner "wiped" dry. When the meter liner has been thoroughly dried, proceed as follows:

1) If integral signal converter supplied, begin with step **a**, below. If a remotely mounted signal converter is supplied, begin with step **b**.

a) Remove meter housing cover from electronics compartment. Loosen the four mounting screws that secure the integral signal converter to the meter base. Disconnect plugs P1 and P3; set the converter aside. Proceed to step 2.

b) Remove field wiring connected to electrode leads "1" and "2". Proceed to step 2). Electrode wiring is shown in Figure 4-1 and 4-2, as applicable.

2) Place Ohmmeter on highest available range (for example, R x 10,000).

3) Connect the Ohmmeter "minus" lead to the meter ground stud and the "plus" lead to electrode line 1. This reading should be infinite. If any resistance can be measured, the meter is defective and must be replaced.

4) Check the other electrode by connecting the Ohmmeter "plus" lead to line 2. This reading must also be infinite. If any resistance can be measured, the meter is defective and must be replaced.

5) If measurement of both electrodes indicates an infinite resistance reading, the meter may then be returned to on-stream operation after wiring has been restored. Re-install the integrally mounted signal converter, if applicable, and replace housing cover.

NOTE

If the signal converter has been removed from the housing, use care when reconnecting the converter interface cable to ensure that plug P1 is in proper alignment with the pins of receptacle J1. (J1 is located on the base board in either the flowmeter or the remote converter housing, as the case may be.) If these connectors do not mate correctly, the signal converter will be inoperable and could be damaged when power is applied.

5.3.3 Flowmeter Board (Model 10D1475J)

The flowmeter board is located in the base of the electronics housing. This pc board includes the constant meter factor/size network. The constant meter factor/size network functions to standardize the particular flowmeter; i.e., provide a constant meter capacity that will be the same for all meters of the same size.

The constant meter factor/size network is factory set by precise calibration prior to shipment. This calibration procedure (used to establish the exact setting for the particular constant meter factor/size network) compensates for variations resulting from manufacturing tolerances. Hence, the value of constant meter factor/size network on each primary board is unique and may be applicable only for the particular flowmeter for which it was supplied.

6.0 PARTS LIST

6.1 Grounding Rings

TABLE 6-1. ANSI CLASS 150 GROUNDING RINGS

Meter Size		Part Number*	Part Number Suffix (Material)			
mm	inch		316 sst	Hast. "C"	Hast. "B"	Alloy 20
3 - 15	1/10 - 1/2	800D508	U01	U09	U34	U27
25	1	800D508	U02	U10	U18	U24
40	1 1/2	800D508	U03	U11	U35	U28
50	2	800D508	U04	U12	U20	---
50	2	800D575	---	---	---	U07
80	3	800D508	U05	U13	U36	---
80	3	800D575	---	---	---	U08
100	4	800D508	U06	U14	U37	---
100	4	800D575	---	---	---	U09

* To complete the part number, add suffix from table; e.g., 800D508U02 for ordering one set (2) of 25 mm (1 in.) 316 sst grounding rings.

6.2 Gaskets

TABLE 6-2. GASKETS FOR ANSI CLASS 150 GROUNDING RINGS (2 Required)

KLINGER SIL C-4401--------Part Number 333J089___*
TEFLON----------Part Number 333J092___*

	Meter Size					
Flange Rating ANSI CL150	1 - 15 mm	25 mm	40 mm	50 mm	80 mm	100mm
	1/25 - 1/2inch	1 inch	1 1/2 inch	2 inch	3 inch	4 inch
Suffix	U01	U10	U15	U19	U22	U29

* To complete the part number, add suffix from table; e.g., 333J089U10 for 25mm (1 inch) meter with KLINGER SIL gaskets.

For applications other than ANSI CLASS 150 Flanges contact ABB.

TABLE 6-3. GASKETS FOR METER BODY (2 required)

KLINGER SIL C-4401--------Part Number 333J089___*
TEFLON----------Part Number 333J092___*

Flange Rating	Meter Size						
	3 - 10 mm	15 mm	25 mm	40 mm	50 mm	80 mm	100 mm
	1/10 - 3/8 in	1/2 inch	1 inch	1 1/2 inch	2 inch	3 inch	4 inch
ANSI CL 150	U01	U01	U10	U15	U19	U22	U29
ANSI CL 300	U02	U02	U11	U16	U25	U26	U30

* To complete the part number, add suffix from table; e.g., 333J089U10 for 25mm (1 inch) meter with KLINGER SIL gaskets.

6.3 Adapter Sleeves

TABLE 6-4. ADAPTER SLEEVE

Part Number 430E020___ *

Flange Rating	Meter Size						
	3 - 10 mm	15 mm	25 mm	40 mm	50 mm	80 mm	100 mm
	1/10 - 3/8 in	1/2 inch	1 inch	1 1/2 inch	2 inch	3 inch	4 inch
ANSI CL 150	N/R	N/R	N/R	N/R	U04	U04	U05
ANSI CL 300	U01	U02	U03	U03	U06	U07	U07

* To complete the part number, add suffix from table; e.g., 430E020U03 for 25mm (1 inch) meter with ANSI CL 300 pressure rating.

N/R = None Required

6.4 Studs & Nuts

TABLE 6-5. STUDS & NUTS (1 Required)

STEEL----------Part Number 614B650___ *

Flange Rating	Meter Size						
	3 - 10 mm	15 mm	25 mm	40 mm	50 mm	80 mm	100 mm
	1/10 - 3/8 in	1/2 inch	1 inch	1 1/2 inch	2 inch	3 inch	4 inch
ANSI CL 150	U01	U01	U01	U04	U07	U09	U14
ANSI CL 300	U01	U01	U03	U05	U08	U10	U15

6.5 Cable Entry Seals

6.5.1 Conduit Entry Seal

P/N 699B390U02 - For use with 1/2 NPT conduit - 2 seals provided (one for each entry port)

6.5.2 Cable Entry Seal

P/N D150A004U01 - For wiring cable without conduit using cable seal fittings (Provides seals for one entry port only - 2 kits required)

P/N 1D150Z1053 - (Dust Cover - 2 required)

PN25006A

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